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LA Denomination: Instituto de Sistemas e Robótica - ISR - Lisboa

Original Research Contract: (Technical Annex to the agreement signed with FCT)

Director: Victor Alberto Neves Barroso

Research Unit(s) Involved:

INSTITUTO DE SISTEMAS E ROBÓTICA - ISR - LISBOA Centro de Estudos em Inovação, Tecnologia e Políticas de Desenvolvimento Centro de Recursos Minerais, Mineralogia e Cristalografia - CREMINER Centro do IMAR da Universidade dos Açores

Reporting Period: 2003 to 2007

Institution(s) on which it is based:

Instituto Superior Técnico - Universidade Técnica de Lisboa ^(PC) Instituto Superior Técnico - Universidade Técnica de Lisboa Fundação da Faculdade de Ciências - Faculdade de Ciências da Universidade de Lisboa Instituto do Mar

Management & Funding

Management Structure of the LA:

The management structure of the associate laboratory has the following organization: management boards, including the Coordinating Board and the Executive Board, and one manager for each thematic area. The LA also has an external advisory board, see section 8.

The Coordinating Board will have as functions to supervise and to guide in general lines the cooperation activities of the four participant R&D units and to decide in cases of doubt resultant of divergent interpretations of the terms of the signed protocol. The Coordinating Board is composed by the scientific coordinators of the involved units and by the managers of the thematic areas, and is presided over by the President of the Executive Board of the Laboratory that will assure that the Coordinating Board will meet at least once a year. The meetings of the Coordinating Board can be convoked by any one of its members.

The Executive Board will be composed by the coordinators of the involved units and presided over by the scientific coordinator of the ISR-Lisbon. The Executive Board will have as functions to assure the current management of the activities resulting from the collaboration among the participant units and to guarantee its accurate fulfillment.

Each thematic area has a manager elected by the researchers involved in that particular area, for a period of 3 years. He will not have responsibilities of executive management, but rather tasks like: to plan the activities to carry through in the thematic area and to promote its strategic orientation; to obtain the necessary human resources; to guarantee the cooperation and integration of the activities of the various groups; to prepare, in cooperation with the area researchers, project proposals and find financing sources for these projects (FCT, European Union, others); and to prepare annual activities plans and reports in the domain of the thematic area, to submit to the consideration of the Coordinating Board.

The activities of the associate laboratory have been followed by an Advisory Board, consisting of national and international experts, selected by decision of the Coordinating Board. The Advisory Board can be requested to give his judgment whenever the Coordinating Board considers it opportune and under proposal of the Executive Board.

Management Structure Diagram: (management-structure.gif)

Funding:

Origin	2003	2004	2005	2006	2007	Total
LA FCT*	1414390,22	1258379	1353151	1557659	1537408	7120987,22
Units FCT**	0	0	0	0	0	0
Project FCT	583274,34	752044,14	1538785,68	958820,26	2805122,34	6638046,76
Other National	824092,07	1397993,87	1445687,63	787199,76	1798581,06	6253554,39
Other International	786587,14	941448,62	970763,57	949277,24	733304,64	4381381,21
National Industry	96842	114366,02	181500,68	105357,65	127216,63	625282,98
International Industry	0	0	0	0	0	0
Total	3705185,77	4464231,65	5489888,56	4358313,91	7001632,67	25019252,56

General Indicators

Composition and Training:

	2003	2004	2005	2006	2007	Total
No. of Researchers Proposed	2	3	4	3	0	12
No. of Researchers Hired	1	0	2	7	0	10
Balance	-1	-3	-2	4	0	-2
No. of Researchers (FTE) (*)	47	43	48	77	73	288
Training Masters (Master thesis completed)	10	20	23	10	33	96
Training PhDs (PhD thesis completed)	4	7	5	5	21	42

Researchers Hired under LA Contract:

» Maria Ana Almeida Colaço
(Start Date: 01-03-2003 | End Date: 29-02-2008 | Institution: n/a)

» António Pedro Rodrigues de Aguiar
(Start Date: 01-07-2005 | End Date: | Institution: n/a)

» Marko Stosic
(Start Date: 03-04-2006 | End Date: | Institution: n/a)

» Luis Montesano
(Start Date: 26-04-2006 | End Date: | Institution: n/a)

» Matthijs Theodor Jan Spaan
(Start Date: 01-11-2006 | End Date: | Institution: n/a)

» Ana Filipa Alfaia Marques
(Start Date: 15-05-2006 | End Date: | Institution: n/a)

» Murat Karaöz

Technical Personnel Hired under LA Contract:

(no technical personel was found)

Research Lines

Sustainable Technologies and Environmental Systems

(Reference: RL-MECH-750009-137 | PI: Paulo Manuel Cadete Ferrao |
Research Field: Mechanical Engineering)

Robotic Monitoring and Surveillance

(Reference: RL-COMP-750009-133 | PI: Jose Alberto Rosado Santos Victor |
Research Field: Electrical and Computer Engineering)

Signal Processing for Communicatio Networks and Multimedia

(Reference: RL-COMP-750009-145 | PI: Joao Paulo Salgado Arriscado Costeira |
Research Field: Electrical and Computer Engineering)

Technologies for Ocean Exploration

(Reference: RL-COMP-750009-151 | PI: Antonio Manuel dos Santos Pascoal |

(Start Date: 13-05-2005 | End Date: | Institution: n/a)

» João Miguel de Oliveira Silva Parente

Research Groups

(Start Date: 02-05-2006 | End Date: | Institution: n/a)

» Alessio Del Bue

(Start Date: 01-09-2006 | End Date: | Institution: n/a)

Evolutionary Systems and Biomedical Engineering

(Reference: RG-LVT-Lisboa-750009-3422 | PI: Agostinho Claudio da Rosa)

Centre of IMAR of the University of the Azores/ Department of Oceanography and Fisheries (IMAR-DOP/UAz)

(Reference: RG-Centro-Coimbra-750009-3433 | PI: Ricardo Piedade Abreu Serrão Santos)

DSORL - Dynamical Systems and Ocean Robotics Laboratory

(Reference: RG-LVT-Lisboa-750009-3438 | PI: Antonio Manuel dos Santos Pascoal)

Signal and Image Processing Group

(Reference: RG-LVT-Lisboa-750009-3447 | PI: Isabel Maria Gonçalves Lourtie)

Mobile Robotics Laboratory - MRLab

(Reference: RG-LVT-Lisboa-750009-3503 | PI: Maria Isabel Lobato de Faria Ribeiro)

Intelligent Systems Laboratory

(Reference: RG-LVT-Lisboa-750009-3505 | PI: Pedro Manuel Urbano de Almeida Lima)

VisLab - Computer and Robot Vision Laboratory

(Reference: RG-LVT-Lisboa-750009-3508 | PI: Jose Alberto Rosado Santos Victor)

Laboratory for Energy and Environmental Studies at IN+ Center for Innovation, Technology and Policy Research

(Reference: RG-LVT-Lisboa-750009-3583 | PI: Paulo Manuel Cadete Ferrao)

Laboratory of Thermofluids, Combustion and Energy Systems, at IN+ Center for Innovation, Technology nad Policy Research

(Reference: RG-LVT-Lisboa-750009-3584 | PI: Antonio Luis Nobre Moreira)

Laboratory of Technology Policy and Management of Technology, at IN+ Center for Innovation, Technology and Policy Research

(Reference: RG-LVT-Lisboa-750009-3585 | PI: Rui Miguel Loureiro Nobre Baptista)

Centre of Mineral Resources, Mineralogy and Crystallography of the Faculty of Science of Lisbon University (CREMINER)

(Reference: RG-LVT-Lisboa-750009-3589 | PI: Fernando José Arraiano de Sousa Barriga)

Other LA Activities

Internal Services and Resources (Indicate here sharing of equipment and other resources both within the LA, between LAs or with other institutions of Higher Education nationally or internationally.)

- MAJOR REEQUIPMENT INITIATIVE-

- Networks of Autonomous Systems for Monitoring, Mapping and Surveillance - Proj. REEQ/956/2001 [VisLab+ISLab+MRLab+DSOR+IN+]static and mobile sensor network, including mobile robots, cameras and other sensors [VisLab+ISLab+MRLab+SPLab+(in the future)IN+];

- cooperative soccer robots (in place since 1997)[ISLab+VisLab+MRLab+several foreign students from RoboCup-involved institutions];

- autonomous blimp hardware and realistic USARSim simulator[ISLab+VisLab+MRLab+USARSim community – first open source dynamic blimp model developed by ISLab members]

- Mobile Geochemical Laboratory [ISR,IMAR,CREMINER]- A custom-built, mobile geochemical laboratory, for installation and operation in different oceanographic research vessels.

- Integrated Sidescan Sonar and Subbottom Profiler Unit [ISR,IMAR,CREMINER]- An integrated sidescan sonar (SSS) and subbottom profiler (SBP) unit for installation in marine robots.

- Multibeam Sonar[ISR,IMAR,CREMINER] - Portable Multi-Beam Sonar for installation in Marine Robots.

- Laser Scanner [ISR,IMAR,CREMINER]- Laser Scanner for accurate mapping of above and underwater structures.

- Calibration Equipment[ISR,IMAR,CREMINER] – Inertial Test table - Two axis automatic positioning and rate table system.

- Spectrum / Logic Analyzer Ensemble [ISR,IMAR,CREMINER]- Ensemble consisting of a Spectrum and a Logic Analyzer

- Spectrophotomer [ISR,IMAR,CREMINER]- Monochromator-based spectrophotometer.

External Services and Resources (Indicate here scientific or technical services provided both nationally or internationally to Governments/Institutions or the community)

ISR-LA through IMAR/AZORES is involved in contracts with Government Bodies concerning, e.g. the following International Policies: International Whaling Commission, Common Fisheries Policies,the Blue and Green Books for the European Maritime Policy, Habitats and Birds Directives (Natura 2000), OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic, Convention of Biological Diversity, Portuguese Strategy for the Oceans (2004)

The Observers Program of the Fisheries of the Azores (POPA: www.popaobserver.org) has contracts with the fishing industry name the can tuna fishing (AICPA – Associação das Indústrias de Conservas de Pescado e Atum), with the APASA (Associação de Produtores de Atum e Similares), with LotAçor (fish auction system of the Azores), and in an irregular basis with different fishing boat owners.

The Lisbon City Hall (CML), that has direct responsibility on Lisbon Civil Protection Department, considered that the project RAPOSA (see ISLab, MRLab and Theme B reports) demonstrated the concept of an equipment of extreme importance and utility for the Civil Protection elements in case of an emergency (earthquake, building collapse) and provided IST (ISR ISLab+MRLab) with a €4.000,00 grant aiming at pursuing search and rescue activities.

ISR-LA Integrated the advisory board set by the Ministry of Internal Administration (MAI) to selecting and commissioning the Portuguese Electronic Passport (www.pep.pt). Played a relevant role in the context of the biometric data collection system. Participated in the technical evaluation of several foreign systems, contributed to the definition of requirements and participated in the equipment selection committee .We have been commissioned to produce the science contents of?Centro Ciência Viva do Lousal.

Networking Actions (Indicate here both national and international activities)

GOCE-CT-2003-505446: MARBEF – Marine Biodiversity and Ecosystem Functioning (Network of Excellence)

INTERREG IIIb - 03/MAC/4.2/A2 2004: MARMAC & 05/MAC/4.2/A4 2007: MARMACII- Knowledge, promotion and valorisation for a sustainable use of marine protected areas in Macaronesia.

GOCE/2005/036851-1: ESONET/NoE – European Seas Observatory Network (Network of Excellence)

ENV/2007/2/2.1.6/211700: CAREX – Coordination Action for Research Activities on life in Extreme Environments

SEAMBOR - Working Group on Science Dimensions of Ecosystem Approach to Management of Biotic Ocean Resources” (MB-ESF, ICES, EFARO)

EURON – European Robotics Network, EU FP6 NoE Contract nº 507728, under which we co-coordinated the Special Interest Group on Cooperative Robotics, joining 25 institutions in Europe (<http://www.aass.oru.se/Agora/EuronCoop/>)

FREESUB (Human Potential Research Training Network HPRN-CT-2000-00032, 2000/2004) – Autonomous Underwater Vehicles for Subsea Intervention (EC Human Potential Research Training Network).

FREESUBNET (Marie Curie Research Training Network, MRTN-CT-2006-036186, 2006/2010)- A European research network on key technologies for intervention autonomous underwater vehicle (Marie Curie Research Training Network)

Training Activities (Indicate here activities of the LA as a whole)

ATHENS courses on “Introduction to Robotics” (2007: 2 editions; 2008: 1 edition.)

Active participation in IST PhD program in Electrical and Computer Engineering and Mechanical Engineering through direct supervision of a large number of graduate students (exceeding 60). Also a significant number of lecturers give courses in this program.

CMU-Portugal Program: Dual Carnegie Mellon-Instituto Superior Tecnico, Doctoral Programs: ISR-LA has a strong involvement in the following Dual PhD programs: Electrical and Computer Engineering, Technological Change and Entrepreneurship and Engineering and Public Policy. ISR-LA members coordinate all programs, a significant share of the lecturers and most of enrolled students in academic year 2008/09 are supervised by LA members

MIT-Portugal Program: Doctoral Program at Instituto Superior Tecnico with the Massachusetts Institute of Technology, in Sustainable Energy Systems. The coordination of the PhD program, lecturers and students of ISR-LA are deeply involved in this program.

Instituto Superior Tecnico (IST)- Ecole Polytechnique Federal de Lausanne (EPFL) - The LA has a major involvement in a Joint Doctoral Initiative in the area of Distributed and Cognitive Robotics.

Outreach/Science and Society (Indicate here activities that the LA as a whole)

- Promotion of S&T:

ISR, namely its IS and MR Laboratories, has nurtured the development of activities of different kinds to promote the scientific and technological culture among the citizens in general, and the youngsters in particular. Among those, the following should be pointed out:

* Yearly organization of the Portuguese Robotics Open, since 2001, counting with approximately 800 participants, 700 of them being high school students and teachers

* One week summer schools for students, since 2001: 170 high school students have participated so far, building and programming small robots from scratch

* Talks and Conferences at High Schools, National Young Scientists Association, National Association of Informatics Engineering Students, Science Museums, incl. "Geologia no Verão"

Other individual contributions from ISR members:

* Isabel Ribeiro was one of the 12 scientists invited in 2004 by the Gulbenkian Foundation to give a talk on the cycle of seminars “Despertar para a Ciência”. The talk entitled “Uma viagem ao mundo dos robots” was attended by a large number of persons (>400), and repeated afterwards in 10 Portuguese universities and high-schools. A written version was published, as a book chapter, in “Despertar para a Ciência: novos ciclos de conferências”, Gradiva, December 2007.

* Isabel Ribeiro authored the entries “Robots Móveis”, “Sensores em Robótica ” and “Navegação em robótica autónoma”, of the Portuguese Encyclopedia Activa Multimédia, Technologies volume, Lexicultural (2004)

* P.Lima authored the entry “O que é um Robot? Como se classificam os robots?” e “Aplicações dos Robots: para que servem os robots?”, of the Portuguese Encyclopedia Activa Multimédia, Technologies volume, Lexicultural (2004)

* Isabel Ribeiro was a guest of the radio program Magazine Ciência, RDP-Antena2, on the topic of robotics perception, October 2004.

* P.Lima was a guest of the TV Science Talk Show 4XCIÊNCIA, RTP-N, 24 January 2006

* Education column article “Robotics Educational Activities in Portugal: A Motivating Experience”, P.Lima, IEEE Robotics and Automation Magazine, Vol. 14, No. 2, pp 16-17, June 2007

* Article “A Experiência Motivadora das Actividades de Robótica em Portugal”, Ciência Hoje (online Science News), P. Lima, 19 September 2007

F. Barriga was interviewed many times on national TV and radio, including several in 2010 Science Magazine (RTP-2) “Por Outro Lado” – Ana Sousa Dias (RTP-2) 4XCIência (RTP-N) interviews on national TV news; authored one of the “Despertar para a Ciência” national conferences in the first edition (2003)

- Public Service:

Carlos Pinto Ferreira: Director of Education Evaluation Office of the Ministry of Education

Luis Custódio: Director of the Information Systems Coordination Office of the Ministry of Education

P.Lima: IST Scientific Board Deputy Vice-President for Scientific Affairs

Isabel Ribeiro: IST Adjoint-Director for Project Management, 2003-2005, ISR/IST Vice-Director, 2002-2006, Evaluator of candidacies for fellowships and project grants for the Portuguese Foundation for Science and Technology (FCT) and Innovation Agency (AdI)

Paulo Ferrão: National Director of the MIT-Portugal Program (MPP). Coordinator of the Doctoral Program in Sustainable Energy Systems at IST(MPP). Coordinator of the research focus area in Sustainable Energy Systems and Engineering Systems of this program

Victor Barroso : Member of the Board of Directors of the Carnegie Mellon- Portugal Program. Director of the Information and Communication Technologies Institute (ICTI@Protugal) which governs the national involvement in the program.

J. Costeira: Coordination of the Dual PhD Program in Electrical and Computer Engineering between Carnegie Mellon and Instituto Superior Técnico. Also coordinates one of the research focus areas

Antonio Pascoal: Member, steering committee of EUROCEAN – A European portal for dissemination of marine science and technology. Participating member, marine board of the European Science Foundation ; member of Conselho Consultivo da Comissão Estratégica dos Oceanos (Portugal)

Jose Santos-Victor: Vice-President of Instituto Superior Tecnico for International Affairs. National delegate of the Mars Exploration Program (AURORA).

Fernando J.A.S. Barriga: Director MNHN; member of COI; member of the scientific committee. of FCT for Earth and Space Sciences; alternate national delegate on the Marine Board (ESF); member of ESSAC Council, delegate on ECORD ; member of C.Consultivo da Comissão Estratégica dos Oceanos ; head of task force for the scientific reequipment of oceanographic research vessel NRP Gago Coutinho (MCTES); member of InterRidge steering Committee

Ricardo S Santos was member of Conselho Consultivo da Comissão Estratégica dos Oceanos ;

Organization of International Events (Indicate here events that are international in dimension and required the involvement of the LA for their implementation)

INTERNATIONAL CONFERENCE: The Maritime European Policy and the Regions. Sociedade Amor da Pátria, Horta, Faial, Azores, 25- 27th June 2006 (Organizer - Host). This event was the first event organized at the end of the period dedicated to Public Consultation of the Green Book on European Maritime Policy and counted with the presence of the President of the EC Dr Durão Barroso and with EC Commissary Joe Borg, among others.

MAR-ECO Workshop on the Patterns and Processes of the Ecosystems of the South-Atlantic Md-Atlantic Ridge. Balneário Camboriú, Brazil, 6-7 September, 2006 (Co-Chair and Organizer)

SEMINAR for the Parliamentary Assembly of the European Council on: "An European Perspective on Environmental and Scientific Issues of the North Atlantic and Adjacent Seas". Royal Garden Hotel. Ponta Delgada, 18 October 2007 (Co-Organizer)

1st IFAC Workshop on Multivehicle Systems, Salvador, Brazil. The objective of this workshop was to provide an international forum for the discussion of recent developments and advances in the field of multivehicle systems. [ISLab(IPC chair)+MRLab (organizer)+USP(BR)+ITA(BR)]

RoboCup 2004: RoboCup is the largest robotics event worldwide - an international initiative with the goals of fostering research and education in AI and Robotics, as well as public awareness of S&T.RoboCup2004 was organized in Lisbon by ISR/IST and attracted a record number of 1627 participants from 37 countries and ~500 robots, split by 346 teams. Symposium Proceedings published by Springer-Verlag Lecture Notes on Comp.ScienceLNCS. [ISLab(General Chair)+MRLab(Registration Chair)+VisLab(Symposium Co-Chair)]

IAV 2004 - Intelligent Autonomous Vehicles, organized in Lisbon by ISR/IST with the sponsorship of IFAC and EURON. The symposium included 165 paper presentations, 6 plenary invited lectures, 5 invited and 26 regular sessions. Proceedings published by Elsevier Science. [MRLab(General Chair)+VisLab(Publications Chair)]

ISOPE-2007 Special Session on Autonomous Vehicles for Ocean Exploration and Exploitation, -the 17th International Offshore (Ocean) and Polar Engineering Conference & Exhibition Lisbon

Pre-Conference Workshop, New Developments in Point-Stabilization, Trajectory Tracking, Path Following, and Formation Control of Autonomous Vehicles, 2006 IEEE Conference on Decision and Control.

IFAC MCMC 2006 (Conference on Maneuvering and Control of Marine Craft), Lisbon

3rd Int. MOMAR (2005, Lisbon); 5th Science Planning Committee of IODP ??

Final summary comparison between original objectives and achievements

Even though these activities were not explicitly detailed in the technical annex, the present report shows that the LA has engaged itself into a large number of initiatives related to:

1- A major buildup of the technical infrastructures to enable science and technology driven research. This includes vehicle

2- Active participation in networks of excellence.

3- Training: Besides the well established PhD programs at IST, University of Azores and Faculty of Sciences of Univ. Lisbon, the LA is at the core of the new collaborative initiatives with top American and European Schools with a strong involvement at the management and scientific level.

4- International Events: The LA has been strongly committed to the organization of international conferences and workshops as well as the dissemination of technical and scientific results to population at large.

Internal Evaluations

Internal Evaluation Reports

Associate Laboratory review 25 June 2006.pdf)

Implementation of the recommendations

Concerning the comments of the Advisory Board (AB) on Theme B, we understand they reflect a lack of Board specific expertise in the covered areas, as the different scales of involved problems (e.g., global versus local, individual versus the collective, simple sensors vs complex nodes like cognitive robots) is common to ambitious projects worldwide (e.g., nano-thera initiative in Switzerland, SWARMS project in the USA) and call for the intervention of multidisciplinary research areas and viewpoints. Most of the Theme B research was actually developed in the framework of similar projects at the European level. Even so, the Theme B Achievements and Future Plans sections of this report reflect some of the recommendations, namely clarifying the goals and underlining the interaction with other groups on sensor networks related research, through collaborative research testbeds and projects. Furthermore, it should be underlined that the Associate aspect of the lab is reflected in the strong interaction among 3 ISR research groups that compose Theme B. Concerning theme D similar steps were followed, in line with the recommendations of the AB. Research effort on signal processing methodologies was refocused to a networked sensing setting, with recent engagement in joint interdisciplinary projects in the area of sustainable energy systems. These projects involve strong cooperation between thematic areas B and C, (energy building optimization, central activity of theme C). Following the same strategy, in the scope of EC-funded projects FreeSubNet and Grex, the interplay between acoustic communications and networked control of multiple marine vehicle is being explicitly addressed, both at the theoretical and practical point of view in a true cooperative effort between themes A and D.

Concerning theme A, the key concern of the reviewers is that the goals set forth in the original proposal are too many and too challenging. We agree that embarking on a pioneering R&D in Portugal to effectively bring together marine science and technology is a difficult experience, and one that may have led to an underestimation of the effort and resources required. However, in our opinion the scope of the work done and the potential acquired for true ocean intervention (after having secured the scientific equipment that was badly needed to equip our marine vehicles) shows that considerable progress has been done towards meeting the main goals established.

Future Internal Evaluations

An international evaluation panel will be convened every two years.

Future Objectives

Summary of proposed future objectives

The future objectives rely on reinforcing the strong interdisciplinarity of ISR-LA and the exploration of formal analogies between different fields in the natural, social and engineering sciences. In general, future activities must require a tight symbiosis between science and technology with societal and economical impact. Also, keeping the key strategic investment in methodologies from basic sciences is expected to produce new theoretical and practical results of great impact. In line with this strategy, we intend to aggregate to the AL people or a research group in Mathematics, namely in the areas of Dynamical Systems, Algebra and Geometry. Also, due to the increasing involvement of the AL in the development of experimental platforms and networked systems, the AL must attract other research groups of excellent quality existing in the country in areas such as embedded and distributed systems. The interaction between robots and humans is becoming a challenging issue, appealing to the close cooperation of research teams in the areas of neural and cognitive sciences, psychology, design, etc.

Tacking benefit of some past and somehow dispersed work on different topics in a generic area that could be referred to as Biosystems, we intend to foster the creation of a research group with the critical mass that is required to face theoretical and practical challenges in a number of areas that may include bio-inspired computing and modeling, biomedical Imaging and classification, etc.

There is an interest in Public Policy that cuts across all the lines of research, namely in topics such as environmental management, sustainable development of biological systems, fisheries, exploitation of energy and mineral resources, sustainable energy systems, technological management, and networked industries. This may evolve to the creation of a line of research addressing eventually subjects that are at the core of those topics and interacting with the other lines of research.

Future vision of the LA

In the near future, we will address the reformulation of the actual AL, as it is somehow envisaged in the previous section. This reformulation will hinge on the creation of new research groups and/or research lines and also on the integration of other research units. Out of this process will probably emerge a different organizational structure for the new AL which will be reflected in its name: Institute for Systems Research in Science, Technology and Policy (ISR-STP).

The key thrust of the AL activity will be threefold: research, training, and public service. In both research and training, the AL will complement its internal multidisciplinary with external cooperation by networking with highly reputed research and academic institutions and industrial partners worldwide. To this effect, impetus will be given to the exchange of scientific personnel, participation in international projects, and hiring of exceptional PhD students and senior researchers.

Public service is foreseen as one of the most important missions of the AL. This can take the form of consultancy services to public administration bodies, including governmental departments and local administrations.

We will reinforce outreaching activities, in particular by taking initiatives to disseminate scientific knowledge and culture to the public at large, with special attention being given to the organization of summer schools and internships.

Human Resources

	2008	2009	2010	2011	Total
Nr of researchers from previous contract	9	7	7	7	30
	2008	2009	2010	2011	Total
Nr of researchers to be hired	0	4	6	7	17
Total	9	11	13	14	47

Justification for human resources

We wish to renew the contracts of 7 out of 9 researchers, and then hire four new ones in 2009, two more in 2010, and finally one more in 2011. With this hiring plan we wish to guarantee that: (i) the number of present hired researchers is preserved, and (ii) in the remaining years, additional researchers are hired in conformity with the expansion of the plan of activities.

Training

The AL is presently involved in several international partnerships: (i) Carnegie Mellon-Portugal Program: Dual Carnegie Mellon-Instituto Superior Tecnico, Doctoral Programs in Electrical and Computer Engineering, Engineering and Public Policy, and Technological Change and Entrepreneurship; (ii) MIT-Portugal Program: Doctoral Program at Instituto Superior Tecnico with the Massachusetts Institute of Technology, in Sustainable Energy Systems, and (iii) Instituto Superior Tecnico (IST)- Ecole Polytechnique Federal de Lausanne (EPFL) - The LA has a major involvement in a Joint Doctoral Initiative in the area of Distributed and Cognitive Robotics.

The programs with Carnegie Mellon and MIT merge several Portuguese research units and AL's, in close collaboration with Universities and Industrial Partners. They can be seen as seed initiatives to the establishment of future top postgraduate schools at an international level. The participation of our AL in these initiatives is in tune with our perception of what the AL shall be in the future.

Here you can find the information submitted for each of the Research Lines.

[Information accessed: 06-11-2008 15:23:46 on www.fct.mctes.pt]

[FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

List of Research Lines

Sustainable Technologies and Environmental Systems

(Reference: RL-MECH-750009-137 | PI: Paulo Manuel Cadete Ferrao | Research Field: Mechanical Engineering)

Robotic Monitoring and Surveillance

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Signal Processing for Communicatio Networks and Multimedia

(Reference: RL-COMP-750009-145 | PI: Joao Paulo Salgado Arriscado Costeira | Research Field: Electrical and Computer Engineering)

Technologies for Ocean Exploration

(Reference: RL-COMP-750009-151 | PI: Antonio Manuel dos Santos Pascoal | Research Field: Electrical and Computer Engineering)

[Information accessed: 06-11-2008 15:29:03 on www.fct.mctes.pt]

[FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Research Line Information

(RL-MECH-750009-137)

Designation: Sustainable Technologies and Environmental Systems

Principal Investigator: Paulo Manuel Cadete Ferrao

Research Area: Mechanical Engineering

General Objectives:

The objective of the Sustainable Technologies and Environmental Systems area were defined as to undertake multidisciplinary research aiming at developing and evaluating emerging and alternative complex engineering systems promoting sustainability, namely in terms of the needs to secure socio-economic development and the quality of the environment, creating a more prosperous and sustainable society. Enabling methods were to be developed and implemented under a systems view, comprising the use and environmental implications of materials, energy, and products in modern societies. To achieve these objectives, research and development activities include the analysis of advanced systems, but also the analysis of the global carbon bio-geochemical cycle and of materials flows in the economy, including product and material life cycle management through reuse, remanufacturing, and recycling. The main research areas were defined as a) Eco-design for sustainability in industry and domestic applications; b) advanced integrated combustion and thermal systems; c) total life-cycle energy chain and environmental impact assessment; d) carbon cycle; e) natural, resource-forming systems; f) flows of materials in the economy from raw-materials extraction to final integration in the natural environment; g) techno-economic assessment, technological change and systems integration.

Major Achievements:

All the objectives defined for the period of evaluation were accomplished and in general, its impact to society was far more relevant than anticipated. In this context, ISR has been able to:

1) Development of the "National policy for Residues Management" in a close cooperation with the Ministry of the Environment, 2) Design and support the implementation of all the new and innovative companies for organizing products end-of-life take back and recycling in Portugal during this period, which resulted in new business opportunities related with the environment 3) Create the IST Design Studio, which aimed at strengthening research and education in engineering design to improve manufacturing competitiveness and innovation.

4) Develop major methodologies and tools that bring together economy and environment in the assessment and the design of new products (Eco-design tools, in particular a new software) and new policies (e.g.: National Integrated framework for Residues Management, Hybrid Economic Input-Output-Life Cycle Assessment or Life Cycle Activity Analysis). 5) Support entrepreneurial initiatives in Industrial Ecology in Portugal, such as the design of a variety of new companies aimed at recycling and further processing end-of-life products or the design and implementation of an Eco-Industrial park at Chamusca. 6) Create a network for sustainability in Portuguese agriculture, comprising close to 100 farmers, occupying 0.7% of Portugal, and close to 30 partners, including universities, NGOs and private firms. 7) Obtain significant results on carbon and water dynamics in forests and grasslands (Granier et al., 2007, Luysaert, 2007, Pereira et al. 2007). 8) Provide support to Portuguese public policy on the use of natural carbon sinks.

[Information accessed: 06-11-2008 15:29:03 on www.fct.mctes.pt]

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Research Groups

Mobile Robotics Laboratory - MRLab

(Reference: RG-LVT-Lisboa-750009-3503 | PI: Maria Isabel Lobato de Faria Ribeiro)

Intelligent Systems Laboratory

(Reference: RG-LVT-Lisboa-750009-3505 | PI: Pedro Manuel Urbano de Almeida Lima)

Laboratory for Energy and Environmental Studies at IN+ Center for Innovation, Technology and Policy Research

(Reference: RG-LVT-Lisboa-750009-3583 | PI: Paulo Manuel Cadete Ferrao)

Centre of Mineral Resources, Mineralogy and Crystallography of the Faculty of Science of Lisbon University (CREMINER)

(Reference: RG-LVT-Lisboa-750009-3589 | PI: Fernando José Arraiano de Sousa Barriga)

[Information accessed: 06-11-2008 15:29:03 on www.fct.mctes.pt]

[FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Research Line Output

Collaborative Publications in peer review Journals (Include only if more than one Research Groups of the LA is involved up to max of 10. Give title and full citation in original language)

Dijkema, G.P.J., P. Ferrão, P.M. Herder and M. Heitor (2006). Trends and opportunities framing innovation for sustainability in the learning society. *Technol. Forecast Soc.*, 73, pp. 215-227. IF=0.88, n° C=2.

Canas, A., Ferrão, P. and Conceição, P. (2003) "A new environmental kuznets curve? Relationship between direct material input and income per capita: evidence from industrialized countries". *Ecological Economics*, 46 (2), pp.217-229.

"Coherent structures in unsteady swirling jet flow" (2006), C. E. Cala, E. C. Fernandes, M. V. Heitor and S. I. Shtork, *Experiments in Fluids*, Volume 40, Number 2 / February, 2006, pp. 267 – 276. IF=1.259,NC=8

"Acoustically excited air-assisted liquid sheets" (2003), V. Sivasdas, E. C. Fernandes and M. V. Heitor, *Experiments in Fluids*, Volume 34, Number 6, pp. 736 – 743. IF=1.259,NC=2

Collaborative Other Publications

(Include only if more than one group is involved and only include here Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

P. Ferrão e M. Águas (2003) "Energia e Ambiente", in: Engenharia e Obra: Uma Abordagem à História da Engenharia em Portugal no Século XX., pp. 304-313. Dom Quixote.

P. Ferrão e M. Águas (2004) "Energia e Ambiente", in: Engenharia em Portugal no Século XX. Coordenado por J. Brito, M. Rollo, M. Heitor. Dom Quixote.

Master and PhD thesis completed (Co-supervision or clearly multidisciplinary projects are allowed here)

NA

[Information accessed: 06-11-2008 15:29:03 on www.fct.mctes.pt]

[FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Future Research

Other Information (Include only if more than one group is involved. Patents/prototypes, organization of conferences, industry contract research)

NA

Future Plans

The future plans are based on building on the strong interdisciplinarity of ISR-LA, the exploration of formal analogies between different fields in the natural, social and engineering sciences, ISR-LA will aim at developing integrated models of environment-energy-economy interaction, at multiple spatial scales (cities, regions, countries), using the models such as input-output, computable general equilibrium modes, and economic growth, para sustainable energy systems planning....

Work will be carried out in the development of sustainability assessment tools and indicators, e.g. Green GDP, ecological footprint, human appropriation of net primary production. Focus will be given to the the analysis of sustainable energy systems at the different levels, such as Urban systems, and green buildings. At a smaller scale, research will be aimed at cleaner and more efficient energy conversion systems. Research on combustion will envisage the application of laboratory diagnostic tools to develop optimized low-emission burners and implement active control systems for eco-burning with emphasis on mini scale energy conversion systems. Fundamental laboratory research on multiphase flow phenomena will address the increased demands for efficient removal of the heat dissipated by high density power systems, such as fuel cells and the electronic systems used in current vehicles. The physics of multiple jet impingements is under study to design a new concept of atomizer for spray-cooling systems; the physics of liquid-solid interfaces and phase change phenomena at the micro-scale will pursue the interaction with materials science for the development of smart interfaces.

We have started a study, funded by FCT, with two main components: power plant CO₂ sequestration and to produce a preliminary inventory of the potential of the Portuguese territory for CO₂ geological sequestration. Study of the dispersion of metals around waste disposal sites and definition of sites for the safe storage of low-level radioactive wastes are also underway.

This is intended to be combined with research in entrepreneurship, technological change and higher education, and development of activities promoting technology commercialization and technology-based entrepreneurship in a university environment, leading to new insights for practitioners and policy makers in science, technology, industry and higher education, and aiming to contribute to economic development, competitiveness and employment growth.

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Research Line Information

(RL-COMP-750009-133)

Designation: Robotic Monitoring and Surveillance

Principal Investigator: Jose Alberto Rosado Santos Victor

Research Area: Electrical and Computer Engineering

General Objectives:

This Thematic Area handles robotic monitoring & surveillance by autonomous sensor networks aiming to develop new models, methods, algorithms and systems and demonstrate their use in application scenarios.

Networks of multiple heterogeneous (static and mobile) autonomous systems can be designed to meet several objectives, e.g., spatial sampling requirements that match the dynamic properties of the observed phenomena, or human activity monitoring and classification. Some components must be able to act and reconfigure the network to improve perception resolution and uncertainty, interact with humans or (re-) establish communication links. Autonomy allows for extended unsupervised operation and requires de-centralized decision-making.

Recent advances in the enabling disciplines of computer vision, AI, systems & control theory; the advent of embedded sensors, actuators, processors and wireless devices, have provided the technologies to build such networks.

Our approach encompasses a hierarchy of concepts and problems from the individual to the collective, e.g:

- single-robot navigation vs. cooperative formation control,
- single sensors (e.g., vision-based activity recognition) vs. cooperative perception,
- sophisticated nodes (e.g. robot assistants) vs. decentralized task planning in the presence of uncertainty.

Major Achievements:

Theme B proposed to develop its research activities around 3 general application areas of public interest illustrating different hierarchical levels or scales when considering the general theme. The R&D achievements include both theoretical contributions and application-relevant results, developed in the context of large-scale international collaborative efforts:

1. Search and rescue operations:

Theoretical developments on cooperative navigation and cooperative plan representation using discrete event systems, cooperative perception and topological SLAM. Demonstration of mobile robot mapping, localization and navigation, in outdoors unstructured environments using topological maps built from video and laser data. Autonomous indoors flights of an aerial blimp, including hovering, waypoint navigation and visually tracking a terrestrial vehicle. Development of the RAPOSA robot, an R&D effort to provide transferable technology. [EU proj URUS; FCT RESCUE, SocRob; AdI RAPOSA]

2. Surveillance of urban areas:

Methodologies for learning how to recognize human activity from video, using statistical learning tools and switched dynamical models, and able to adapt to different contexts and scenarios. Pedestrian group tracking was addressed with probabilistic models capturing the interaction between pedestrians. Probabilistic models of sensor measurements, localization and fusion were studied and developed, including multiple cameras, and mobile sensors. Active cooperative perception was addressed, so as to move mobile sensors to reduce the team uncertainty about what is being perceived. [EU proj. CAVIAR, URUS; AdI INTELTRAF].

3. Cognitive robotic assistant:

Study and development of biologically plausible models for action recognition using motor information, sensorimotor coordination, cognitive development, social interaction and learning, based on the available anthropomorphic platforms. These models provide additional support for theories established in neuroscience (e.g. the mirror neurons) or developmental psychology. Work carried out in large EU Projects establishing ISR as a key player in some of the aspects of computational neuroscience. [EU proj. MIRROR, ROBOTCUB, CONTACT; FCT COOPERA, SACOR].

Underlying all the above topics, middleware for the integration, through a service-base SW architecture, of the different subsystems composing a networked robot system, as well as architecture and systems integration concepts, were developed. [EU proj. URUS; FCT SocRob].

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Research Groups

Mobile Robotics Laboratory - MRLab

(Reference: RG-LVT-Lisboa-750009-3503 | PI: Maria Isabel Lobato de Faria Ribeiro)

Intelligent Systems Laboratory

(Reference: RG-LVT-Lisboa-750009-3505 | PI: Pedro Manuel Urbano de Almeida Lima)

VisLab - Computer and Robot Vision Laboratory

(Reference: RG-LVT-Lisboa-750009-3508 | PI: Jose Alberto Rosado Santos Victor)

[Information accessed: 06-11-2008 15:29:46 on www.fct.mctes.pt]
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Research Line Output

Collaborative Publications in peer review Journals (Include only if more than one Research Groups of the LA is involved up to max of 10. Give title and full citation in original language)

1. "Markov Localization in the Robocup Simulation League", C. Penedo, J. Pavão, P. Lima, M. I. Ribeiro, *Robotica*, 4th trimester, pp. 16-21, 2003
2. G. Almeida, J. Santos-Victor, P. Lima, "Controlo de um Manipulador Robótico Usando Visão", *Robótica*, No. 62, 2006
3. C. Marques, J. Cristovão, P. Alvito, Pedro Lima, João Frazão, M. Isabel Ribeiro, R. Ventura, "A Search and Rescue Robot with Tele-Operated Tether Docking System", *Industrial Robot*, Emerald Group Publishing Limited, Vol. 34, No.4, pp. 332-338, 2007

Collaborative Other Publications

(Include only if more than one group is involved and only include here Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

1. P. Lima, L. Custódio, M. I. Ribeiro, J. Santos-Victor, "The RESCUE Project: Cooperative Navigation for Rescue Robots", Prof. 1st Int. Workshop on Adv. in Service Robotics, ASER'03, Bardolino, Italy, pp. 94-101, 2003
2. P. Marcelino, P. Nunes, P. Lima, M. I. Ribeiro, "Improving object localization through sensor fusion applied to soccer robots", Proc. ROBOTICA2003 - 3rd Portuguese Robotics Open, Lisbon, Portugal, 2003
3. F. Melo, M. I. Ribeiro, P. Lima, "Navigation Controllability of a Mobile Robot Population", Proc. RoboCup 2004 Symposium, Lisbon, Portugal, 2004
4. F. Melo, P. Lima, M. I. Ribeiro, "Event-driven Modelling and Control of a Mobile Robot Population", Proc. IAS8 - 8th Conference on Intelligent Autonomous Systems, Amsterdam, The Netherlands. pp. 237-244, 2004
5. M. Tajana, J. Gaspar, J. Nascimento, A. Bernardino, P. Lima, "3D tracking by Catadioptric Vision Based on Particle Filters", Proc. of RoboCup 2007 Symposium, Atlanta, USA, 2007
6. M. Tajana, J. Gaspar, J. Nascimento, A. Bernardino, P. Lima, "On the Use of Perspective Catadioptric Sensors for 3D Model-Based Tracking with Particle Filters", Proc. of IEEE/RSJ IROS 2007, San Diego, CA, USA, 2007
7. A. Khmelinskii, R. Ventura, J. Sanches, "Chromosome Pairing for Karyotyping Purposes", Proc. of RecPad 2007 - 13ª Conferência Portuguesa de Reconhecimento de Padrões, Lisbon, Portugal, 2007
8. M. Tajana, J. Gaspar, J. Nascimento, A. Bernardino, "On the Use of Perspective Catadioptric Sensors for 3D Model-Based Tracking with Particle Filters", 2007 IEEE/RSJ International Conference on Intelligent Robots and Systems, San Diego, USA, October 2007
9. F. Melo, M. Lopes, J. Santos-Victor and M. I. Ribeiro, "Unified framework for imitation-like behaviors", AISB - 4th International Symposium on Imitation in Animals and Artifacts, Newcastle, United Kingdom, April, 2007
10. D. Hall, J. Nascimento, P. Ribeiro, E. Andrade, P. Moreno, S. Pesnel, T. List, R. Emonet, R. B. Fisher, J. Santos-Victor and J. L. Crowley, "Comparison of target detection algorithms using adaptive background models", Proc. 2nd Joint IEEE Int. Workshop on Visual Surveillance and Performance Evaluation of Tracking and Surveillance, (VS-PETS), ICCV, Beijing, October 2005.

Master and PhD thesis completed (Co-supervision or clearly multidisciplinary projects are allowed here)

PhD

- Collaborative work in the supervision of 1 PhD Thesis (M. I. Ribeiro/MRLab, P. Lima/ISLab): Francisco Melo's PhD thesis – "Blocking Controllability of a Mobile Robot Population", F. Melo, M. I. Ribeiro, P. Lima, Tech. Report, RT-601-04, ISR/IST, 2004

M.Sc.

- M.Sc.Thesis in co-supervision (A. Bernardino/VisLab, P.Lima/ISLab), "3D model-based tracking with one omnidirectional camera and particle filters," Matteo Taiana, IST & Politecnico di Milano, October 2007
- MSc Thesis in co-supervision (J. Santos-Victor/VisLab, P. Lima/ISLab): "Controlo de um Manipulador Robótico Usando Visão", M. da Graça Almeida, Instituto Superior Técnico, Lisbon, Portugal, 2004

[Information accessed: 06-11-2008 15:29:46 on www.fct.mctes.pt]

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Future Research

Other Information (Include only if more than one group is involved. Patents/prototypes, organization of conferences, industry contract research)

Thematic Area B has been a platform for collaboration between different groups at ISR. The topic of (distributed) monitoring and surveillance, taken in its wider perspective and considering the different scales of problems (e.g., global versus local, the individual versus the collective, distributed sensing and actuation, simple sensors vs complex nodes like assistant robots interacting with humans) calls for the intervention of multidisciplinary research areas and viewpoints.

The work in this Area results from the close collaboration of the VisLab, ISLab and MRLab and contributions from SPLab, DSORL and IN+ members.

The two researchers hired by the AL in this area were instrumental for collaborative research achievements. They organized reading groups, submitted project proposals to FCT and EU and were strongly involved in international activities (e.g., EU projs and new international partnerships).

The hiring of a 3rd researcher to work in camera networks and video surveillance is expected after the AL evaluation.

Prototype/tech. transfer

- RAPOSA: robot for Search and Rescue operations in outdoors hazardous environments, developed together with a spinoff SME IdMind and the Lisbon Fire Dept. The robot was tested successfully during an earthquake drill, performed in Sicily, joining several European Civil Protection institutions, EUROSOT 2006. A license for technology, mark and intellectual rights usage by IdMind is under negotiation. [ISLab, MRLab]

- iCub: within the EU Proj. RobotCub, the head of the iCub humanoid robot was designed and will be replicated and used by the research community world wide. The VisLab will have an iCub robot, an unique, standard testbed for research in vision, cognition, learning and computational neuroscience, that will enable the collaboration of multiple groups within Theme B. [VisLab+ISLab]

Organization of Conferences/Workshops:

- 1st IFAC MVS Wks, Salvador, Brazil, 2006. The objective of this workshop was to provide an international forum for the discussion of recent developments and advances in the field of multivehicle systems. [ISLab+MRLab]

- RoboCup 2004: RoboCup is the largest robotics event worldwide - an initiative with the goals of fostering research and education in AI & Robotics and public awareness of S&T. RoboCup2004 was organized in Lisbon by ISR/IST and attracted a record number of 1627 participants from 37 countries and ~500 robots, split by 346 teams. Symposium Proceedings published by Springer-Verlag LNCS. [ISLab+MRLab+VisLab]

- IAV 2004, organized in Lisbon by ISR/IST with the sponsorship of IFAC and EURON. The symposium included 165 paper presentations, 6 plenary invited lectures, 5 invited and 26 regular sessions. Proceedings published by Elsevier Science. [MRLab+VisLab]

- Robótica 2003: the largest and most prestigious national Robotics event, including robot competitions for senior and junior teams. Robótica 2003 achieved a record number of 90 teams and about 500 participants. [ISLab+MRLab]

- Theme B Workshop in 2005, provided a forum for the exchange of ideas and identification of common interests amongst ISR researchers involved in related topics (~ 50 participants), including an open-lab day.

EU Projects

- URUS - Ubiquitous Networking Robotics in Urban Settings, Dec06 – Nov09 [VisLab+ISLab+MRLab]

- ROBOTCUB - ROBotic Open-architecture Technology for Cognition, Understanding, and Behaviour, Sep 04 – Aug09 [VisLab+ISLab]

- CAVIAR - Context Aware Vision using Image-based Active Recognition, Oct02 – Sep05 [VisLab+SPLab]

National Projects

- REEQUIPMENT, Aug05-Mar07 [VisLab+MRLab+ISLab+DSOR+IN+]

- RESCUE – Cooperative Navigation for Rescue Robots, Nov00–Oct04 [ISLab+MRLab+VisLab]

- RAPOSA-Semi-Autonomous Robot for Rescue Operations, Mar03–Sep04 [ISLab+MRLab]

- DecPUCS: Decentralized Planning Under Uncertainty for Cooperative Systems, Oct07–Sep10 [ISLab+MRLab+VisLab]

- SUES – “Sustainable Technologies and Environmental Systems Research” - initiative led by IN+, with the goal to deploy a large-scale sensing and actuation infrastructure to monitor, profile and optimize energy consumption in buildings, involving GALP Energy and SIEMENS Portugal. Theme B involvement concerns decision making supported by data integration and video surveillance. [ISLab+SPLab+VisLab]

International partnerships & training

- Large Scale Dynamic Sensing and Actuation Ecosystem - submitted (Oct. 2008), CMU-PT proposal [SPLab+ISLab+VisLab+DSORLab]

- IST-EPFL: active involvement in this joint PhD program, Focus Areas of “Distributed & Cognitive Robotics” and “Biological & bio-medical imaging”. Start 2009. [VisLab, ISLab, MRLab, SPLAB]

- ATHENS courses on “Introduction to Robotics” (2007: 2 editions; 2008: 1 edition)

Future Plans

Theme B future activities will consolidate the originally planned research and embrace new research themes in the frontier of the existing ones.

Reinforced topics:

- i) extend work on search and rescue to the more comprehensive areas of field robotics and networked robot systems, including a deliverable renaming to "Distributed Robot Networks", generalizing the research focus to innovative results on unstructured environments blending sound theory and technological developments, while notwithstanding the societal impact. Topics of interest will include decentralized sequential decision making under uncertainty methods based on POMDP models, cooperative perception and navigation, vision-based topological mapping and navigation and human-robot interaction;
- ii) develop new representations to describe human activities in a given scenario. The models developed should be able to characterize behavior at different temporal scales. The work will be extended in the direction of gesture-based human robot interfaces.
- iii) improve the skills and level of integration of the cognitive robot assistant. In addition to developments in vision and attention, we will study the integration of speech and vision during manipulation to associate verbal descriptions to actions and/or objects and develop methods for fine manipulation.

New research actions:

- Besides the collaboration with researchers from the natural sciences already existing for years in the robot assistant work, we are now exploring multidisciplinary, thought-provocative research topics, which have demonstrated potential for introducing breakthrough concepts in areas such as coordination of robot collectives based on concepts borrowed from the social and natural sciences, namely Economy and Biology and medical image analysis, as part of other Bioengineering topics. We plan to strengthen those areas by increasing the collaboration with experts in those fields and by recruiting post-docs researchers.
- Strengthen the collaboration with other groups in the AL (e.g., IN+) or external (national or international) (e.g., CMU, MIT, EPFL, Örebro U., UPC, IIT, U.Genova, ISR-Coimbra) in the areas of research of this thematic area.
- Create a training center in cognitive and humanoid robots to take advantage of the available, quite unique, experimental platforms soon available at ISR.
- Promote the development and use of other rich experimental platforms such as static and mobile sensor network already deployed at ISR (w/ e.g. cameras, mobile robots);

Here you can find the information submitted for each of the Research Lines.

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Research Line Information

(RL-COMP-750009-145)

Designation: Signal Processing for Communicatio Networks and Multimedia

Principal Investigator: Joao Paulo Salgado Arriscado Costeira

Research Area: Electrical and Computer Engineering

General Objectives:

Modern technologies in the communication and multimedia context, require a whole new set of methodologies to enabling new applications and increased levels of performance. The next generation of Wireless Communications of Radio Systems (e.g. cellphones), Underwater Acoustic Communication or Image and Video-based Recognition Systems, all share in common the need to handle large scale and usually nonlinear data representations and processing. Actions in this thematic area share the common goal of developing advanced signal processing algorithms with low computational complexity. To achieve this goal, we use new methodologies based on adequate mathematical disciplines, such as optimization theory, non-linear algebra, and differential geometry, leading to tools with a wide area of application. On the more technological view, the thrust was put on using developed methods to tackling fundamental problems in wireless communications and inference of 3D content from video streams.

Details on site: <http://www.isr.ist.utl.pt/temaD>

Major Achievements:

Wireless Communications:

Methods for coping with nonlinearity in multicarrier systems (OFDM architectures). Channel estimation and equalization methods for block single/multicarrier transmission in radio and acoustic communications. New methods for automatic equalization based on time reversal, with application in underwater communication systems.

It was developed a methodology for optimal design of the set of symbols (codebook), used to code information in multi-antenna wireless communication systems (known as 4G systems). The new codebooks, which can take any arbitrary noise correlation structure in the design stage, outperform the previous constructions available, both in the high and low Signal to Noise Ratio (SNR) regimes.

Signal Processing on Manifolds: The Cramér-Rao bound (CRB) can only handle flat parameter spaces, whereas modern applications involve curved ones. We have generalized the CRB to this more encompassing setting. The usage of this new theoretical tool has been demonstrated in several applications such as : blind identification of MIMO channels, attitude and position estimation from range measurements.

Centroid computation is the first step in Principal Component Analysis (PCA) and does not have a closed-form solution in Riemannian manifolds, which are the natural data ambient spaces in modern signal and image applications. We designed a Newton algorithm for center-of-mass computation thus achieving a quadratic rate of convergence.

3D content from images:

To infer 3D content from video sequences it is necessary to use large sets of images to constrain the problem as to obtain accurate estimates of 3D positions and camera orientations. This leads to a nonlinear problem of very large dimensionality.

We developed an original method for 3D reconstruction, based on the robust factorization of a large observation matrix that is highly rank deficient in a noiseless situation.

Imposing rigidity as a prior model we developed a multiview matching algorithm by introducing a multidimensional assignment structure, which determines pixel assignments among images.

The connecting line between these achievements and others within the thematic area, stems from the fact that they, usually, require solving problems formulated as large scale nonlinear (some combinatorial) optimization problems. One testimony of this relevance are the two IBM Scientific Prizes won by young researchers and just recently the best paper award at ICIP08, and the best presentation award(FG2008)

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Research Groups

Signal and Image Processing Group

(Reference: RG-LVT-Lisboa-750009-3447 | PI: Isabel Maria Gonçalves Lourtie)

VisLab - Computer and Robot Vision Laboratory

(Reference: RG-LVT-Lisboa-750009-3508 | PI: Jose Alberto Rosado Santos Victor)

[Information accessed: 06-11-2008 15:30:18 on www.fct.mctes.pt]

[FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Research Line Output

Collaborative Publications in peer review Journals (Include only if more that one Research Groups of the LA is involved up to max of 10. Give title and full citation in original language)

[OXC07] R. Oliveira, J. Xavier, J. Costeira- Multi-View Correspondence by Enforcement of Rigidity Constraints, Image and Vision Computing, vol 25, Issue 6,

Collaborative Other Publications

(Include only if more than one group is involved and only include here Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

[AOPX06] A. Alcocer, P. Oliveira, A. Pascoal and J. Xavier. Maximum likelihood attitude and position estimation from pseudo-range measurements using geometric descent optimization. IEEE Conference on Decision and Control (CDC'06), San Diego, CA, USA, December 2006

[AOPX06b] A. Alcocer, P. Oliveira, A. Pascoal and J. Xavier. Estimation of attitude and position from range only measurements using geometric descent optimisation on

the special Euclidean group. 9th International Conference on Information Fusion – FUSION'06, Florence, Italy, July 2006

[FCSSS06] R. Ferreira, J. P. Costeira, C. Silvestre, I. Sousa, J. Santos, Using Stereo Image Reconstruction to Survey Scale Models of Rubble-Mound Structures - Proceedings of the First International Conference on the Application of Physical Modeling to Port and Coastal Protection , June 2006, Porto.

[FXCB06] R. Ferreira, J. Xavier, J. P. Costeira, V. Barroso. Newton Method For Riemannian Centroid Computation in Naturally Reductive Homogeneous Spaces, International Conference on Acoustics, Speech and Signal Processing ICASSP 2006.

Master and PhD thesis completed (Co-supervision or clearly multidisciplinary projects are allowed here)

[Information accessed: 06-11-2008 15:30:18 on www.fct.mctes.pt]

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Future Research

Other Information (Include only if more that one group is involved. Patents/prototypes, organization of conferences, industry contract research)

In the context of the research line, in cooperation with Dynamic Systems and Ocean Robotics Group (DSOR), VisLab - Computer and Robot Vision Laboratory, under the framework of Project MEDIRES, a prototype of a stereo system was developed to estimate 3D submerged structures (publication [FCSSS06]). This system provides massive data for testing scaled models of real breakwaters in laboratory environment. Important parameters are obtained from the structural assessment of the real breakwater (done using autonomous vehicles developed by DSOR) which can validate the models. Further improvements are under way towards a possible pre-competitive prototype.

In cooperation with VISLAB, DSOR and Signal and Image Processing Group (SIPG), a prototype is being developed for automatic control of car assembly (smooth automatic docking of convertible tops using vision). The main contractor MDU (www.mdu.pt) is involved in a technology transfer process with ESA, and ISR-LA provides scientific consultancy and development of critical software parts.

In cooperation with thematic area "Robotic Surveillance and Monitoring" and "Sustainable Technologies and Environmental Systems Research" (involving VISLAB, ISLAB, SIPG, IN+) an initiative is being launched to deploy a large scale sensing and actuation infrastructure, to monitor, profile and optimize energy consumption in buildings. This initiative cut-crosses all areas. In particular we are involved in the estimation of dense fields (temperature, humidity etc). We are investing in distributed signal processing algorithms to localize and track sensors and estimate those variables in a sensor network with mobility. This initiative (lead by IN+) involves major industrial companies.

In the framework of Carnegie Mellon-Portugal Program, a collaborative initiative was put forward into building a large heterogeneous sensor network (VISLAB, SPIG, ISLAB, DSOR). Besides basic aspects of sensing and actuation in massively distributed systems, joint supervision of PhD students are already in place to develop mechanisms for reliable positioning and tracking of targets in sensor networks and recognition in video.

Future Plans

This thematic area will keep the key strategic investment in basic methodologies which can spin new solutions to signal processing problems that lead, in general, to large-scale, nonlinear or distributed optimization problems. We refocused the domain of development/application to: (i) signal processing algorithms for large distributed sensor networks and (ii) algorithms to 3D reconstruction and shape recognition from video. These are in line with the above mentioned collaborations and the strong involvement within the CMU-Portugal program.

Signal Processing on manifolds: We plan to deepen the preliminary achievements such as: (i) performance bounds for estimators on manifolds (ii) principal component analysis on manifolds (iii) statistical models on manifolds.

A great effort will be put into solving certain classes of nonconvex problems by constructing explicitly the convex hull of their epigraph. This technique is to be applied to quadratic problems over the Stiefel manifold which finds immediate and important applications in computer vision.

Fast distributed solutions by exploring some tools available from the theory of optimization (e.g. Augmented Lagrangian approaches coupled with new coordination procedures). These are fundamental tools in applications in sensor networks and multiple image processing.

These developments will enable new solutions to a set of important applied problems such as designing distributed algorithms that take into account the intrinsic properties of networked sensing: (dynamic) topology link reliability, limited bandwidth and energy and quantization effects. These constraints pose challenges in particular developments (i) design of (nonlinear) consensus algorithms, (ii) selecting the most informative sensors on the network for hypothesis testing and for target tracking. (iii) trajectory estimation of moving targets and sensor position (SLAT). In a different scope these methodologies are key to solving large scale problems such as: (iv) very low complexity shape recognition algorithms from images with massive number of points (landmarks) and (v) Parallel and distributed large scale assignment problems for image correspondence. (vi) (nonlinear) estimation problems with incomplete data (e.g for 3D shape computation, object recognition).

Here you can find the information submitted for each of the Research Lines.

[Information accessed: 06-11-2008 15:34:10 on www.fct.mctes.pt]

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Research Line Information

(RL-COMP-750009-151)

Designation: Technologies for Ocean Exploration

Principal Investigator: Antonio Manuel dos Santos Pascoal

Research Area: Electrical and Computer Engineering

General Objectives:

The main goal of thematic area A, entitled Technologies for Ocean Exploration, is to carry out research and development in marine science and technology for a better understanding of the oceans, and to use this knowledge for the sustainable benefit of society. This far-reaching goal set the stage for the work program adopted. The area brings to the core of its R&D activities research groups with different, yet complementary expertise and encompasses a wide spectrum of activities that touch upon theoretical and practical issues on marine science and technology. The program targets the Azores as a natural laboratory for the study of a number of challenging scientific issues in the fields of biological, chemical, geological, and physical oceanography.

At a technological level, this concerted effort is in line with the current trend worldwide, aimed at the development of ocean sampling networks (OSN) providing a nested ocean observation capability through cooperative control of networked, fixed and mobile sensor platforms. We aim to bring advances in robotics, communications, and systems and information theory to bear on the development of advanced marine platforms (including autonomous vehicles) that will afford marine scientists far more efficient tools than available today to study the ocean and its frontiers.

Major Achievements:

The R&D activity addressed a vast number of issues that are at the crossroad of science and engineering.

Engineering:

A large spectrum of problems were addressed, the solutions of which are key to the development of advanced technology for marine exploration. Theoretical work led to novel algorithms for navigation, guidance, and control of autonomous systems, as well as cooperative motion control of multiple heterogeneous uninhabited systems in the presence of stringent acoustic communication constraints.

Science:

Through IMAR, the Associated Lab has effectively become a leading research center for integrated studies on seamounts and hydrothermal vents, involved in 8 projects of the FP6. It is also the world leading research center on the study of the deep-sea chemo-synthetic mussel *Bathymodiolus* and the 23rd Web of Knowledge ranked institution on the study of hydrothermal vent extreme ecosystems. The implementation of LabHorta (a new international laboratory for the study of hydrothermal vents) was a major milestone, for it opened a new window on the studies of extreme ecosystems of the deep-sea.

Public outreach through Creminer was noteworthy, with involvement in the National Museum of Natural History and in the setting-up of two "live science" centers. In what concerns marine geology (including studies on hydrothermal activity, deep biosphere, and submarine volcanology) the areas of work included the Azores Sea, the Southwest Pacific, and the North Atlantic. Especially relevant was the discovery of how the Rainbow ores were formed in a new environment with unusual rocks.

Bridging the gap between science and technology:

Representative milestones include: i) mission with a MAYA autonomous underwater vehicle (AUV) in Goa, India that allowed for the detection of hypoxia in a water dam; ii) MOMARETO cruise in the Azores, where instrumentation and algorithms for acoustic backscatter data acquisition were used to automate the process of marine habitat mapping classification near deep water hydrothermal vents, iii) bathymetric data acquisition with the Delfim ASC and digital terrain map building around the island of Faial, iv) development of the key components (scientific equipment and laboratory space) of an Environmental Laboratory in the Azores, as envisioned in the scope of the Re-Equipment program of FCT, v) joint participation in the GREX and FREEsubNET EC programs, leading to the definition of mission scenarios and techniques for networked marine vehicle operation.

[Information accessed: 06-11-2008 15:34:10 on www.fct.mctes.pt]

[FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Research Groups

Centre of IMAR of the University of the Azores/ Department of Oceanography and Fisheries (IMAR-DOP/UAz)

(Reference: RG-Centro-Coimbra-750009-3433 | PI: Ricardo Piedade Abreu Serrão Santos)

DSORL - Dynamical Systems and Ocean Robotics Laboratory

(Reference: RG-LVT-Lisboa-750009-3438 | PI: Antonio Manuel dos Santos Pascoal)

Centre of Mineral Resources, Mineralogy and Crystallography of the Faculty of Science of Lisbon University (CREMINER)

(Reference: RG-LVT-Lisboa-750009-3589 | PI: Fernando José Arraiano de Sousa Barriga)

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Research Line Output

Collaborative Publications in peer review Journals (Include only if more than one Research Groups of the LA is involved up to max of 10. Give title and full citation in original language)

F. Cardigos, A. Colaco, P. R. Dando, S. P. Avila, P. M. Sarradin, F. Tempera, P. Conceicao, A. Pascoal, and R. S. Santos, "Shallow water hydrothermal vent field

fluids and communities of the D. Joao de Castro Seamount (Azores)," *Chemical Geology*, vol. 224, pp. 153-168, Dec 2005

A. Colaço, P. Bustamante, Y. Fouquet, P. M. Sarradin, and R. S. Santos, "Bioaccumulation of Hg, Cu, and Zn in the Azores triple junction hydrothermal vent fields food web," *Chemosphere*, vol. 65, pp. 2260-2267, Dec 2006.

A. Colaço, I. Martins, M. Laranjo, L. Pires, C. Leal, C. Prieto, V. Costa, H. Lopes, D. Rosa, P. R. Dando, and R. S. Santos, "Annual spawning of the hydrothermal vent mussel, *Bathymodiolus azoricus*, under controlled aquarium, conditions at atmospheric pressure," *Journal of Experimental Marine Biology and Ecology*, vol. 333, pp. 166-171, Jun 2006.

A. Colaço, C. Raghukumar, C. Mohandass, F. Cardigos, and R. S. Santos, "Effect of shallow-water venting in Azores on a few marine biota," *Cahiers de Biologie Marine*, vol. 47, pp. 359-364, 2006.

E. Kadar, R. Bettencourt, V. Costa, R. S. Santos, A. Lobo-Da-Cunha, and P. Dando, "Experimentally induced endosymbiont loss and re-acquirement in the hydrothermal vent bivalve *Bathymodiolus azoricus*," *Journal of Experimental Marine Biology and Ecology*, vol. 318, pp. 99-110, May 2005.

I. Martins, V. Costa, F. M. Porteiro, and R. S. Santos, "Temporal and spatial changes in mercury concentrations in the North Atlantic as indicated by museum specimens of glacier lanternfish *Benthosema glaciale* (Pisces : Myctophidae)," *Environmental Toxicology*, vol. 21, pp. 528-532, Oct 2006.

C. Pusch, A. Beckmann, F. M. Porteiro, and H. von Westernhagen, "The influence of seamounts on mesopelagic fish communities," *Archive of Fishery and Marine Research*, vol. 51, pp. 165-186, 2004.

Collaborative Other Publications

(Include only if more than one group is involved and only include here Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

Person R, Beranzoli L, Berndt C, Dañobeitia JJ, Diepenbroecke M, Favali P, Gillooly M, Lykousis V, Miranda JM, Pouliquen S, Priede IE, Santos RS, Thomsen L, Van Weering T, Waldman C (2007) ESONET: A network to integrate European research on sea observatories. 2007 OCEANS, Vols 1-5: 1182-1187 [ISIP:000256526300179; doi 10.1109/OCEANSE.2007.4302235].

A. Alcocer, P. Oliveira, A. Pascoal and J. Xavier. Maximum likelihood attitude and position estimation from pseudo-range measurements using geometric descent optimization. IEEE Conference on Decision and Control (CDC'06), San Diego, CA, USA, December 2006

A. Alcocer, P. Oliveira, A. Pascoal and J. Xavier. Estimation of attitude and position from range only measurements using geometric descent optimisation on the special Euclidean group. 9th International Conference on Information Fusion – FUSION'06, Florence, Italy, July 2006

R. Ferreira, J. P. Costeira, C. Silvestre, I. Sousa, J. Santos, Using Stereo Image Reconstruction to Survey Scale Models of Rubble-Mound Structures - Proceedings of the First International Conference on the Application of Physical Modeling to Port and Coastal Protection , June 2006, Porto.

J. Sarrazin et al., MoMARETO: A cruise dedicated to the spatio-temporal dynamics and the adaptations of hydrothermal vent fauna on the Mid-Atlantic Ridge, *InterRidge News*, Vol. 15, pp. 24-33, 2006

Sarradin PM, Sarrazin J, Cadiou J, Olu K, Desbruyeres D, Rigaud V, Drogou JF, Lecornu F, Rolin J, Vuillemin R, Cambon-Bonavita MA, Sauter E, von Juterzenka K, Boetius A, Santos RS, Colaco A, Pascoal A, Oliveira P, Shillito B, Zal F, Schultz A, Taylor P, Lane D, Loke RE, du Buf H, Waldmann C, Cormack A, Sanfilippo L, Masson M (2004) EXtreme Ecosystem Studies in the Deep OCEan: Technological developments. Proceedings of the Fourteenth (2004) International Offshore and Polar Engineering Conference, Vol 1: 738-745. [ISIP:000223780000111].

Barriga F, Santos RS (2003) The MOMAR Area: a prime candidate for development of a seafloor observatory. 3rd International Workshop on Scientific Use of Submarine Cables and Related Technology, Proceedings: 259-262

Master and PhD thesis completed (Co-supervision or clearly multidisciplinary projects are allowed here)

PhD Thesis

Telmo Morato Gomes - Ecology and fisheries of seamount ecosystems (co-supervisor: PhD awarded by the University of British Columbia, Canada)

Pedro Afonso dos Santos - Marine protected areas: Ecological effects and benefits for fisheries. (co-supervisor: PhD awarded by the University of Hawaii, USA)

Vera Domingues - Reconstruction of post-glacial colonization routes of fish with tropical and sub-tropical affinities in the Azores: A biogeographic and molecular approach. (PhD awarded by the University of the Azores)

Fernando Tempera - Classification and Mapping of Benthic Sublittoral Biotopes in the Faial-Pico Channel (Azores) (co-supervisor: PhD awarded by the University of St Andrews, UK)

Multidisciplinary Projects

[1] Projects involving LA Research Units ISR and IMAR

MAROV (FCT Funding) – Mapping of Marine Habitats in the Azores using Robotic Vehicles.

Objectives: marine habitat mapping using an autonomous surface vehicle (ASV) and an autonomous underwater vehicle (AUV). Successful testes were carried out at Horta, Faial.

MAYASub (AdI Funding) – Development of a Miniaturized AUV for Commercial and Scientific Applications.

Objectives: to develop and demonstrate the performance of a small, modular, autonomous underwater vehicle (AUV) for scientific and commercial applications. The project witnessed the execution of scientific missions in Goa, India.

EXOCET (EC Funding) – Extreme Ecosystem Studies in the Deep Ocean: Technological Developments.

Part of the work of IST/ISR and IMAR in the scope of the project focused on the development of the acoustic systems required to acquire backscattering data. The final systems developed were tested at sea during the MOMARETO mission in the Azores.

GREX (EC Funding) - Coordination and Control of Cooperating Heterogeneous Unmanned Systems in Uncertain Environments.

Objectives: study and development of advanced systems and sensor units enabling the concerted operation of fleets of marine vehicles.

FREEsubNET (EC Funding) - A European Research Network on Key Technologies for Intervention Autonomous Underwater Vehicles.

Objectives: to provide a European-wide excellence in quality training to young and experienced researchers in the emerging field of Cooperative Autonomous Intervention Underwater Vehicles (I-AUV).

RUMOS (FCT Funding) - RUMOS: Robotic Underwater Vehicles and Marine Animals Tracking Systems.

Objective: to develop a set of devices and methodologies for precise estimation of trajectories of underwater robotic vehicles (autonomous and remotely operated) and marine animals.

NAV (FCT Funding): Development and Application of Advanced Nonlinear Control Techniques for the Coordination and Motion Control of a Network of Autonomous Vehicles.

Objectives: to develop, implement and test advanced robust control strategies for the coordination and cooperative motion a network of autonomous vehicles (NAV).

[2] Projects involving LA Research Units ISR and CREMINER

DREAM (FCT Funding) – Development of a Semi-Deep ROV for Scientific Applications and Environmental Monitoring.

Objective: development of a Remotely Operated Vehicle capable of “semi-deep” intervention (down to the 1000m range) to be used by the Portuguese scientific community in a variety of ocean research missions. The project witnessed the development and testing of key mechanical., electrical, and electronic components of the ROV as well as of its navigation and control systems. Additional funds are being sought to purchase the mechanical components still needed.

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Future Research

Other Information (Include only if more than one group is involved. Patents/prototypes, organization of conferences, industry contract research)

ORGANIZATION OF CONFERENCES (REPRESENTATIVE SELECTION)

“Seamounts: Ecology, Fisheries and Conservation, Centro do Mar, 16- 22 May, 2005, Horta, Portugal” an international workshop which led to the publication of the first synthesis book on seamounts: Pitcher, T. J., T. Morato, P. J. B. Hart, M. R. Clark, N. Haggan & R.S. Santos (Eds.) 2007. Seamounts: Ecology, Fisheries and Conservation. Blackwell Publishing, Oxford, UK; Iowa, USA; Victoria, Australia: xxiv + 528pp with 156 illustrations. (ISBN: 978-1-4051-3343-2). This book was an editorial success and is going, in less than one year for the second edition.

MARECO – Patterns and Processes of the Ecosystems of the Northern Mid-Atlantic Ridge, Field Phase Workshop and Steering Group Meeting, 2-5 June, 2005, IPIMAR, Lisbon, Portugal. This was the synthesis workshop for the scientific and technological results related with the 2004 cruise between the Azores and Iceland which resulted in the special issue of Deep Sea Research Part II: Topical Studies in Oceanography, Volume 55, Issues 1-2, Pages 1-268 (January 2008).

The Policy oriented seminar of the Parliamentary Assembly of the European Council on: “An European Perspective on Environmental and Scientific Issues of the North Atlantic and Adjacent Seas”. Royal Garden Hotel. Ponta Delgada, 18 October 2007 .

Special Session on Autonomous Vehicles for Ocean Exploration and Exploitation, ISOPE-2007-the 17th International Offshore (Ocean) and Polar Engineering Conference & Exhibition Lisbon, Portugal, 2007.

Pre-Conference Workshop, New Developments in Point-Stabilization, Trajectory Tracking, Path Following, and Formation Control of Autonomous Vehicles, IEEE Conference on Decision and Control, 2006

7th IFAC Conference on Manoeuvring and Control of Marine Craft, MCMC'2006, Lisbon, Portugal, September 2006.

8th European Conference on Underwater Acoustics, Carvoeiro, Portugal, 2006

5th IFAC Symposium on Intelligent Autonomous Vehicles, IAV 2004, Lisbon, Portugal.

PROTOTYPES developed and operated by the Associated Lab in the scope of activities involving the research units of ISR and the IMAR

- DELFIM Autonomous Surface Vehicle (ASC) – An autonomous surface craft (Catamaran-type) to carry out experimental research in the area of ocean robotics and to perform scientific missions at sea. The vehicle has been used extensively for marine data acquisition and bathymetry operations in the Azores, in cooperation with the partner IMAR/DOP.
- DELFIM_X Autonomous Surface Vehicle (ASC) – An autonomous surface craft similar to the DELFIM, but with improved hydrodynamic characteristics and increased autonomy.
- INFANTE Autonomous Underwater Vehicle (AUV) –An autonomous underwater vehicle to carry out experimental research in the area of ocean robotics and to perform scientific missions at sea.
- MAYA AUV – designed and built by a Luso-Indian consortium consisting of NIO (Goa, India), ISR/IST, IMAR/DOP/Azores, and RINAVE. A small, modular, autonomous underwater vehicle (AUV) for scientific and commercial applications. The first prototype has been tested and used extensively in Goa, India.
- CARAVELA 2000 Autonomous Research Vessel – designed and built by IMAR/DOP/Azores, ISR/IST, and the companies RINAVE and CONAFI Prototype of an autonomous surface craft for long range missions at sea
- Autonomous Helicopter (Bergen Industrial Twin) - a small-scale industrial helicopter. This is a transformed radio-controlled helicopter, about 1.6m long (including the rotor diameter), with a payload capability of 10 kg, and a top speed of 70 Km per hour.
- IRIS TOOL – designed and built by ISR/IST. A high accuracy surveying tool for both the above water and submerged parts of semi-submerged structures. IRIS is equipped with an accurate Laser Scanner, a profiler sonar, a high end motion reference unit, and a surveying class GPS. This tool can be used either from a rubber boat in autonomous mode or equip an Autonomous Surface Craft to produce tri-dimensional surveys with the spatial regularity required to this kind of structures.

PATENTS

“A Controlled Thruster-Driven Profiler for Coastal Waters”, US patent Number 6786087 sept 7, 2004. The patent is the outcome of joint work done by the

INDUSTRY CONTRACT RESEARCH

Project name: MAYASub

Scientific Coordination: Instituto Superior Técnico

Leading Company: Rinave - Registro Internacional Naval SA, Portugal,

External Partners: RINAVE (PT), IMAR/DOP/Univ. Azores (PT), National Institute of Oceanography (NIO) , Dona Paula, Goa, India, System Technologies (ST), Ulverston, UK.

Future Plans

What follows is but a sample of the type of future activities that will require a tight symbiosis between science and technology with societal and economical impact.

A. Dam and coastal area surveying and monitoring using autonomous surface and underwater vehicles

Dams obstruct the normal flow of sediments from the continents to the ocean. Coastal erosion is increasing dramatically as a consequence. Additionally, agriculture and other soil moving activities (forestry, etc) greatly increase soil erosion. The fine fraction of topsoil is being lost (worldwide) at alarming rates. There is great need of monitoring the sediment accumulation to then establish adequate policies. There is an ongoing cooperation program with Cape Verde, where we hope to determine sediment erosion rates under catastrophic climatic events. To meet these goals, it is planned to use fully autonomous underwater and surface vehicles (where the latter can be operated in a semi-autonomous mode) equipped with scientific sensors and instrumentation for navigation and data geo-referencing. The same types of vehicles can of course be used for coastal area surveying.

B. Mapping and monitoring of hydrothermal sites using autonomous underwater vehicles.

B.1 The Mid-Atlantic ridge and the Azores hot-spot. Future activities concerning the sea floor along the mid-Atlantic Ridge near the Azores include hydrothermal and volcanic mapping of the ridge between the MOMAR hydrothermal fields and the shallow areas between the Azores islands. We intend to use mapping and sampling operations along the ridge as a school for students, including undergraduates.

B.2 Shallow water hydrothermalism / volcanism (Banco DJC and Serreta). We are interested in monitoring the young submarine volcanic systems in the Azores sea, such as the Serreta volcano and Banco D. João de Castro. This includes volcanic interpretation, hydrothermal activity and rapid response monitoring in case of new, shallow eruptions.

C. Observation and tracking of marine mammals and fish schools using aerial and oceanic autonomous vehicles. The objective is to greatly drastically improve the methods to do fish telemetry (this theme is strongly motivated by joint work of ISR and IMAR in the scope of the EC projects FREEsubNET and GREX). This action will also witness, in the scope of the FCT OBSERVFLY project, the development of a versatile UAV for location and tracking of marine mammals and commercially important or threatened pelagic species such as the Atlantic Tuna.

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Research Groups

Evolutionary Systems and Biomedical Engineering

(Reference: RG-LVT-Lisboa-750009-3422 | PI: Agostinho Claudio da Rosa)

Centre of IMAR of the University of the Azores/ Department of Oceanography and Fisheries (IMAR-DOP/UAz)

(Reference: RG-Centro-Coimbra-750009-3433 | PI: Ricardo Piedade Abreu Serrão Santos)

DSORL - Dynamical Systems and Ocean Robotics Laboratory

(Reference: RG-LVT-Lisboa-750009-3438 | PI: Antonio Manuel dos Santos Pascoal)

Signal and Image Processing Group

(Reference: RG-LVT-Lisboa-750009-3447 | PI: Isabel Maria Gonçalves Lourtie)

Mobile Robotics Laboratory - MRLab

(Reference: RG-LVT-Lisboa-750009-3503 | PI: Maria Isabel Lobato de Faria Ribeiro)

Intelligent Systems Laboratory

(Reference: RG-LVT-Lisboa-750009-3505 | PI: Pedro Manuel Urbano de Almeida Lima)

VisLab - Computer and Robot Vision Laboratory

(Reference: RG-LVT-Lisboa-750009-3508 | PI: Jose Alberto Rosado Santos Victor)

Laboratory for Energy and Environmental Studies at IN+ Center for Innovation, Technology and Policy Research

(Reference: RG-LVT-Lisboa-750009-3583 | PI: Paulo Manuel Cadete Ferrao)

Laboratory of Thermofluids, Combustion and Energy Systems, at IN+ Center for Innovation, Technology nad Policy Research

(Reference: RG-LVT-Lisboa-750009-3584 | PI: Antonio Luis Nobre Moreira)

Laboratory of Technology Policy and Management of Technology, at IN+ Center for Innovation, Technology and Policy Research

(Reference: RG-LVT-Lisboa-750009-3585 | PI: Rui Miguel Loureiro Nobre Baptista)

Centre of Mineral Resources, Mineralogy and Crystallography of the Faculty of Science of Lisbon University (CREMINER)

(Reference: RG-LVT-Lisboa-750009-3589 | PI: Fernando José Arraiano de Sousa Barriga)

Here you can find the information submitted for each of the Research Groups.

[Information accessed: 06-11-2008 15:35:03 on www.fct.mctes.pt]

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Research Group Information

(RG-LVT-Lisboa-750009-3422)

Designation: Evolutionary Systems and Biomedical Engineering

Principal Investigator: Agostinho Claudio da Rosa

Location of Group: Instituto Superior Técnico - Universidade Técnica de Lisboa

Keywords: Biomedical Engineering ,Artificial Life ,Bio-Inspired Algorithms ,Cognition

Funding, sources, dates

The LaSEEB main funding sources were the research projects funded by FCT/MCTES, namely:

1) from pluriannual base funding of FCT: 17 500€ (for the five year period) distributed as follow: Agostinho C. da Rosa 2 500€ per year and Vitor V. Lopes 2 500€ per year since 2006; from the pluriannual programmatic funding: No funding.

2) from research project participations: 10 046€ from the OpenMicroBIO FCT Project PTOC/BIO/693/2006 (LaSEEB total budget 57 652€) and no funding from the project MS-Agency POSI/P/EEI/12175/1998 2001/08-2004/5

[Information accessed: 06-11-2008 15:35:03 on www.fct.mctes.pt]

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Group Team

List of Researchers in the Group:

001. Agostinho Claudio da Rosa (**Cat.:** Professor Associado **Gr. Acad.:** Agregação)

List of Collaborators (w/PhD):

001. Fernando Manuel Fernandes Melicio (**Cat.:** Professor Coordenador **Gr. Acad.:** Doutoramento)

002. Cristian Gabriel Munteanu (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

003. Vitor Manuel Vieira Lopes (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

004. Ernesto Saias Soares (**Cat.:** Outra **Gr. Acad.:** Doutoramento)

List of Collaborators (w/o PhD):

001. Rogério dos Santos Largo (**Cat.:** Professor-Adjunto **Gr. Acad.:** Mestrado)

002. João Paulo dos Santos Caldeira (**Cat.:** Assistente **Gr. Acad.:** Mestrado)

003. Nuno Maria Carvalho Pereira Fernandes Fachada (**Cat.:** Monitor **Gr. Acad.:** Mestrado)

004. Carlos Miguel Da Costa Fernandes (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)

005. Daria Migotina (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)

006. Hongfei Gong (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)

007. Maria Raquel Lemos Ferreira Lobo César (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)

008. Nelson Ricardo Perdígão Pereira (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)

009. Marco Paulo Pinheiro Miranda (**Cat.:** Outra **Gr. Acad.:** Bacharelato)

010. Paulo Jorge Roque Mendes da Silva (**Cat.:** Outra **Gr. Acad.:** Licenciatura)

011. Vitorino Jorge Castelo Ramos (**Cat.:** Outra **Gr. Acad.:** Mestrado)

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Objectives & Achievements

Objectives:

The group long term objectives are in two inter-related scientific domains:

1) biomedicine – the main research is the development of model-based real-time detection and classification of brain states using the multi-channel electroencephalogram (EEG) signal fused with other neuro signal and imaging techniques (MEG, iEEG, ECoEG, fMRI, DTI, TAC, PET, etc). The final goal is not only to provide a better understanding of the brain functions but also providing affordable EEG based efficient training, prevention and therapy techniques. A specific goal is to propose a new Classification Paradigm for Sleep Classification, based on structural analysis of phasic events.

2) biosystems modelling and simulation – the long research goal is to have better understanding of how the complexity inherent of biological systems can be described by inter-individual interactions. There are two lines of research under this topic: a) the development of methodologies based on agent-based models for biosystems – for better monitoring and optimization of bio-process, such as: biological reactor design, processed food quality improvement or insect plague monitoring; and b) bio-inspired algorithms – inspired by the study of biological natural mechanisms, this research topic focus on the development of new methodologies for solving engineering problems, such as population based stochastic optimization algorithms to solve global optimization problems.

Main Achievements:

The group works can be framed in two main topics:

In the modelling topic we have developed two main different type of models for bio-systems. The first type are mathematical models with many variables where the problem is to fit the model parameters to real data. We have successfully applied this modelling methodology on the fungi *Mildium Mildew* of the grapevine *Plasmopara viticola*, to the olive fly *Bractocera olea* (with Bayer), to the Nile Fever Mosquito (with Cornell) and currently with Dengue and Malaria mosquitoes. The second type of methodology called usually as Artificial Life (ALife), is mainly agent based modelling, where the main objective is to model behaviours of individual agents and its interaction between different agents and with the simulated environment. ALife models have been developed for the artificial test system similar of polyworld (GAIA) and for the Artificial Immune System (AIS and LAIS). The later a simulator still under development but already produced high potential simulations. In 2007 we started with University of Minho the OpenMicroBio project, where the goal is to model and optimize bio-reactors of bacteria for food-industry using ALife methodology.

On the bio-inspired search optimization methodologies, the group have contributed many new variation operators (Simple Inversion, Infected Gene Crossover and Mutation, PCA mutation, double ladder neighbourhood Simulated Annealing), new selection methods (Variable population selection, assortative and dissortative mating) and global evolutionary search algorithms (Binary Ant System, Digital Landscape ANTS, AREA, ARGGA), an open source distributed library in Java for Evolutionary Algorithms (JDEAL) and a new unsupervised hybrid classifier (Kohonen Ants System). These methodologies have been applied with great success to a large variety of search and optimization, static and dynamic problems.

In the neurophysiology signals analysis and classification, the group have been engaged collaborative research with leading sleep labs (Stanford Human Sleep Clinic, Parma Sleep Center and Sleep Institute of Sao Paulo) developing automatic classification methods for Human Sleep analysis, namely providing the first commercially available automatic classifier for the Cyclic Alternating Pattern paradigm. Currently the group is developing a new paradigm and corresponding classifier for the "Activation Complex" a structured and detailed model of the microstructure of the human sleep process.

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Group Productivity

Publications in peer review Journals (3000 ca.) (Up to a max of 10. Always indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language. DO NOT translate)

- 1.[RPMC2007] Methodology in clinical sleep research. Agostinho Rosa, Dalva Poyares, Walter Moraes, Fatima Cintra Cellular and Molecular Life Sciences 64, pp 1244-1253, 2007. IF = 5.239
- 2.[GLHR2007] The Cyclic Alternating Pattern Demonstrates Increased Sleep Instability and Correlates with Fatigue and Sleepiness in Adults with Upper Airway Resistance Syndrome. Christian Guilleminault , M.Cecilia Lopes, Chad C Hagen, Agostinho Rosa. Sleep 2007, Vol 30, Issue 5, pp 641-647, 2007. IF = 5.126 , C = 5
- 3.[ML2007] Modelling supercooling in frozen strawberries: Experimental analysis, cellular automation and inverse problem methodology. R. C. Martins and V. V. Lopes. Journal of Food Engineering, 80:126–141, 2007. IF = 1.848, C = 2
- 4.[LRPR+2005] Cyclic Alternating Pattern in peripubertal Children. MC Lopes, A Rosa, D Poyares, S Roizenblatt, C Passarelli, S Tufik. Sleep Vol 28, Issue 2, pp 215-219, 2005. IF = 5.126 , C = 14
- 5.[GPRH2005] Heart rate variability, sympathetic and vagal balance and EEG arousals in Upper Airway Resistance and mild Obstructive Sleep Apnea Syndromes Christian Guilleminault, Dalva Poyares, Agostinho Rosa, Yu-Shu Huang. Sleep Medicine, Vol.6, No.5, pp 451-457, 2005. IF = 2.926 , C = 4
- 6.[MR2004a] Gray-Scale Image Enhancement as an Automatic Process driven by Evolution. C Munteanu, AC Rosa. IEEE – Transactions on Systems Man and Cybernetics – Part B, vol. 34 N=2, pp 1292-1298, 2004. IF = 1.538 , C = 4
7. [MR2004b] Adaptive Reservoir Evolutionary Algorithm: An evolutionary on-line adaptation scheme for global function optimization. C Munteanu, AC Rosa Journal of Heuristics, 10, pp 555-586, 2004. IF = 0.74, C = 1
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9. [CPCB+2002] The intranuclear mobility of messenger RNA binding proteins is ATP dependent and temperature sensitive Alexandre Calapez, Henrique M Pereira, Angelo Calado, José Braga, José Rino, Célia Carvalho, João Paulo Tavanéz, Elmar Wahle, Agostinho C Rosa, Maria Carmo-Fonseca. Journal of Cell Biology, Volume 159, Number 5, pp 795-805, 2002. IF = 10.951 , C = 49
10. [TRPR+2002] CAP and arousals in the structural development of sleep: an integrative perspective. MG Terzano, L Parrino, A Rosa, V Palomba, A Smerieri Sleep Medicine, Vol 3(3), pp 221-229, 2002. IF = 2.926, C = 15

For the complete list of publications please check: <http://welcome.isr.ist.utl.pt/labs/laseeb/pub/>

Other publications National (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

1. [RPG2007] "Processamento de sinais eletrofisiológicos para análise e classificação automática do sono". AC. Rosa, D. Poyares, C Guilleminault. In "Biologia e Medicina do Sono", S. Tufik (Edt), Manole Editors, SP, Brazil, Chap 40, pp 451-469, 2007
2. [RALP+2007] "Padrão Alternante Ciclico (CAP)". AC. Rosa, GR Alves, MC Lopes, D Poyares, C Guilleminault. In "Biologia e Medicina do Sono", S. Tufik (Edt), Manole Editors, SP, Brazil, Chap 39, pp 440-450, 2007

3. [FLR2007] Agent Based Modeling and Simulation of Immune System: a Review. N Fachada, Vitor V. Lopes, A. C. Rosa. New Trend in Artificial Intelligence, J Neves, M Santos, J Machado (eds), pp 300-315, EPPIA 2007
4. [MCLP+2007] A. Monitorização da qualidade do leite de cabra durante a pasteurização e processamento óhmico usando sensores de fibra óptica. Rui C.Martins, A. M. Coelho, Vitor V. Lopes, Ricardo Pereira, J. A. Teixeira, A Vicente, Leite I+D+T, pp 4-5, 2007
5. [RABt2006] Visual and Automatic CAP Scoring: inter-rate reliability study. AC Rosa, GR Alves, M Brito, MC Lopes, S Tufik. Arquivos de Neuro-Psiquiatria, 64(3-A), 578-581, 2006
6. [LR2005] Wavelets based detection of a phases in sleep EEG. Rogerio Largo, Agostinho Rosa. Proc. II Int Conf Computacional Bioengineering 2005, Vol 2, pp 1105-1115. ISBN 972-8469-37-3, IST Press
7. [PR2005] Multiple Sequence Alignment By Hybrid Evolutionary Algorithms Applied to Balibase. Nelson Perdigao, Agostinho Rosa. Proc. II Int Conf Computacional Bioengineering 2005, Vol 2, pp 849-860, ISBN 972-8469-37-3, IST Press.
8. [LR2003] Sleep EEG Processing with Wavelets. Rogerio Largo, Agostinho Rosa. Proc 7th Portuguese Conference on BioEng 2003
9. [GOR2003] Sleep Apnea related micro arousal detection with EEG Analysis. Pedro Gouveia, Ricardo Oliveira, Agostinho Rosa. Proc 7th Portuguese Conference on BioEng 2003
10. [R2003] Solving Puzzles and Games by Evolutionary Algorithms. Proc Mathematical Techniques and Problems in Telecommunications. Agostinho Rosa. CIM 24, pp 281-312, 2003

Other publications International (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

1. [MR2007] Symmetry at the Genotypic Level and the Simple Inversion Operator. C Munteanu C, AC Rosa. LNAI 4874, Progress in Artificial Intelligence, J Neves, M Santos, J Machado (eds), pp 209-222, Springer 2007
2. [FRR2007] Binary Ant Algorithm. Fernandes C, Rosa A.C., Ramos V. GECCO'07 – Genetic and Evolutionary Computation Conference, ACM Press, London, UK, pp 41-48, 2007
3. [RFR2007] Computational Chemotaxis in Ants and Bacteria over Dynamic Environments. Vitorino Ramos, Carlos Fernandes, Agostinho Rosa, Abraham Ajith. IEEE CEC 2007, IEEE Press, USA, ISBN 1-4244-1340-0, pp. 1009-1017, Sep. 2007
4. [RFR1006] On Self-Regulated Swarms, Societal Memory, Speed and Dynamics. Vitorino Ramos, Carlos Fernandes, Agostinho C. Rosa. ALIFE X Proc. of the Tenth Int. Conf. on the Simulation and Synthesis of Living Systems, L.M. Rocha, L.S. Yaeger, M.A. Bedau, D. Floreano, R.L. Goldstone and A. Vespignani (Eds.), pp. 393-399, MIT Press, 2006
5. [FR2006] Self-Regulated Population Size in Evolutionary Algorithms. C Fernandes, A Rosa. PPSN 06 – Parallel Problem solving in Nature, pp 921-929, 2006
6. [AGR2006] Abraham, Ajith; Grosan, Crina; Ramos, Vitorino (Eds.), Stigmergic Optimization, Studies in Computational Intelligence (series), Vol. 31, Springer-Verlag, ISBN: 3-540-34689-9, 295 p., Hardcover, 2006.
7. [GR2003] Simulation Model for the Control of Olive Fly *Bactrocera oleae* Using Artificial Life Technique. HongFei Gong, Agostinho Cláudio da Rosa. In "Computacional Intelligence and Control", m Mohammadian, RA Sarker, Xin Yao (Edts), Chapter XI, pp 183-196, Idea Group Publishing, 2003. ISBN: 1-591-40-037-6, 2003
8. [MR2002] Adaptive Reservoir Genetic Algorithm with on-line decision making. Cristi Munteanu, Agostinho Rosa. PPSN VII, Lectures Notes in Computer Science 2439, pp 432-441, Springer-Verlag, 2002
9. [GCR2002] Immune System Simulation through a Complex Adaptive System Model. Antonio Grilo, Artur Caetano, Agostinho Rosa. Springer Engineering Series, Soft Computing in Industrial Applications - Recent Advances, Eds. R. Roy, M. Koppen, S. Ovaska, T. Furuhashi, F. Homann Springer Engineering Series, 681-704, 2002
10. [AGR2006a] Abraham, Ajith; Grosan, Crina; Ramos, Vitorino (Eds.), Swarm Intelligence in Data Mining, Studies in Computational Intelligence (series), Vol. 34, Springer-Verlag, ISBN: 3-540-34955-3, 267 p., Hardcover, 2006

Master and Ph.D. thesis completed (3000 ca.)

Thesis Supervised (or Co-) by Agostinho Rosa:

Tito Livio Silva, PDEEC-IST "Reconhecimento Visual de Objectos por Coerência Estrutural de Características" PhD.Thesis. 03 Março de 2002.

Fernando Manuel Fernandes Melício, PDEEC-IST "Horários Escolares Semanais Simulated Annealing" PhD.Thesis. 22 de Dezembro de 2005.

Maria Cecília Lopes Conceição, EPM-UNIFESP (Supervisor: Prof Dalva Rollenberg Poyares) Padrão Alternante Cíclico em Crianças e Adolescentes PhD.Thesis. 8 de Dezembro de 2005.

Cristian Gabriel Munteanu, PDEEC-IST "Increasing Adaptability in Evolutionary Algorithms for Solving Complex Optimization Problems"

PhD.Thesis. 27 de Março de 2006

Ernesto Saias Soares PDEEC-IST (Co-Supervisors: Prof. James Brown – Caltech, Profs Miguel Nicolelis and Prof Sidney Simon - Duke University, USA) "Physiological Modeling and characterization of olfactive discrimination in rats" PhD.Thesis. 19 de Março de 2007.

Carlos Fernandes, MEEC-IST "Horários Escolares por NIGAVAPS – Non-Incensual Variable population GA"

MSc Thesis. 29 de Maio de 2002.

João Paulo Caldeira, MEEC-IST "Evolutionary Tabu Search Algorithms in Jobshop Scheduling"

MSc Thesis. 14 de Outubro de 2003.

Nelson Ricardo Perdigão Pereira – MEI-IST "Algoritmo Evolutivo Híbrido – alinhamento Múltiplo de Sequências"

Internationalization (2000 ca.)

(Collaborative publication, Research, Graduate Training Networks or other forms of participation of the Research Group at the international level)

Collaborative research and exchange of researchers (AR, AS) between 1996-2003 with the Sleep Medicine Centre of the Università degli Studi di Parma – Italy, fostering the use of cyclic Alternating Pattern paradigm in clinical practice, resulting in the publication of an Atlas and CAP user group.

Collaborative research and exchange of researchers (AR, CG) since 2000 with the Human Sleep Clinic of Stanford University – United States in the area of Heart Rate Variability analysis and Cyclic Alternating Pattern Classification of sleep polysomnography signals in adults.

Collaborative research and exchange of researchers (AR, RL, DP, GA, VA) since 2004 with the Sleep Institute of the Federal University of Sao Paulo – Brazil, in the area of Heart Rate Variability analysis, Cyclic Alternating Pattern Classification of sleep polysomnography signals in children and also in sleep epidemiology studies.

Collaborative research and exchange of researchers (CF, VR) since 2007 with University of Granada – Spain, in the area of Evolutionary systems for the development of new algorithms in Ant Colony Optimization and Swarm Intelligence.

Collaborative research and exchange of researchers (CM) since 2005 with University of Canarias – Spain, in the area of Evolutionary based processing on ultrasound medical images.

Scientific Research papers have been published in all mentioned collaborative partnerships.

Technical collaboration with Flaga HF - Iceland, between 2001-2005, in the development of the Automatic CAP classifier for clinical research purpose. The CAP plug-in is available in the Somnologica Science distribution of Medcare-Embla.com since 2006.

Industry contract research (2000 ca.)

Technical collaboration protocol (through IST) with Meditron Electromedicina Lda, Sao Paulo, Brazil, since 2006, for the design of the EEG and Sleep Analyser Interface and the development of automatic analysis plug-in.

Organization of conferences (2000 ca.)

Track Co-Chair

Agostinho Rosa:

ACM SAC - Artificial Intelligence and Computational Logic – 2002-2007.

Track Co-Chair

Agostinho Rosa

Artificial Life and Evolutionary Algorithms - ALEA 2007 - EPPIA 2007

International Program Committee

Agostinho Rosa:

ICEIS – International conference of Enterprise Information Systems

ICANN – International conference of Artificial Neural Networks

IRMA – International conference of Information Resources Management Association,

ACM SAC – Evolutionary Computation and Optimization,

BIOMED - IASTED – Int Conference on Biomedical Engineering

ICINCO – Informatics in Control, Automation and Robotics

IAV – International Conference on Autonomous Vehicles

MIC – IASTED Conference on Modeling, Identification and Control,

BioMed – IASTED International Conference on Biomedical Engineering,

MICEIS- International Conference on Enterprise Information Systems

ICCB – International Conference on Computational Bioengineering

BioMech – IASTED International Conference on Biomechanics

BIC – International Symposium on Bio-Inspired Computing

ICANNGA – International Conference on Adaptive and Natural Computing Algorithms

IEEE WISP – Intelligent Signal Processing

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Future Research

Objectives:

Besides the continuation of current research work LaSEEB future main research activity will be oriented towards the development of novel and integrative approaches for the modelling and simulation of biological systems. LaSEEB research activities have been focused mainly in the development of agent based models/algorithms inspired by nature to be used in a variety of different engineering tasks, such as: optimization algorithms, simulation of biological systems and modelling, identification and classification of biomedical signals. The future research goals defined for the next years are a natural consequence of the work developed so far. Research effort will be focused in four synergistic research areas, describe in the 1.1 - 1.4 paragraphs.

1.1 Development of a new framework for the simulation of biological systems based on agent based methodologies – this framework aims to assist the biological research in testing qualitatively and quantitatively new biological theories. The framework will be developed as part of an ongoing research project with the University of Minho – OpenMicroBIO. Specifically, it aims at describing cell dynamics (cycle and metabolism), cell to cell communication and networking, and colony dynamics (quorum sensing) inside bio-reactors for the modelling and simulation of flocculating yeast (*Saccharomyces cerevisiae* - eukaryotic cell forming proto-tissue colonies) growth during fed-batch fermentations.

1.2 Development of novel multi-way data decomposition algorithms to help in the characterization of biological samples and assist in the validation of experimental biological data analysis (process analytical techniques – PAT): the development of novel computational tools to assist in the process of biological data collection and validation is an important aspect identified in our existent collaborative research. Techniques based on low rank data decomposition can provide an important role in dealing with the high-throughput biological analytical methods such as the gas chromatography-mass spectroscopy or hyper-spectral chemical imaging (under the collaboration with project CLARO: cancer light assisted receding oncological therapies which aims at using hyper-spectral FTIR microscopic data for tumorous tissue classification).

1.3 Development of new algorithms that can exploit the computational capabilities of the new multi-core and many-core processing hardware of heterogeneous systems (GPU, Cell and multi-core Intel processors) – the development of agent based modelling strategies for the simulation of biological systems requires an huge computational power. Research will address the development of special purpose algorithms that will allow distributing the high computational workload characteristic of ABM systems among different heterogeneous processing units. This research will benefit from the existent high-performance computational capabilities at LaSEEB (5 PS3 and 6 multi-GPU quad-core PC).

1.4 Development of a fully automatic analysis system for Advanced Diagnosis of Sleep Disorders in collaboration with industry partners incorporating a new model for the micro structural organization of the Sleep process in partnership with Stanford University and State University of São Paulo, culminating with the proposal of a new Paradigm for Sleep Classification

Funding, source, dates (indicate in full including amount of current and pending funding)

The research will be partial supported by OpenMicroBIO research project (total 57 652EUR) and by the existent pluri-annual base funding (5 000 EUR per year). An extra funding of 36 460 EUR for the acquisition of a hyper-spectral imaging system is pending approval by the ISR direction.

A large effort will be developed by the group members in the forthcoming years to submit new research project proposal on FCT/MCTES future grant calls and contacts are being conducted for the participation in european research projects. Future research activities will benefit from data collected from the existent collaborative research projects and, thus magnify the existent research collaboration initiatives with: a) Centro de Biologia Molecular and Centro de Engenharia Biologica of the Instituto de Biotecnologia e BioEngenharia at Universidade do Minho; b) Departamento de Engenharia Biomédica de Faculdade de Engenharia at Universidade Católica Portuguesa; c) Departamento de Biotecnologia at INETI; d) Stanford University; and e) Federal and State Universities of São Paulo.

Previous publications in the area (5 in the last 5 years. If available you must indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language)

The LaSEEB has a long record of publications in the field of complex systems. From this, we selected the latest publications that reflect the research work applications with different biological systems, ranging from agriculture, food engineering modelling to biomedical signal processing.

Christian Guilleminault , M.Cecilia Lopes, Chad C Hagen, Agostinho da Rosa. The Cyclic Alternating Pattern Demonstrates Increased Sleep Instability and Correlates With Fatigue and Sleepiness in Adults with Upper Airway Resistance Syndrome. *Sleep* 2007, 30(5), pp 641-647. IF= 5.126, C=5

Cristian Munteanu, Francisco Cabrera, and Agostinho C. Rosa. Enhancing Obstetric and Gynaecology Ultrasound Images by Adaptation of the Speckle Reducing Anisotropic Diffusion Filter. *Artificial Intelligence in Medicine*. 43, pp 223-242, 2008. IF=1.825

Computational shelf-life dating: complex systems approaches to food quality and safety. R. C. Martins, V. V. Lopes, A. A. Vicente, and J. A. Teixeira. *Food and Bioprocess Technology: An International Journal*, 1(3):207–222, 2008, IF=(new journal, not determined)

Modeling super-cooling in frozen strawberries: Experimental analysis, cellular automation and inverse problem methodology. R. C. Martins and V. V. Lopes. *Journal of Food Engineering*, 80:126–141, 2007. IF=1.848

Book chapter:

Chapter 1.4: Numerical solutions - finite element and finite volume methods. R. C. Martins, V. V. Lopes, A. A. Vicente, and J. A. Teixeira. *Optimization in Food Engineering*, Ferruh Erdogdu (Ed.), In Press (2008)

Simulation Model for the Control of Olive Fly *Bactrocera Oleae* Using Artificial Life Technique, Hongfei Gong, Agostinho Rosa, In “Computacional Intelligence and Control”, M. Mohammadian, RA Sarker, Xin Yao (Edts), Chapter XI, pp 183-196, Idea Group Publishing, 2003. ISBN: 1-591-40-037-6, 2003

Special Requirements (equipment, facilities, staff or other special needs essential to carry out the future research program)

The LaSEEB research group needs the integration of new more permanent members and new posdoc fellowships and have access to ISR programmatic pluri-annual research funding from MCTES/FCT in order to take full advantage of the existent collaborative research environment conditions. It is believed that this additional funding would:

- provide an additional contribution from ISR to the complex systems research field;
- increase ISR leverage in existent and future scientific research collaborations; and
- increase ISR aptitude for integration on new multidisciplinary research networks.

In a short time period, it would magnify the scientific outcome of existent collaborations.

For a more synergistic effort within ISR, LaSEEB group is proposing the formation of a new group under the bio-systems scientific field. This new group will integrate the current members, all other ISR members interested to join and by new contracted researchers in order to achieve the necessary critical mass to address more ambitious long term objectives. This new group would comprise horizontal activities in most bio-related areas and, more important, would strive for excellence in that specific domain according to the institution strategic policy.

Here you can find the information submitted for each of the Research Groups.

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Research Group Information

(RG-Centro-Coimbra-750009-3433)

Designation: Centre of IMAR of the University of the Azores/ Department of Oceanography and Fisheries (IMAR-DOP/UAZ)

Principal Investigator: Ricardo Piedade Abreu Serrão Santos

Location of Group: Instituto do Mar

Keywords: Ocean Ecosystems ,Biodiversity ,Oceanography ,Management Biotic Ocean Resources

Funding, sources, dates

There were three main sources of funding (the information refers to 2003-2007 and the indicative funding concerns the amount for the research group as partner):

1) Protocols with the Azorean Regional Government (Fisheries/ Environment/ Science and Technology) concerning aspects of monitoring, evaluation and implementation of policies e.g. Common Fisheries Policies, EC Habitats and Birds Directives, OSPAR convention, etc. There were several pluriannual contracts totalling between € 600 thousands and €1 million/year.

2) Research cooperative projects funded by the EC through DG Research (11 projects: totalling around € 3 million), DG Fish (2 projects: totalling around € 500 thousand), DG Environment (2 projects: €1,2 million) and DG Regio (the case of InterReg/Macaronesia: 7 projects: €2 million).

3) Research projects funded by FCT/MCTES on the general calls (6 projects), of the PDCTM (2 projects), the PDCTE (1) and the special call for infrastructures (1) totalling around €1 million. Pluriannual + programmatic funding of FCT (around €1 million).

Besides this the RG has obtained funding from other sources: e.g. FLAD, CoML, etc.

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Group Team

List of Researchers in the Group:

001. Ana Maria de Pinho Ferreira Silva Fernandes Martins (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)

002. Joao Alberto Gil Pereira (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)

003. João Pedro da Silva Ramos Barreiros (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)

004. Ricardo Piedade Abreu Serrão Santos (**Cat.:** Investigador Principal **Gr. Acad.:** Doutoramento)

005. Eduardo Jose Louca Florencio Isidro (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)

006. Gui Manuel Machado Menezes (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)

007. Helena Maria de Noronha Krug (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)

008. Joao Manuel dos Anjos Goncalves (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)

009. Maria Ana Almeida Colaço (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)

010. Mario Rui Rilho de Pinho (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)

011. Ralf Bublitz (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)

012. Raul Silva Bettencourt (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)

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014. Joel Jean-Michel BRIED (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

015. Marina Parra Carreiro e Silva (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

016. Mónica Cordeiro de Almeida e Silva (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

017. Paula Cristina Barbosa Aguiar (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

018. Pedro Afonso Agostinho dos Santos (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

019. Ruth Higgins (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

020. Sergio Paulo Avila Campos Marques (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

021. Sérgio Stefanni (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

022. Telmo Alexandre Fernandes Morato Gomes (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

023. Veronica Rodrigues Costa Neves (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

024. Filipe Jorge Monteiro de Mora Porteiro (**Cat.:** Outra **Gr. Acad.:** Doutoramento)

List of Collaborators (w/PhD):

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003. Maria da Conceição Carvalho Magalhães (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

List of Collaborators (w/o PhD):

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002. Alexandra Guedes da Rosa (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
003. Ana Paula Horta Martins de Mergulhao Mendonca (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
004. Andreia Filipa Domingues Braga Henriques (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
005. Daphne Valérie Cuvelier (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
006. Diana Sofia de Oliveira Catarino (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
007. Fabiola Sabino Gil (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)
008. Frederic WLA Vandeperre (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)
009. HUGO MIGUEL CAVALEIRO DIOGO (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)
010. Inês do Carmo Alves Martins (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
011. Íris Raquel Ferreira Sampaio da Costa (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
012. Irma Margarida Andrade Cruz Espregueira Cascão (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
013. João Gama Monteiro (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
014. Jorge Miguel Rodrigues Fontes (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
015. Karina Valente Vieira de Sousa (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
016. Mara Schmiing (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)
017. Marco Aurélio Robalo dos Santos (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
018. Marisa Sofia Bernardeco Antunes (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
019. Mirko De Girolamo (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
020. Natacha Dentes de Carvalho (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
021. Riou Virginie (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
022. Rui Conde de Araújo Brito Prieto da Silva (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
023. Vanda Alexandra Santos do Carmo (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
024. Alierta Maria Gonçalves Rosa Pereira (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
025. Ana Filipa Rodrigues Silva (**Cat.:** Outra **Gr. Acad.:** Licenciatura)
026. Carla Sofia Marques Chainho Dâmaso (**Cat.:** Outra **Gr. Acad.:** Mestrado)
027. Carlos José Gonçalves Braga (**Cat.:** Outra **Gr. Acad.:** Ensino Básico)
028. Carmelina Maria da Silva Lima Leal (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
029. Christopher Pham (**Cat.:** Outra **Gr. Acad.:** Licenciatura)
030. Cláudia Inês Botelho de Oliveira (**Cat.:** Outra **Gr. Acad.:** Mestrado)
031. Emmanuel Pierre Roland Arand (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
032. Humberto Macedo Rodrigues (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
033. Humberto Manuel Dias Lopes (**Cat.:** Outra **Gr. Acad.:** PAPCC)
034. Jaen Nieto Amat (**Cat.:** Outra **Gr. Acad.:** Mestrado)
035. Joana Maciel (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
036. Joao Carlos Madruga da Silva Santos (**Cat.:** Outra **Gr. Acad.:** Licenciatura)
037. JOSE ANTONIO RODRIGUES PEREIRA (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
038. José da Costa Rodrigues Branco (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
039. José Gabriel Ferreira Matos (**Cat.:** Outra **Gr. Acad.:** Ensino Básico)
040. José Manuel Rocha Fontes (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
041. Leslie Patrick Gallagher (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
042. Lourenço Manuel Jorge Azevedo (**Cat.:** Outra **Gr. Acad.:** Ensino Básico)
043. Luís Carlos Nunes Pires (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
044. Manuel Fernandes Garcia Serpa (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
045. Marco Pedro da Rosa (**Cat.:** Outra **Gr. Acad.:** Ensino Básico)
046. Maria Adelaide da Rosa Andrade (**Cat.:** Outra **Gr. Acad.:** Ensino Básico)
047. Maria de Fátima Bettencourt Mendes (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
048. Maria de Fátima da Rosa Andrade (**Cat.:** Outra **Gr. Acad.:** Ensino Básico)
049. Maria Domitília Carlos da Rosa (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
050. Maria Rodrigues Homem da Rosa (**Cat.:** Outra **Gr. Acad.:** Ensino Básico)
051. Miguel Angelo Gaspar do Couto Chancerelle de Machete (**Cat.:** Outra **Gr. Acad.:** Mestrado)

052. Norberto Manuel Cabral Serpa (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
053. Octavio Emanuel Barros Moura Melo (**Cat.:** Outra **Gr. Acad.:** Mestrado)
054. Patrícia Alexandra da Silva Amorim (**Cat.:** Outra **Gr. Acad.:** Licenciatura)
055. Paulo Gilberto Silva Azevedo e Castro (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
056. Paulo Jorge Vieira (**Cat.:** Outra **Gr. Acad.:** Ensino Básico)
057. Paulo José Gonçalves Martins (**Cat.:** Outra **Gr. Acad.:** Ensino Básico)
058. RENATO PAULO MARTINS BETTENCOURT (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
059. RICARDO NUNO GARCIA DOS SANTOS MEDEIROS (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
060. Rui Carlos Rosa (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
061. RUTE MARIA ANTUNES MATOS (**Cat.:** Outra **Gr. Acad.:** Licenciatura)
062. SANDRA ANDRADE (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)
063. Sílvia Patrícia Pena Lino (**Cat.:** Outra **Gr. Acad.:** Licenciatura)
064. Valentina Furtado Leal da Costa (**Cat.:** Outra **Gr. Acad.:** Licenciatura)
065. Victor Manuel da Rosa (**Cat.:** Outra **Gr. Acad.:** Ensino Básico)

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Objectives & Achievements

Objectives:

The conservation of marine life and the sustainable use of living resources in the North-East Atlantic Ocean and the ecosystems of islands slopes, the Deep-Sea and Open Ocean at large are the main objectives of the research and outreach activities developed at the Centre of IMAR of the University of the Azores/Department of Oceanography and Fisheries (IMAR-DOP/UAç). Those objectives are shared with the generations of young students and newly graduated researchers in marine sciences that integrate IMAR-DOP/UAç. The members of IMAR-DOP/UAç have been involved in the development of different activities within these fields, in a multidisciplinary effort to integrate the research for a better understanding of the dynamics of this region, and its biological, physical, chemical and geological backgrounds.

The Research Group operates in 5 flexible Working Groups and 6 Laboratories. The actual WGs are dedicated to: "Ecosystem Based Approaches to Marine Habitats & Biodiversity", "Ecosystem Based Management to Fisheries", "Chemosynthetic Ecosystems", "Seamounts and Cold Water Corals", "Oceanography". The main fields of research are: molecular genetics, eco-toxicology, satellite oceanography, physical oceanography, fisheries dynamics, behavioural ecology, bio-telemetry, acoustic of the seabed and water column in view of the mapping of habitats and biodiversity and scenarios for sea-going technologies.

This centre supports and helps pure and applied research. It is highly involved in co-operation activities with public and private institutions from Portugal and other countries, including universities, research centres and institutes, enterprises and professional associations. IMAR-DOP/UAç is part of the national network of IMAR- Institute of marine Research (www.imar.pt) and of the Associated Laboratory ISR-Lisbon in a successful effort of opening horizons and framing research activities in larger partnerships. IMAR-DOP/UAç also carries out services for industry and public administration. It is also involved in activities of promotion and divulgation of research activities in media, museums, at the primary and high school system and through the internet.

Main Achievements:

The group was successful in terms of reaching national and international recognition in ocean studies. It became one of the leading worldwide teams in terms of seamount and hydrothermal vent studies, being considered by the Research*EU: Magazine of the European Research Area one of the 9 "main pillars of European oceanographic excellence" (...) "all of which are setting very high standards". (December 2007 Issue: pg. 42 or http://ec.europa.eu/research/research-eu/sea/article_mer42_en.html).

The research group achieved important milestones, devising and proceeding to the installation of new technological capabilities which are leading to a breakthrough in advanced areas of research, both pure and applied.

One of the achievements was the installation of LabHorta (the International Laboratory for Deep-Sea Ecosystems), a unique feature of its gender, enabling the study of deep-sea live organisms, including those leaving at hydrothermal vents. The lab is equipped with two hyperbaric chambers, with video systems and regulation of gazes incorporated, that may simulate depths down to -4000m. LabHorta operates in association with a system of deep-sea retrievable cages enabling the provision of organisms throughout the year. These facilities have clearly improved our national and international collaboration in deep-sea biology and helped to create new knowledge concerning the physiology, eco-toxicology, immunology, genomics and proteomics of some deep-sea organism thus enhance our role in biotechnology research.

A second achievement is the research concerning the mapping of habitats and biodiversity which involved a set of cross theme technologies and data/information collection involving acoustics (hydrophones, sounders, side and multi-beam scans), SST and Chl satellite oceanography, biotelemetry (acoustic and satellite), data-loggers for physical parameters, video mosaiking, molecular tools, etc. A great part of these studies were made in association with our technological partners of underwater robotics.

Management plans for 17 SICs and 13 ZPEs were produced, besides other management advice given to regional, national, European and international governance bodies.

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Group Productivity

Publications in peer review Journals (3000 ca.) (Up to a max of 10. Always indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language. DO NOT translate)

ABoim MA, Menezes GM, Schlitt T, Rogers AD (2005) Genetic structure and history of populations of the deep-sea fish *Helicolenus dactylopterus* (Delaroche,

1809) inferred from mtDNA sequence analysis. *Molecular Ecology* 14:1343-1354

Bettencourt R, Roch P, Stefanni S, Rosa D, Colaco A, Santos RS (2007) Deep sea immunity: Unveiling immune constituents from the hydrothermal vent mussel *Bathymodiolus azoricus*. *Marine Environmental Research* 64:108-127

Bjorndal KA, Bolten AB, Dellinger T, Delgado C, Martins HR (2003) Compensatory growth in oceanic loggerhead sea turtles: Response to a stochastic environment. *Ecology* 84:1237-1249

Bried J, Pontier D, Jouventin P (2003) Mate fidelity in monogamous birds: a re-examination of the Procellariiformes. *Animal Behaviour* 65:235-246 (IF: 2.752)

Cardigos F, Colaco A, Dando PR, Avila SP, Sarradin PM, Tempera F, Conceicao P, Pascoal A, Santos RS (2005) Shallow water hydrothermal vent field fluids and communities of the D. Joao de Castro Seamount (Azores). *Chemical Geology* 224:153-168

Cheung, WWL; Watson, R; Morato, T; et al. (2007) Intrinsic vulnerability in the global fish catch. *Marine Ecology-Progress Series* 333:1-12

Colaco A, Bustamante P, Fouquet Y, Sarradin PM, Serrao-Santos R (2006) Bioaccumulation of Hg, Cu, and Zn in the Azores triple junction hydrothermal vent fields food web. *Chemosphere* 65:2260-2267

Domingues VS, Santos RS, Brito A, Almada VC (2006) Historical population dynamics and demography of the eastern Atlantic pomacentrid *Chromis limbata* (Valenciennes, 1833). *Molecular Phylogenetics and Evolution* 40:139-147

Kadar E, Costa V, Santos RS, Lopes H (2005) Behavioural response to the bioavailability of inorganic mercury in the hydrothermal mussel *Bathymodiolus azoticus*. *Journal of Experimental Biology* 208:505-513

Kadar E, Bettencourt R, Costa V, Santos RS, Lobo-Da-Cunha A, Dando P (2005) Experimentally induced endosymbiont loss and re-acquirement in the hydrothermal vent bivalve *Bathymodiolus azoricus*. *Journal of Experimental Marine Biology and Ecology* 318:99-110 (IF: 1.750) (C= 23)

Menezes. G. M., M. F. Sigler, H. M. Silva, M. R. Pinho, 2006. Structure and zonation of demersal fish assemblages off the Azores archipelago (Mid Atlantic). *Marine Ecology Progress Series*, 324:241-260.

Morato T, Watson R, Pitcher TJ, Pauly D (2006) Fishing down the deep. *Fish and Fisheries* 7:24-34

Other publications National (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

Santos, R. S., A Colaço & S Christiansen (Eds.) 2003. Planning the Management of Deep-sea Hydrothermal Vent Fields MPAs in the Azores Triple Junction (Workshop proceedings). *Arquipélago – Life and Marine Sciences*, Supplement 4: xi + 70pp.. (ISBN: 972-8612-14-1)

Gonçalves, J.M. & R.M. Prieto 2003. Da baleação ao "whale watching". *Sociedade e Território* (Revista de Estudos Urbanos e Regionais - Edições Afrontamento, Porto), nº 35 (Abril): 46-53.

Forjaz, V.H., J.M. Tavares, E.M.V.B. Azevedo, J.C. Nunes, R.S. Santos, J.P. Barreiros, L. Gallagher, P.J.M. Barcelos, P.H. Silva, F. Cardigos, Z.T.M. França, T. Dentinho, M.P. Costa, L. Magalhães, M.C. Rodrigues, J.F. Gonçalves, V. Silva, V. Serpa 2004. Atlas Básico dos Açores. OVGA - Observatório Vulcanológico dos Açores, 112p.

Ávila, S.P., F. Cardigos, R.S. Santos 2004. D. João de Castro Bank, a shallow water hydrothermal-vent in the Azores: checklist of the marine molluscs. *Arquipélago, Life and Marine Sciences*, 21A: 75-80.

García-Diez, C., F.M. Porteiro, A. Meirinho, F. Cardigos & F. Tempera. 2005. Taxonomic Review of Selected Invertebrate Groups Collected During the Campaigns of the Prince Albert 1st of Monaco in the Azorean Waters. *Arquipélago. Life and Marine Sciences*. 22A: 35-59.

Seabra, M.I., F. Tempera & R.S. Santos. 2005. Experiences in Applying Geographic Information Systems to Marine Conservation and Ecology in the Azores. *GeoInova*, 11: 139-159.

Neves, V.C., N. Murdoch & R.W. Furness 2006. Population status and diet of the Yellow-legged Gull in the Azores. *Arquipélago. Life and Marine Sciences* 23A: 59-73

Santos, R. S. 2006. Recursos do mar profundo: potencialidades e ameaças. *Europa – Novas Fronteiras*, 20: 89-98.

Santos, R. S. 2006. Conservação dos habitats e da biodiversidade marinha nos Açores. In: *Gestão e Ordenamento das Actividades Litorâneas (1º Seminário)*. Academia da Marinha de Lisboa: 103-122.

Gallagher, F. Porteiro & C. Dâmaso 2006. Consumer's Guide to Azorean Fish/ Guia do Consumidor dos Peixes Açorianos. DOP/ Universidade dos Açores. V + 51pp. (ISBN 972-8612-27-3)

Santos, R. S., C. de la Cerda Gomes, F. M. Porteiro & L. Gallagher 2006. Virtual Center of Marine Interpretation/ Centro Virtual de Interpretação Marinha. DOP/ Universidade dos Açores (DVD) [978-972-8612-33-7]

Other publications International (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

Barriga F, Santos RS (2003) The MOMAR Area: a prime candidate for development of a seafloor observatory. 3rd International Workshop on Scientific Use of Submarine Cables and Related Technology, Proceedings: 259-262

Bashmachnikov I, Lafon V, Martins A (2004) SST stationary anomalies in the Azores region. In: Bostater CR, Santoleri R (eds) Remote Sensing of the Ocean and Sea Ice 2004, Vol 5569, p 148-155

Lafon V, Martins A, Bashmachnikov I, Jose F, Melo-Rodrigues M, Figueiredo M, Mendonca A, Macedo L (2004a) SST variability in the Azores region using AVHRR imagery: regional to local scale study. In: Bostater CR, Santoleri R (eds) Remote Sensing of the Ocean and Sea Ice 2004, Vol 5569, p 130-139

Martins A, Bashmachnikov I, Lafon V, Mendonca A, Jose F, Figueiredo M, Macedo L (2004) Discovering the Azores Front/Current system with SeaWiFS imagery. In: Bostater CR, Santoleri R (eds) Remote Sensing of the Ocean and Sea Ice 2004, Vol 5569, p 156-167

Silva, H.M. and Pinho, M.R. (2007) Small-Scale Fishing On Seamounts. Chapter 16 in Pitcher, T.J., Morato, T., Hart, P.J.B., Clark, M.R., Haggan, N. and Santos, R.S. (eds) Seamounts: Ecology, Fisheries and Conservation. Fish and Aquatic Resources Series, Blackwell, Oxford, UK. Pp 335-360.

Morato, T. and Clark, M.R. (2007) Seamount Fishes: Ecology and Life Histories. Chapter 9 in Pitcher, T.J., Morato, T., Hart, P.J.B., Clark, M.R., Haggan, N. and Santos, R.S. (eds) Seamounts: Ecology, Fisheries and Conservation. Fish and Aquatic Resources Series, Blackwell, Oxford, UK. Pp170-188.

Porteiro, F.M. and Sutton, T. (2007) Midwater Fish Assemblages And Seamounts. Chapter 6 in Pitcher, T.J., Morato, T., Hart, P.J.B., Clark, M.R., Haggan, N. and Santos, R.S. (eds) Seamounts: Ecology, Fisheries and Conservation. Fish and Aquatic Resources Series, Blackwell, Oxford, UK. 101-116.

Probert, P.K., Christiansen, S., Gjerde, K.M., Gubbay, S. and Santos, R.S (2007) Management and conservation of seamounts. Chapter 20 in Pitcher, T.J., Morato, T., Hart, P.J.B., Clark, M.R., Haggan, N. and Santos, R.S. (eds) Seamounts: Ecology, Fisheries and Conservation. Fish and Aquatic Resources Series, Blackwell, Oxford, UK. Pp 442-475.

Santos, M.A., Bolten, A.B., Martins, H.R., Riewald, B. and Bjorndal, K.A. (2007) Air-breathing Visitors to Seamounts: Sea Turtles. Chapter 12 Section B in Pitcher, T.J., Morato, T., Hart, P.J.B., Clark, M.R., Haggan, N. and Santos, R.S. (eds) Seamounts: Ecology, Fisheries and Conservation. Fish and Aquatic Resources Series, Blackwell, Oxford, UK. Pp 239-244.

White, M., Bashmachnikov, I., Aristegui, J. and Martins, A. (2007) Physical Processes and Seamount Productivity. Chapter 4 in Pitcher, T.J., Morato, T., Hart, P.J.B., Clark, M.R., Haggan, N. and Santos, R.S. (eds) Seamounts: Ecology, Fisheries and Conservation. Fish and Aquatic Resources Series, Blackwell, Oxford, UK. Pp 65-84.

Master and Ph.D. thesis completed (3000 ca.)

PhDs

Filipe Mora Porteiro - Praxis XXI/BD/17053/98: Mesopelagic fish of the north-eastern Atlantic. (concluded 2004).

Maria Ana Couto Pinto Aboim - SFRH/BPD/24927/2001: Population genetics and evolutionary history of some deep-sea demersal fishes from the Azores – North Atlantic (concluded 2005)

Paula Cristina F. Tavares – Praxis XXI/BD/19789/99: The Study of a Bioindicator of Mercury Contamination in Coastal Wetland Areas. (concluded 2005)

Telmo Morato Gomes - SFRH/BD/4473/2001: Ecology and fisheries of seamount ecosystems (concluded 2007).

Mónica Silva - SFRH/BD/8609/2002: Population structure of the bottlenose dolphin (*Tursiops truncatus*) in the Archipelago of the Azores, determined by genetic analysis and photo-identification studies (concluded 2007).

Pedro Afonso dos Santos - SFRH/BD/11132/2002: Marine protected areas: Ecological effects and benefits for fisheries (concluded 2007).

Vera Domingues – SFRH/BD/13069/2003: Reconstruction of post-glacial colonization routes of fish with tropical and sub-tropical affinities in the Azores: A biogeographic and molecular approach (concluded 2007)

Maria C. Magalhães – MARMAC fellowship 2002-2006: Foraging strategies of Cory's Shearwater *Calonectris diomedea borealis* in the Azores (concluded 2007)

MSc

Joana Matzen da Silva Caracterização qualitativa do fenómeno de afloramento costeiro de verão na região de Aveiro com utilização de um modelo Ecológico 3D e de imagens de satélite SeaSTAR (2004)

Maria Inês Gomes Leandro de Seabra – Distribuição do roaz (*Tursiops truncatus* Montagu 1821) e do cachalote (*Physeter macrocephalus* Linnaeus 1758) nas águas do arquipélago dos Açores (Portugal): aplicação de sistemas de informação geográfica e modelação ecológica na caracterização do habitat. (Mestrado em Biologia e Gestão de Recursos Marinhos - 2006)

Cláudia I. Oliveira – A actividade de observação turística de cetáceos no arquipélago dos Açores. Contribuição para o seu desenvolvimento sustentável. (Mestrado em Gestão e Conservação da Natureza 2005).

Miguel Ângelo Machete – Peixe Espada Preto - Abordagem a um Recurso Alternativo dos Açores. (Mestrado em Estudos Integrados dos Oceanos 2007)

Carla Sofia Marques Dâmaso – Interacção de Cetáceos na Pesca de Atum com Arte de Salto e Vara no Arquipélago dos Açores. (Mestrado em Estudos Integrados dos Oceanos 2007)

Hugo Miguel Cavaleiro Diogo – .Contribuição para o Estudo da Pesca Recreativa no Arquipélago dos Açores. (Mestrado em Estudos Integrados dos Oceanos 2007)

Organization of conferences (2000 ca.)

MarBEF THEME 1 – Workshop on deep-sea and open ocean reference sites, Oslo, Norway 30th June- 1st July 2004 (Chair - Organizer)

INTERNATIONAL WORKSHOP in Marine Molecular Phylogenetics "Use of molecular markers for the study of marine biodiversity", Horta, September 2004 (Organizer – Chair - Host)

INTERNATIONAL WORKSHOP: Seamounts: Ecology, Fisheries and Conservation, Centro do Mar, 16- 22 May, 2005, Horta, Portugal (Chair – Organizer - Host)

MARECO – Patterns and Processes of the Ecosystems of the Northern Mid-Atlantic Ridge, Field Phase Workshop and Steering Group Meeting, 2-5 June, 2005,

IPIMAR, Lisbon, Portugal (Co-Organizer – Co-Chair)

OASIS Final Project Workshop and 2nd Stakeholders Meeting, 12-14 October, 2005, Centro do Mar, Horta, Portugal (Organizer)

MARECO/CoML - Satellite Telemetry Workshop. Centro do Mar, Horta, Faial, Azores, 30-31 January 2006 (Organizer – Chair - Host)

INTERNATIONAL WORKSHOP on “Applied Aspects of Marine Parasitology” Centro do Mar, Horta, Faial, Azores, 21-24 of May 2006. (Organizer – Chair - Host)

INTERNATIONAL CONFERENCE: The Maritime European Policy and the Regions. Sociedade Amor da Pátria, Horta, Faial, Azores, 25- 27th June 2006 (Organizer - Host). This event was the first event organized at the end of the period dedicated to Public Consultation of the Green Book on European Maritime Policy and counted with the presence of the President of the EC Dr Durão Barroso and with EC Commissary Joe Borg, among others.

MAR-ECO Workop on the Patterns and Processes of the Ecosystems of the South-Atlantic Md-Atlantic Ridge. Balneário Camboriú, Brazil, 6-7 September, 2006 (Co-Chair and Organizer)

OSPAR Meeting of the Working Group on Marine Protected Areas Species and Habitats (MASH). Sociedade Amor da Pátria, Horta, Faial, Azores, 2-5 October 2006 (Organizer and Host)

SEMINAR for the Parliamentary Assembly of the European Council on: “An European Perspective on Environmental and Scientific Issues of the North Atlantic and Adjacent Seas”. Royal Garden Hotel. Ponta Delgada, 18 October 2007 (Co-Organizer)

CONVENTION OF BIOLOGICAL DIVERSITY: “Expert Workshop on Ecological Criteria and Biogeographic Classification Systems for Marine Areas in Need of Protection”. Marina Hotel, Ponta Delgada, 2-4 October 2007 (Co-organizer and Chair)

Patents/propotypes (2000 ca.)

There is a pending process for a patent for “FishMetrics” an automation method for the visual measurement and sampling of fish at the fish auctions.

Industry contract research (2000 ca.)

The contracts with the industry were made on the field of Satellite Oceanography with EdiSoft under the project OceanEye.

The Observers Program of the Fisheries of the Azores (POPA: www.popaobserver.org) has contracts with the fishing industry name the can tuna fishing (AICPA – Associação das Indústrias de Conservas de Pescado e Atum), with the APASA (Associação de Produtores de Atum e Similares), with LotAçor (fish auction system of the Azores), and in an irregular basis with different fishing boat owners.

A consortia was established with the enterprise SeaExperts in view of the development of aquaculture projects in teh Azores, namely the giant barnacles.

Government/Organization contract research (2000 ca.) (Include here work carried out by the group that resulted in a publication or report. Of particular importance are those involved in public policy advice)

The Research Group (RG) has been involved in contracts with Government Bodies concerning, e.g. the following International Policies: International Whaling Commission, Common Fisheries Policies, Habitats and Birds Directives (Natura 2000), OSPAR Commission for the Protection of the Marine Environment of the North-East Atlantic, Convention of Biological Diversity. The RG was involved in many reports and publications among which:

IWC see references at:

http://www.iwcoffice.org/_documents/sci_com/SCRepFiles2007/59-Rep1.pdf

M. Sequeira, M. Silva, M.J. Pitta-Grós & L. Freitas (2007). Portugal Progress Report on Cetacean Research, January 2003 to December 2006, with Statistical Data for the Calendar Year 2003, 2004, 2005 and 2006.. International Whaling Commission. Anchorage, Alaska. SC/59/Prog Rep Portugal: 25pp.

M. A. Silva, C. Dâmaso, M. Machete, R. Prieto, D. Reis, M. Santos & R. S. Santos (2007). A review of interactions between cetaceans and fisheries in the Azores. International Whaling Commission, Anchorage, Alaska SC/59/BC3: 36pp.

C. Oliveira, J. Gonçalves, S. Magalhães, R. Prieto, M. A. Silva & R. S. Santos (2007). Whale watching management in the Azores: An updated review of the regulations. International Whaling Commission. Anchorage, Alaska. SC/59/WW7: 4pp.

C. Oliveira, G. Filla, J. Gonçalves, M. A. Silva, R. Prieto, S. Magalhães & R. S. Santos (2007). A social-economic perspective of the whale watching activity in the Azores. International Whaling Commission. Anchorage, Alaska. SC/59/WW8: 8pp.

S. Magalhães, R. Prieto, M. A. Silva & R. S. Santos (2007). Impact of whale watching on cetaceans: assessing the appropriateness of existing regulations. International Whaling Commission. Anchorage, Alaska. SC/59/WW9: 6pp.

OSPAR (www.ospar.org)

OSPAR (2006). Proposals for Lucky Strike, Menez Gwen, Rainbow, D. João de Castro seamount to be considered for the OSPAR network of Marine Protected Areas. Presented by Portugal at the MASH Workshop 2006. MASH 06/5/4-E, ANNEX 3/ MASH 06/5/4-E, ANNEX 4/ MASH 06/5/4-E, ANNEX 5/ MASH 06/5/4-E, ANNEX 6/ : 6p. +7p. +7p. +11p.

OSPAR (2006). Guidelines for establishing an assessment and monitoring strategy for hydrothermal vents: Presented by Portugal. MASH 06/6/12-E(L) 6p.

OSPAR (2006). Guidelines for establishing an assessment and monitoring strategy for seamounts: Presented by Portugal. MASH 06/6/13-E(L) 11p.

CBD (www.cbd.int)

CBD (2007). Report of the Expert Workshop on Ecological Criteria and Biogeographic Classification Systems for Marine Areas in Need of Protection UNEP/CBD/EWS.MPA/1/2 13 November 2007: 24pp.

ECOLABELING (<http://www.horta.uac.pt/projectos/cepropesca/index.htm>)

C. Dâmaso & P. Bray (2006). Azorean Demersal Fishery Preliminary Analysis: Report for the Candidacy of the Azorean Demersal Fisheries to the Eco-label “Friend of the Sea”. Arquivos do DOP: Série Relatórios Internos nº 3/2006. 95 pp. [ISSN 0873-2841]

Internationalization (2000 ca.)

(Collaborative publication, Research, Graduate Training Networks or other forms of participation of the Research Group at the international level)

The Research Group is member of the Marine Association of Research Stations (MARS) since 1996, and one of its researchers is member of the Scientific Steering Committee (SSC). The Research Group is also member of the European Network of Excellence on Marine Biodiversity (MarBEF), and the European Seas Observatory Network (ESONET) and of their respective SSC. Members of the RG participate in the SSC of three Census of Marine Life projects (www.coml.org): ChEss (Biogeography of Chemosynthetic Ecosystems), MAR-ECO (Patterns and Processes of the Ecosystems of the Mid-Atlantic Ridge) e CenSeam (A Global Census of Marine Life on Seamounts). The RG is partner of the Ocean Tracking Network initiative (<http://oceantrackingnetwork.org>)

Members of the RG are involved in many committees and international working groups: e.g. Co-Chair of the WG of Monitoring and Observatories of InterRidge (<http://interridge.whoi.edu/en/WG/MonObs>), Co-Chair of the ESF/ICES/EFARO WG on "Science Dimensions of Ecosystems Approaches to Management of Biotic Ocean Resources" (SEAMBOR), Chair of the WG of Research and Statistics of ICCAT. One of the members of the RG was, for 4 years the Portuguese delegate to the European Strategy Forum for Research Infrastructures (ESFRI) and is delegate to the Committee of Research Infrastructures (FP6 and FP7). Members of RG participate in several of the ICES WGs, e.g. WGMHM, WGDDeep, WGEIasmobranchs, WGDEC, etc.

Members of the WG are part of the editorial board of the following scientific journals: The Scientific World Journal, Journal of Marine Biology, Acta Ethologica, Marine Biodiversity.

Members are regularly invited to give plenary talks in International Scientific Conferences and Policy Conferences, recent examples were: the Trondheim Conferences on Biodiversity: Norway/UN Conference: People and ecosystems - biodiversity for development, 29 October – 2 November 2007; the NATO Parliamentary Assembly: the 2007 Conference of the Science and Technology Committee; the Asia-Europe Meeting (ASEM) Oceans Initiative on 29 – 31 March 2006 at the Peninsula Manila in Makati City, etc.

A member of the RG contributed to the synthesis "The Deep-Sea Frontier: Science challenges for a sustainable future" (2007: ISBN 92-79-05266-8), produced under the scope of the 7th FP for EC – DGRResearch.

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Future Research

Objectives:

Research will be focused on key issues of ecosystem functioning in a time of changes, climate change and anthropogenic exploration of ocean biotic resources. We will keep the focus on island slopes, deep-sea ridge systems and open ocean. A lot is still left to do in view to have a synoptic and holistic perspective integrating these components of the ecosystem, and these is a need to accomplish the ecosystems approach for management. Thus said we intend to keep the WGs mention above, since we understand that a global vision still needs sectoral approaches.

Our research will be based on the funded projects listed in the following section. Focus will be given to bio-telemetry studies of top predators together with habitat mapping at the level of seafloor and water column. These studies will serve to characterize essential habitats of priority species namely cold water corals and deep-sea fishes, and large pelagic predators.

New sensors and permanent stations, including landers, will be deployed. Together with the fixed observatory type studies of seamount and vents ecosystems, we will continue tagging several species with acoustic and satellite transmitters incorporating data-loggers for different types of environmental and physiological data acquisition.

We expected to make use of the sea on-going facilities now available in Portugal, in particular in conjunction with our partners of the Institute of Systems and Robotics. Many of the scenarios and work at sea will employ robotic equipments. With this we intend to contribute with answers for some key scientific questions raised by the European Science Group on Deep-sea frontier on whose synthesis a member of the RG was involved: 1) How do deep-sea and other oceanic ecosystems respond to global change? 2) What is the relative importance of biotic and abiotic time-varying factors in structuring deep sea communities? 3) How does biodiversity and ecosystem functioning vary over very small regional and global scales, and with environmental heterogeneity, latitude and depth? 4) What are the effects of geobiological processes on deep-sea ecosystem functioning? 5) What are the life cycles and dispersal for deep-sea/ open ocean organisms, and what are their physiological adaptations? 6) How resilient are deep-sea ecosystems to deep-sea fisheries? 7) Can deep-sea resources be managed in an ecologically sustainable way? What ecosystems/ecoregions should be given conservation priority?

Taking the opportunity of the missions at sea and the conditions available at LabHorta and satellite laboratories we intend to continue developing advanced experimental research in the areas of genomics, proteomics, immunology, eco-toxicology, molecular biology, physiology, processes of calcification, enzymology. The studies will be primarily done under controlled experimental conditions and are intended to explore new molecules for bio-technology with from organisms living at the deep-sea both in chemosynthetic and photosynthetic driven environments. This is also a clear follow up of the capabilities and know how acquired and developed by the team during the last 5 years.

Facing the new global economical reality, special efforts will be also applied in the local economy, namely looking and encourage research initiatives or entrepreneurs aiming to rise the local value chains through the development of new products or services with potential to be commercialized.

Funding, source, dates (indicate in full including amount of current and pending funding)

FP6 IST/2005/035223: GREX – Coordination and control of cooperating heterogeneous unmanned systems in uncertain environments (STEP): 2006-2009. [Funding: € 234 200; Pending: € 87 194]. RTN/2006/2/036186-2: FREESUBNET – A European Research Training Network on Key technologies for Intervention Autonomous Underwater Vehicles: 2007-2010. [Funding: € 187 941; Pending: € 156 553]. FP7 KBBE/2007/1/210496: MADE – Mitigating Adverse Ecological Impacts of Open Ocean Fisheries: 2008-2012. [Funding: € 345 168; Pending: € 345 168]. ENV/2007/1/213144: CORALFISH - Assessment of the interaction between corals, fish and fisheries, in order to develop monitoring and predictive modelling tools for ecosystem based management in the deep waters of Europe and beyond: 2008-2012. [Funding: € 452 930; Pending: € 452 930] ENV/2008/1/226354: HERMIONE - Hotspot Ecosystem Research and Man's Impact on European Seas: 2009-2012 [Funding: € 123 762; Pending: € 123 762] FCT-PTDC MAR/74071/2006: TRACE - Cetacean habitat associations in oceanic ecosystems: an integrated approach: 2008-2011 [Funding: € 154 926; Pending: € 154 926] MAR/72169/2006: CORAZON - Mid-depth benthic communities of conservation importance in the Azores: cold water coral ecosystems. [Funding: € 187 967; Pending: € 187 967] MAR/65991/2006: IMUNOVENT- A study of immune reactions in the deep-sea hydrothermal vent mussel *Bathymodiolus azoricus*: insights into survival strategies and discovery of immune molecules in animals living under extreme environments: 2008-2011 [Funding: € 192 652; Pending: € 192 652] EEA PT0040/2008: CONDOR - Observatory for long-term study and monitoring of Azorean seamount ecosystems: 2008-2011 [Funding: € 716198; Pending: € 716198]

Previous publications in the area (5 in the last 5 years. If available you must indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language)

[IN THIS ITEM ABOUT THE FUTURE WE OPTED TO INCLUDE PUBLICATIONS ONLY FROM 2008]

Afonso P, Fontes J, Holland KN, Santos RS (2008) Social status determines behaviour and habitat usage in a temperate parrotfish: implications for marine reserve design. *Marine Ecology-Progress Series* 359:215-227

Arrizabalaga H, Pereira JG, Royer F, Galuardi B, Goni N, Artetxe I, Arregi I, Lutcavage M (2008) Bigeye tuna (*Thunnus obesus*) vertical movements in the Azores Islands determined with pop-up satellite archival tags. *Fisheries Oceanography* 17:74-83

Claudet J, Osenberg CW, Benedetti-Cecchi L, Domenici P, Garcia-Charton JA, Perez-Ruzafa A, Badalamenti F, Bayle-Sempere J, Brito A, Bulleri F, Culioli JM, Dimech M, Falcon JM, Guala I, Milazzo M, Sanchez-Meca J, Somerfield PJ, Stobart B, Vandeperre F, Valle C, Planes S (2008) Marine reserves: size and age do matter. *Ecology Letters* 11:481-489

Kadar E, Bettencourt R (2008) Ultrastructural and molecular evidence for potentially symbiotic bacteria within the byssal plaques of the deep-sea hydrothermal vent mussel *Bathymodiolus azoricus*. *Biometals* 21:395-404

Magalhaes MC, Santos RS, Hamer KC (2008) Dual-foraging of Cory's shearwaters in the Azores: feeding locations, behaviour at sea and implications for food provisioning of chicks. *Marine Ecology-Progress Series* 359:283-293

Morato T, Varkey DA, Damaso C, Machete M, Santos M, Prieto R, Santos RS, Pitcher TJ (2008) Evidence of a seamount effect on aggregating visitors. *Marine Ecology-Progress Series* 357:23-32

Special Requirements (equipment, facilities, staff or other special needs essential to carry out the future research program)

- There is the need of improving and upgrading of the experimental laboratories close to the harbor in view to take profit of the system of running salt water, hyperbaric chambers and system of gas regulation to simulate different environments for the study of a set of organisms going from bacteria, to cold water corals, deep-sea invertebrates and even deep-sea fishes.

- In terms of applied bio-technology, namely in the fields of research of innate immunity, genomic and proteomics devoted to study deep-sea organisms) special facilities are need: e.g. laboratory space for carrying out cDNA libraries construction, storage for cDNA clones. Equipment: The need for incubators with orbital shaker; Dry-ice machine for preservation, transportation and shipment of biological samples; cryostat instrument for frozen tissue sectioning (histology, immunostaining, in-situ histochemistry of tissue sections); flow cytometer (for analysis of live cells).

- A network of different sensors for monitor purposes should be planned and implemented in the next years, able to respond to different research areas (biology, animal ecology and distribution, oceanography and climate change) making use of the strategic location of the Azores in the central Atlantic. For this a good investment to keep and improve bio-telemetry capabilities and habitat mapping (both benthos and pelagos) are a priority.

- Manpower: apart from high quality post-doc researches needed to accomplish our research goals, new technicians will be necessary to operate and maintain new research technologies. This rather relevant issue since our RG has been losing permanent staff and no substitutes were appointed at the University level. This would mean around two administrative staff, 5 technicians and up to 8-10 post-doc researchers in full contract.

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 [FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Research Group Information

(RG-LVT-Lisboa-750009-3438)

Designation: DSORL - Dynamical Systems and Ocean Robotics Laboratory

Principal Investigator: Antonio Manuel dos Santos Pascoal

Location of Group: Instituto Superior Técnico - Universidade Técnica de Lisboa

Keywords: Marine and Aerial Robotics , Guidance Navigation and Control , Nonlinear Systems , Networked Control Systems

Funding, sources, dates

Source.....Project.....Reference.....DSORL Funding 2003-2007

National

FCT DREAM - 2001/2004.....PDCTM/P/MAR/15254/1999.....58244

FCT MAROV - 2001/2004.....POCTI/MAR/15248/99.....71264

FCT ALTICOPTER 2003-2005.....POSI/SRI/41938/2001.....41000

ADI MAYA - 2003/2007.....POSC.....351015

ADI MEDIRES 2003-2007.....POSC.....227863

FCT SADOGEOROB - 2005-2008...POCI/MAR/61178/2004.....24000

FCT EQUIP OCEAN - 2005-2007...REEQ/953/MAR/2005.....1100000

FCT RUMOS 2006-2009.....PDCT/MAR/55609/2004.....42246

FCT DENO 2007-2010.....PTDC/EEA-ACR/67020/2006.....8154

FCT HELICIM 2007-2010.....PTDC/EEA-ACR/72853/2006.....3600

FCT NAV 2007-2010.....PTDC/EEA-ACR/65996/2006.....7578

European

EC...FREESUB - 2000-2004.....HPRN-CT-2000-00032.....88500

EC...FP6 EPOCH- 2003-2007.....EC - 507382.....29450

EC...EXOCET - 2004- 2006.....FP6-GOCE-CT-2003-505342.....155750

EC...GREX- 2006-2009FP6-EU-IST-035223.....168500

EC...VENUS - 2006 - 2009.....FP6-EU-IST-034924.....130000

EC...FREEsubNET - 2006-2010....MRTN-CT-2006-036186.....61897

.....Total...2569061 Euro

[Information accessed: 06-11-2008 15:36:02 on www.fct.mctes.pt]
 [FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Group Team

List of Researchers in the Group:

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003. Paulo Jorge Coelho Ramalho Oliveira (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)
004. António Pedro Rodrigues de Aguiar (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)
005. Reza Ghabcheloo (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)
006. Rita Maria Mendes de Almeida Correia da Cunha (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

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001. Alex Alcocer Penas (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)
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009. João Manuel de Ascensão Alves (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)
010. Jose Maria Fernandes Vasconcelos (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
011. Luis Amorim Coelho Sebastiao (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
012. Manuel Cecílio Rufino (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)
013. Marco Martins Morgado (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
014. Mohammadreza Bayat (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)
015. Paulo André Nobre Rosa (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
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018. Pedro Tiago Martins Batista (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
019. Pramod Kumar Maurya (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)
020. Vahid Hassani (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)
021. Andre Batista de Oliveira (**Cat.:** Outra **Gr. Acad.:** Licenciatura)
022. Loic Thierry Bamdé (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)

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Objectives & Achievements

Objectives:

One of the key objectives of the DSORL is to meet some of the challenges in advanced robotic vehicle systems design and control contributing to the development of faster, cheaper, and far more efficient methods for ocean exploration and exploitation. This motivated the definition of a research and development program addressing theoretical and practical engineering issues, as well as issues related to the interplay between marine sciences and marine technology that fall in the scope of Thematic Area A. Two main lines of action were set:

1. Contributing to furthering the knowledge in the general area of dynamical systems theory.
2. Developing new analysis and design tools in the areas of navigation, guidance, and control (NGC) and applying them to the development of advanced systems that enable the operation of multiple networked autonomous marine and aerial vehicles.

Theoretical Objectives:

- A. Linear and nonlinear systems theory: study and development of theoretical tools for the analysis and design of linear and nonlinear control / filtering systems.
- B. Robust Multiple Model Adaptive Control (RMMAC): Development of new methodologies for the design of robust adaptive controllers for plants with structured and unstructured uncertainty.
- C. Design of Navigation Systems for autonomous vehicles. Study of advanced solutions focusing on the: i) development of high-performance and moderate cost heading and attitude reference units; ii) study and practical evaluation of acoustics-based systems for underwater vehicle positioning; iii) development of geophysical-based navigation algorithms.
- D. Motion Control of single and multiple vehicles under stringent communication constraints, including those imposed by a very special medium: the ocean. Problems addressed: i) Motion control of autonomous vehicles; ii) Visual servoing control; iii) Path Following; iv) Terrain Contour Tracking; v) Coordinated/cooperative control of groups of autonomous vehicles; vi) Networked control over faulty communication links

Practical Objectives:

- A. Design and development of AUVs, ASCs, and UAVs and on-board integration of scientific sensor suites and data acquisition / logging systems.
- B. Distributed hardware and software architectures for coordinated navigation and motion control of multiple vehicles as well as for mission control.
- C. Tests and scientific missions with the robots developed in cooperation with the scientific partners in Thematic Area A and other international institutions.

Main Achievements:

Theoretical achievements:

1. Study and development of several nonlinear control algorithms for motion control (point stabilization, trajectory tracking, and path following) of fully and underactuated autonomous robotic vehicles in three-dimensional space [J2,J3,J4,J7,J8,C8,C9].
2. Design of optimal minimum-energy based state estimators for systems with perspective outputs. The convergence and robustness to noise, latency, and intermittency of observations were formally analyzed [J6,C7].

3. Design of a novel nonlinear kinematic observer for pose estimation in SE(3). An almost globally exponentially stable attitude and position observer was obtained [C2].

4. Study of a Robust Multiple-Model Adaptive Control (RMMAC) architecture for linear time-invariant systems subject to structured and unstructured uncertainty [J5].

5. Development and experimental evaluation, in the Catamaran DELFIMx, of a low cost Inertial navigation System (INS) based on nonlinear complementary filters that merge inertial measurements with Earth's magnetic field observations and GPS data.

6. Development and practical evaluation of acoustics-based systems for underwater vehicle positioning and tracking. Estimation algorithms were derived and their performance tested during real missions at sea [J1,C10].

7. Study and assessment in simulation of algorithms aimed at steering a fleet of mobile robots along a set of given spatial paths, while keeping a desired inter-vehicle formation pattern. Decentralized algorithms that explicitly address the dynamics of the cooperating vehicles and the constraints imposed by the nature of the inter-vehicle communications network were derived [C1,C3,C5,C6].

8. Development of feature based navigation algorithms for the execution of long range missions with AUVs in unstructured environments. Integrated navigation solutions based on bathymetric and geomagnetic data were derived [J9, C4].

Practical Achievements:

9. The work developed has led to the design and construction of the robotic ocean vehicles DELFIMx ASC and INFANTE AUV, the miniaturized MAYA AUV (in cooperation with India), the IRIS (automatic surveying tool), and one Autonomous Helicopter. These vehicles have the dual purpose of serving as i) advanced testbeds for field testing new theoretical concepts for single and multiple vehicle navigation and control, and ii) platforms for actual operations at sea, paving the way for a fruitful symbiosis between marine science and technology [J10].

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Group Productivity

Patents/propotypes (2000 ca.)

Patent

"A Controlled Thruster-Driven Profiler for Coastal Waters", Elgar Desa, A. Pascoal, Ehrlich Desa, P.Mehra, R.Madhan, G.P.Naik, US patent Number 6786087 sept 7, 2004. The patent is the outcome of joint work done by IST/ISR and the NIO, Goa, India.

Prototypes

DELFIM Autonomous Surface Vehicle (ASC) – designed and built by ISR/IST. An autonomous surface craft (Catamaran-type) designed to carry out experimental research in the area of ocean robotics and to perform scientific missions at sea. Length: 3.5m, Width: 2m, Weight: 320 Kg, Propulsion by electric motors. Equipped with on-board resident systems for navigation, guidance, vehicle, and mission control. The vehicle has been used extensively for marine data acquisition and bathymetry operations in the Azores, in cooperation with the partner IMAR/DOP.

DELFIM_X Autonomous Surface Vehicle (ASC) – designed and built by ISR/IST. An autonomous surface craft similar to the DELFIM, but with improved hydrodynamic characteristics and increased autonomy due to the use of Lithium Polymer batteries. Length: 4.5 m, Width: 2.4 m, Weight: 300 Kg, Propulsion by electric motors. Equipped with on-board resident systems for navigation and guidance, vehicle, and mission control. The vehicle has been used to acquire marine data in the Azores, in cooperation with the partner IMAR/DOP and to carry out experiments on single and multiple vehicle cooperative control.

INFANTE Autonomous Underwater Vehicle (AUV) – designed and built by ISR/IST and the company RINAVE. An autonomous underwater vehicle designed to carry out experimental research in the area of ocean robotics and to perform scientific missions at sea. The vehicle is 4:5m long, 1:1m wide and 0:6m high. It is equipped with two main thrusters (propellers and nozzles) for cruising and fully moving surfaces (rudders, bow planes and stern planes) for vehicle steering and diving in the horizontal and vertical planes, respectively. It has a payload capability of 50Kg.

MAYA AUV – designed and built by a Luso-Indian consortium consisting of NIO (Goa, India), ISR/IST, IMAR/DOP/Azores, and RINAVE. A small and modular AUV for scientific and commercial applications. Missions include geological and oceanographic surveys, marine biology studies, marine habitat mapping for environmental management, inspection of harbours and estuaries, and marine pollution assessment, to name but a few. The first prototype has been tested and used extensively in Goa, India.

CARAVELA 2000 Autonomous Research Vessel – designed and built by IMAR/DOP/Azores, ISR/IST, and the companies RINAVE and CONAFI. Prototype of an autonomous surface craft for long range missions at sea (co-owned by IST/ISR, IMAR/Dept. Oceanography and Fisheries of the Univ. Azores, RINAVE, and CONAFI).

Autonomous Helicopter (Bergen Industrial Twin) - a small-scale industrial helicopter. This is a transformed radio-controlled helicopter, about 1.6m long (including the rotor diameter), with a payload capability of 10 kg, and a top speed of 70 Km per hour.

IRIS TOOL – designed and built by ISR/IST. A high accuracy surveying tool for both the above water and submerged parts of semi-submerged structures. IRIS is equipped with an accurate Laser Scanner, a profiler sonar, a high end motion reference unit, and a surveying class GPS. This tool can either be used from a rubber boat in autonomous mode or equip an Autonomous Surface Craft to produce tri-dimensional surveys with the spatial regularity required for this kind of structures.

Publications in peer review Journals (3000 ca.) (Up to a max of 10. Always indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language. DO NOT translate)

[J1] Study and Implementation of an EKF GIB-based Underwater Positioning System, Alex Alcocer, Paulo Oliveira, António Pascoal, IFAC Journal of Control Engineering Practice, Vol. 15, No. 6, pp. 689-701, 2007.

[J2] Depth Control of the INFANTE AUV using Gain-Scheduled Reduced Order Output Feedback, Carlos Silvestre, António Pascoal, IFAC Journal of Control Engineering Practice, Vol. 15, No. 7, pp. 883-895, 2007.

[J3] Trajectory-Tracking and Path-Following of Underactuated Autonomous Vehicles with Parametric Modeling Uncertainty, António Aguiar, J. P. Hespanha, IEEE Transactions on Automatic Control, Vol. 52, No. 8, pp. 1362-1379, 2007.

[J4] Switched seesaw control for the stabilization of underactuated vehicles, António Aguiar, J.P. Hespanha, António Pascoal, IFAC Automatica, Vol. 43, No. 12, pp. 1997-2008, 2007.

[J5] Robust Multiple Model Adaptive Control (RMMAC): A Case Study, Sajjad Fekri Asl, Michael Athans, António Pascoal, International Journal of Adaptive Control and Signal Processing, Vol. 21, No. 1, pp. 1-30, 2007.

[J6] Minimum-Energy State Estimation for Systems with Perspective Outputs, António Aguiar, João P. Hespanha, IEEE Transactions on Automatic Control, Vol. 51, No. 2, pp. 226-241, 2006.

[J7] Affine Parameter-Dependent Preview Control for Rotorcraft Terrain Following Flight, N. Paulino, Carlos Silvestre, Rita Cunha, AIAA Journal of Guidance, Control and Dynamics, Vol. 29, No. 6, pp. 1350-1359, 2006.

[J8] Path-Following for Non-Minimum Phase Systems Removes Performance Limitations, António Aguiar, J. Hespanha, P. Kokotovic, IEEE Transactions on Automatic Control, Vol. 50, No. 2, pp. 234-239, 2005.

[J9] Linear Parametrically Varying Systems with Brief Instabilities: an Application to Integrated Vision / IMU Navigation, J. Hespanha, O. Yakimenko, I. Kaminer, António Pascoal, IEEE Transactions on Aerospace and Electronic Systems, Vol. 40, No. 3, pp. 889-902, 2004.

[J10] Control of the Infante AUV using Gain-Scheduled Static Output Feedback, Carlos Silvestre, António Pascoal, IFAC Journal Control Engineering Practice, Vol. 12, No. 12, pp. 1501-1509, 2004.

Other publications National (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

[N1] A 2D Sensor Based Control Law for Homing of AUVs in the Horizontal Plane, Pedro Batista, Carlos Silvestre, Paulo Oliveira, Proc. Controlo2006 - 7th Portuguese Conference in Automatic Control, Lisbon, Portugal, 2006.

[N2] H-infinity Estimation of Systems with Implicit Outputs: An Application to Pose Estimation of Autonomous Vehicles, António Aguiar, J. Hespanha, Proc. Controlo2006 - 7th Portuguese Conference in Automatic Control, Lisbon, Portugal, 2006.

[N3] Novos Instrumentos para a Inspeção e Diagnóstico de Quebra-mares de Taludes, J. Santos, M. Neves, L. Silva, Carlos Silvestre, Paulo Oliveira, António Pascoal, Luís Sebastião, João Alves, Tecnologia da Água, March, pp. 44-50, 2006.

[N4] Novos Instrumentos para a Inspeção e Diagnóstico de Quebra-mares de Taludes, J. Santos, M. Neves, L. Silva, Carlos Silvestre, Paulo Oliveira, Luís Sebastião, João Alves, 4^ªs Jornadas Portuguesas de Engenharia Costeira e Portuária, Angra do Heroísmo, Portugal, 2005.

[N5] Robots Marinheiros para Aplicações Científicas: a Experiência do IST, António Pascoal, Revista Técnica, IST, 2004.

[N6] Ferramentas de Inspeção e Diagnóstico de Obras de Protecção Portuária, L. Silva, J. Santos, M. Neves, Carlos Silvestre, Paulo Oliveira, António Pascoal, 2^a Jornadas Portuguesas de Engenharia Costeira e Portuária, Sines, Portugal, 2003.

Other publications International (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

[C1] Coordinated Path-Following Control for Nonlinear Systems with Logic-Based Communication, António Aguiar, António Pascoal, Proc. of CDC 2007 - 46th IEEE Conference on Decision and Control, New Orleans, LA, USA, 2007.

[C2] Nonlinear Pose Estimation on SE(3), José Vasconcelos, Rita Cunha, Carlos Silvestre, Paulo Oliveira, Proc. of CDC 2007 - 46th IEEE Conference on Decision and Control, New Orleans, LA, USA, 2007.

[C3] Synchronization in multi-agent systems with switching topologies and non-homogeneous communication delays, Reza Ghabcheloo, A. Pedro Aguiar, Antonio M. Pascoal, and Carlos Silvestre, Proc. of CDC 2007 - 46th IEEE Conference on Decision and Control, New Orleans, LA, USA, Dec. 2007.

[C4] Geophysical Based Navigation of Autonomous Underwater Vehicles, F. Teixeira, A. Pascoal, Proc. 2007 Conference on Control Applications in Marine Systems (CAMS '07), Bol, Croatia, 2007.

[C5] Vehicle and Mission Control of Single Multiple Autonomous Marine Robots, António Pascoal, Carlos Silvestre, Paulo Oliveira, In Advances in Unmanned Marine Vehicles, IEE Control Engineering Series, G. Roberts and R. Sutton (Eds), pp. 353-386, 2006.

[C6] Nonlinear Coordinated Path Following Control with Bidirectional Communication Constraints, Reza Ghabcheloo, António Pascoal, Carlos Silvestre, I. Kaminer, in Group Coordination and Cooperative Control, Springer Series on Lecture Notes in Control and Information Sciences, K. Pettersen, J. Gravedahl, and H. Nijmeijer (Eds.), pp. 93-111, 2006.

[C7] A Quaternion Sensor Based Controller for Homing of Underactuated AUVs, Pedro Batista, Carlos Silvestre, Paulo Oliveira, Proc. of CDC 2006 - 45th IEEE Conference on Decision and Control, San Diego, USA, 2006.

[C8] State Estimation of Continuous-Time Systems with Implicit Outputs from Discrete Noisy Time-Delayed Measurements, António Aguiar, J. Hespanha, Proc. of CDC 2006 - 45th IEEE Conference on Decision and Control, San Diego, CA, USA, 2006.

[C9] Output-feedback Control for Point Stabilization on SE(3), Rita Cunha, Carlos Silvestre, J. Hespanha, Proc. of CDC 2006 - 45th IEEE Conference on Decision and Control, San Diego, USA, 2006.

[C10] USBL/INS Tightly-Coupled Integration Technique for Underwater Vehicles, Marco Martins Morgado, Paulo Oliveira, Carlos Silvestre, José Vasconcelos, Proc. FUSION2006 - 9th International Conference on Information Fusion, Florence, Italy, 2006.

Master and Ph.D. thesis completed (3000 ca.)

PhD Theses

[TP1] Reza Ghabcheloo - (FCT PhD Grant) Coordinated Path Following Control of Multiple Autonomous Vehicles, (concluded 2007).

[TP2] Francisco Curado Teixeira - (FCT PhD Grant) Terrain-Aided Navigation and Geophysical Navigation of Autonomous Underwater Vehicles (concluded 2007).

[TP3] Rita Cunha - (FCT PhD Grant) Advanced Motion Control for Autonomous Air Vehicles, (concluded 2007).

[TP4] Sajjad Fekri - (FCT PhD Grant) Robust Adaptive MIMO Control using Multiple Model Hypothesis Testing and Mixed Mu-Synthesis (concluded 2005).

Pre-Bologna MSc Theses

[TM1] João Alves - Real Time Distributed Architectures for Autonomous Vehicle Control, (concluded 2006).

[TM2] Nuno Paulino - Terrain Following Control for Autonomous Rotorcrafts, (concluded 2005).

[TM3] Miguel Prado - Dynamic Modelling and Control of an Autonomous Surface Craft, (concluded 2005).

[TM4] Pedro Alves - Prediction and tracking of mobile targets in two dimensions, (concluded 2004).

[TM5] Rodolfo Oliveira - Supervision and mission control of autonomous vehicles (concluded 2003).

Bologna MSc Theses

[TM6] João Almeida - Coordinated control of multiple oceanic vehicles (concluded 2007).

[TM7] Ricardo Aguiar - Design and development of tri-dimensional computer game using VIRTTOOLS software and tracking technology (concluded 2007).

[TM8] Pedro Serra - Sensor Based Autolanding Controller for Unmanned Helicopters, (concluded 2007).

[TM9] Nuno Valverde - Local/INS navigation for formations of autonomous vehicles, (concluded 2007).

[TM10] Pedro Valverde - INS/USBL Tracking System for Unmanned Underwater Vehicles, (concluded 2007).

[TM11] Francesco Vanni - Coordinated Motion Control of Multiple Autonomous Underwater Vehicles, (concluded 2007).

MSc Theses in cooperation with the Imperial College of London

[TM12] Sarabjit Bhojee - Landing controller for Autonomous Rotorcraft, (concluded 2006)

[TM13] Jeremy Wilkinson - Coordinated/cooperative control of a group of autonomous vehicles, (concluded 2007).

[TM14] Robert Hammond - Motion control of an Autonomous Helicopter, (concluded 2007).

MSc Theses in cooperation with the NTNU, Trondheim, Norway

[TM15] Christian Skaar - Coordinated Motion Control between an ROV and a Surface Vessel (concluded 2004).

[TM16] Havard Bo - Hydrodynamic Estimation and Identification of an AUV (concluded 2004)..

MSc Theses in cooperation with the Università di Pisa

[TM17] Andrea de Vito - An Underwater Acoustic Positioning System Based on Buoys with GPS (concluded 2007).

Organization of conferences (2000 ca.)

Organization, Special Session on Autonomous Vehicles for Ocean Exploration and Exploitation, ISOPE-2007-the 17th International Offshore (Ocean) and Polar Engineering Conference & Exhibition Lisbon, Portugal, 2007.

International Program Committee, IFAC Workshop on Control Applications in Marine Systems (CAMS' 07), Bol, Croatia.

International Program Committee, 6th IFAC Symposium on Intelligent Autonomous Vehicles, IAV 2007, Toulouse, France.

Organization, Pre-Conference Workshop, New Developments in Point-Stabilization, Trajectory Tracking, Path Following, and Formation Control of Autonomous Vehicles, 2006 IEEE Conference on Decision and Control.

Vice Chair, International Program Committee, 7th IFAC Conference on Manoeuvring and Control of Marine Craft, MCMC'2006, Lisbon, Portugal, September 2006.

General Chair, IFAC MCMC 2006 (Conference on Maneuvering and Control of Marine Craft), Lisbon, Portugal.

International Program Committee, 14th Mediterranean Conference on Control Automation, MED2006, Ancona, Italy, June 2006.

Member, Organizing Committee, 8th European Conference on Underwater Acoustics, Carvoeiro, Portugal, 2006.

International Program Committee, IWUR 2005, International Workshop on Underwater Robotics for Sustainable Management of Marine Ecosystems and Environmental Monitoring, Genova, Italy, 2005.

National Chair, IFAC Symposium on Intelligent Autonomous Vehicles IAV2004, Lisboa, Portugal, July 2004.

Program Vice-Chair, 5th IFAC Symposium on Intelligent Autonomous Vehicles, IAV 2004, Lisbon, Portugal, July 2004.

International Program Committee, IFAC Workshop on Control Applications in Marine Systems (CAMS' 04), Ancona, Italy.

International Program Committee, 1st IFAC Workshop on Guidance and Control of Underwater Vehicles, GCUV '03, April 2003, Newport, South Wales, UK.

International Program Committee, IEEE International Conference on Emerging Technologies and Factory Automation, ETFA'2003, Lisbon, Portugal, September 2003.

One day Tutorial on Control of Autonomous Vehicles, IFAC Conference on Manoeuvring and Control of Marine Craft, MCMC'2003, Girona, Spain.

Industry contract research (2000 ca.)

Project name: MAYASub (Development of a Small Miniaturized Autonomous Underwater Vehicles for Scientific and Commercial

Scientific Coordination: Instituto Superior Técnico

Leading Company: Rinave - Registro Internacional Naval SA, Portugal,

Research Areas: Marine Vehicle Design, Hydrodynamic Parameter Estimation and Identification, Navigation, Guidance, and Control, Acoustic Marine Sensors, Underwater Positioning and Communications.

External Partners: RINAVE (PT), IMAR/DOP/Univ. Azores (PT), National Institute of Oceanography (NIO) , Dona Paula, Goa, India, System Technologies (ST), Ulverston, UK.

Initiated: January 2003

Concluded: July 2007

Supervisor Agency: AdI (Agência de Inovação).

Project description: The key objective of the contract was to develop and demonstrate the performance of a small, modular, autonomous underwater vehicle (AUV) for scientific and commercial applications. Envisioned missions include geological and oceanographic surveys, marine biology studies, marine habitat mapping for environmental management, inspection of harbours and estuaries, and marine pollution assessment, to name but a few. Vehicle miniaturization was achieved by resorting to small embedded processors, miniaturized sensors, and high performance actuators. Modularity allows for easy vehicle reconfiguration according to different mission scenarios. Reduced weight makes it possible to launch and retrieve the vehicle by resorting to small ships of opportunity. The project witnessed the development (by a Portuguese-Indian consortium) of a highly reliable mobile platform that has the potential to act as a natural extension of its support ship, effectively allowing an operator to probe the surrounding 3D environment from the comfort of his/her lab at sea. A number of successful missions involving Indian and Portuguese partners have been performed in India. A second prototype vehicle is being re-designed for increased performance and capabilities.

Project name: MEDIRES

Scientific Coordination: Laboratório Nacional de Engenharia Civil, Lisbon, Portugal

Research Areas: Real Time Architectures, Inertial Navigation, Laser and Acoustic Mapping.

Leading Company: Administração do Porto de Sines, Sines Portugal

Other Partners: Autoridade do Porto de Avilez, Avilez, Spain.

Initiated: March 1 2003

Concluded: June 30 2007

Supervisor Agency:: AdI (Agência de Inovação).

Project description: The cost of a rubble-mound breakwater, its expected behaviour, as well as the consequences of its failure, do justify the existence of a monitoring programme which helps in the decision making process relative to the timing of the maintenance, or even repair, works. However, the continuous monitoring of the status of any given breakwater stretch is not yet feasible. That is why the most common procedure consists of the periodic inspection of these structures. The goals of the MEDIRES project were twofold:

1 - To use the latest technological breakthroughs in positioning, navigation and control of surface autonomous vehicles to develop new techniques for accurate and efficient inspection of the geometry of semi-submerged structures with application to rubble mound breakwaters. This activity led to development of a tool, named IRIS, for high accuracy surveying of both the above water and submerged parts of the armour layer of rubble-mound breakwaters (or semi-submerged structures, in general). This tool can be used in autonomous mode in an occasion surveying vessel or mounted in the DELFIMx Autonomous Surface Craft.

2 - To condense the large volume of data from the periodic inspections into a small set of parameters that enables the characterization of the structure's status and evolution. The definition of the parameters thresholds, needed for the structure's diagnosis, will be based on LNEC's past experience as well as on results from scale model tests.

Government/Organization contract research (2000 ca.) (Include here work carried out by the group that resulted in a publication or report. Of particular importance are those involved in public policy advice)

Internationalization (2000 ca.)

(Collaborative publication, Research, Graduate Training Networks or other forms of participation of the Research Group at the international level)

The DSORL has been involved in a number of projects and concerted actions with national and foreign institutions with the objective of advancing the development of engineering methodologies, marine technology, and autonomous robotic vehicles to the point where the latter can be used as versatile tools to expand our understanding of the oceans. This concerted effort is reflected in the co-authorship of publications, participation in international organization committees, networks, co-supervision of graduate work, and invited talks. Selected institutions include the following (8 of 15):

[1] Department of Mechanical Engineering and Aeronautics, Naval Postgraduate School, Monterey, CA (USA) – a long standing collaborative research program on AUV and UAV NGC, as well as multiple vehicle control.

[2] Center for Control, Dynamical Systems, and Computation (CCDC) at University of California, Santa Barbara, CA (USA) – joint work on control, estimation theory, and networked control systems.

[3] National Institute of Oceanography (NIO), Goa (India) – an intensive research and development program was initiated in 1999, leading to the development of the MAYA AUV.

[4] Department of Engineering Cybernetics, Norwegian University of Science and Technology (NTNU), Trondheim (Norway) - exchange of students and research personnel; joint work on cooperative path following control.

[5] IFREMER (French Institute for Ocean Exploitation) – (France). Joint participation in the network of excellence FREESUB and in the EU projects EXOCET and GREX. Joint realization of missions at sea.

[6] Department of Mechatronics, University of São Paulo (Brazil) – joint work on Modeling, Parameter Estimation and Identification of AUVs (Autonomous Underwater Vehicles).

[7] University of Girona, Institute of Informatics and Applications, Escola Politècnica Superior , Girona (Spain) – joint theoretical and practical work on Mission

Control Systems for autonomous underwater vehicles.

[8] Dept. Electrical and Computer Engineering, University of Maryland (USA) – exchange of research personnel and joint initiatives on Networked Control Systems.

The DSORL has played an active role in two European Training Networks (ETN):

[ETN1] FREESUB (2000-2004) – Autonomous Underwater Vehicles for Subsea Intervention (EC Human Potential Research Training Network).

[ETN2] FREESUBNET (2006-2010)- A European research network on key technologies for intervention autonomous underwater vehicle (Marie Curie Research Training Network).

Participation in International Technical Committees

[1] Member of the IFAC Technical Committee on Aerospace

[2] Member and Vice-Chair, IFAC Technical Committee on Marine Systems

[3] Member, IFAC Technical Committee on Intelligent Autonomous Vehicles

[4] Participating Member, Marine Board, European Science Foundation

[5] Member, SCOR Panel on New Technologies for Observing Marine Life

[6] Member, Steering Committee of EurOcean, the European Centre for Information on Marine Science and Technology

Selected Invited Talks (4 of 16)

[1] Time coordinated path-following for multiple AUVs. Invited Talk, Naval Postgraduate School (NPS), Monterey, CA, USA - September 2007.

[2] Coordinated Path Following of Multiple Underactuated Vehicles with Communication Constraints. Invited Talk, NTNU, Trondheim, Norway – April 12, 2007.

[3] Control of Single and Multiple Autonomous Robots for Ocean Exploration". Invited Talk, Fellows Lecture Series. United Technology Corporation / Pratt and Whitney, Hartford, Connecticut, USA, August 22, 2006.

[4] Mission and Vehicle Control of Marine and Aerial Vehicles at Institute for Systems and Robotics. Computer Engineering Department University of California at Santa Cruz, California, USA, August 19, 2005.

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Future Research

Objectives:

Meeting the objectives of the DSORL Research Unit requires further R&D in topics that stand at the crossroads of science and technology. Besides the topics tackled in the first 5 year period, the following new theoretical and practical tasks will also be addressed with the objective of consolidating current areas of R&D and opening new promising avenues for cooperation:

1- Study of joint positioning and navigation aiding systems for autonomous underwater robots with the explicit inclusion of disturbances observed during field operations. This work will build upon previous design and analysis results derived for tracking and integrated navigation systems through the use of non-linear time-varying filters. New computationally efficient signal processing techniques will be used to overcome the occurrence of dropouts and delays experienced by the acoustic signals used.

2- Cooperative navigation and motion control for multi Autonomous Vehicles. Considerable effort is now being placed on the deployment of groups of networked autonomous robotic vehicles which can interact autonomously with the environment and other vehicles to perform, in the presence of uncertainty and adversity, tasks beyond the ability of individual vehicles. This entails the development of advanced systems for coordinated motion control and navigation in the presence of severe underwater communication constraints together with the respective software and hardware architectures. Preliminary research results in this direction can be found in [F1].

3- Non-conventional, geophysical-based navigation (GN) holds great potential for the development of a new generation of navigation systems that rely on bathymetric, magnetic, and gravimetric data. The key idea is to use conspicuous, well mapped local characteristics of the medium in which the vehicle moves (digital terrain maps, maps of gravimetric and/or magnetic anomalies, etc.) to help in the navigation process [F5].

4- Study of optimal continuous-time filters with discrete-time delayed measurements for classes of nonlinear time-varying systems (such as kinematic systems) with application to the estimation of linear motion quantities (position, linear velocity, and acceleration of gravity), in three dimensions. Preliminary results are included in [F2, F4] and constitute a promising alternative to standard navigation filters used nowadays in autonomous vehicles.

5- Development and discrete time implementation of nonlinear kinematic observers for pose estimation, with application to Marine and Air Vehicles equipped with different sensor suites. Based on recent theoretical results on the synthesis and analysis of nonlinear observers on SE(3) [F3] a new class of filters will be proposed validated and tested on the DSORL platforms.

6- Development of a network of small Autonomous Marine Robotic Vehicles and a human machine interface (HMI) to perform cooperative tasks involving human divers in the loop (work to be done in the scope of an EC funded program due to start in 2009)

7- Development of an autonomous helicopter specially tailored for critical infrastructure monitoring under the HELICIM project.

8- Development of a versatile fixed wing unmanned aircraft specially tailored for marine science applications under the OBSERVFLY project.

9- Study and implementation of advanced methodologies for underwater archaeological applications. This follows the successful participation of the Associated Lab in a EC funded project that witnessed the use of marine robots for archaeological site mapping in Italy, Portugal, and France.

Funding, source, dates (indicate in full including amount of current and pending funding)

Source.....Project.....Reference.....DSORL Approved Funding after 2007

National

FCT RUMOS 2006-2009.....	PDCT/MAR/55609/2004.....	20813
FCT DENO 2007-2010.....	PTDC/EEA-ACR/67020/2006.....	99120
FCT HELICIM 2007-2010.....	PTDC/EEA-ACR/72853/2006.....	46400
FCT OBSERVFLY 2008-2011.....	PTDC/MAR/64546/2006.....	163954
FCT NAV 2007-2010.....	PTDC/EEA-ACR/65996/2006.....	102542
European		
EC...GREX-2006-2009.....	FP6-EU-IST-035223.....	168500
EC...VENUS-2006 - 2009.....	FP6-EU-IST-034924.....	130000
EC...FREEsubNET-2006-2010....	MRTN-CT-2006-036186.....	123794
EC...CO3AUVs-2009-2012.....	FP720073 ICT2007.2.1.....	498000
.....Total		1353123 Euro

Previous publications in the area (5 in the last 5 years. If available you must indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language)

[F1] R. Ghabcheloo, A. P. Aguiar, A. Pascoal, C. Silvestre, I. Kaminer, and J. Hespanha. Coordinated path-following in the presence of communication losses and time delays. *SIAM - Journal on Control and Optimization*. Provisionally accepted, pending minor revision, 2008.

[F2] A. Pedro Aguiar and João P. Hespanha. Robust Filtering for Deterministic Systems with Implicit Outputs. To appear in *Systems & Control Letters*, 2008.

[F3] Vasconcelos, J. F., Silvestre, C., Oliveira, P., A Nonlinear GPS/IMU Based Observer for Rigid Body Attitude and Position Estimation, Proc. 47th IEEE Conference on Decision and Control, Cancun, Mexico, December 2008.

[F4] Batista, P., Silvestre, C., Oliveira, P., Optimal Position and Velocity Navigation Filters with Discrete-Time Delayed Measurements, Proc. 47th IEEE Conference on Decision and Control, Cancun, Mexico, December 2008.

[F5] F. Teixeira and A. Pascoal, Geophysical Navigation of Autonomous Underwater Vehicles Using Geomagnetic Information, Proc. NGCUV'08 - IFAC Workshop on Navigation, Guidance and Control of Underwater Vehicles, Killaloe, Ireland, Apr. 2008.

Special Requirements (equipment, facilities, staff or other special needs essential to carry out the future research program)

Most of the theoretical and experimental developments carried out at the DSORL are largely supported by EU and National project funding. This highly competitive funding will continue to be sought in the future. However, because of the tight temporal schedules associated with it, it is very challenging to do the sustained work that is required to have a set of robotic platforms available at a true operational level, capable of being used by scientific and commercial end users on a far more regular basis, in many practical applications that range from marine habitat mapping to inspection of critical infrastructures.

The key required resources are:

Equipment:

- 1- Electronics Lab: Pick-and-place soldering station for standard SMD devices including ball grid array (BGA) integrated circuits.
- 2- High quality underwater camera to equip the INFANTE and the MAYA AUVs
- 3- Underwater acoustic camera for obstacle detection and avoidance purposes.
- 4- Ultra-Short-Baseline System for comparison studies aimed at assessing the efficacy of the underwater target tracking systems developed in-house.
- 5- Set of underwater acoustic modems for experimental trials of networked control and navigation.

Manpower:

- 1- One Post-Doc researcher to conduct independent research in the area of navigation and control of single and multiple autonomous vehicles with applications to ocean and air robots.
- 2- One Post-Doc researcher to carry out research at the crossroads of acoustics, acoustic communication and positioning, and navigation and control.
- 3- One software technician: responsible for the software architecture of the DSORL robots, with the objective of increasing the operational capabilities of the existing vehicles.
- 4- One electronic engineer: responsible for the existing vehicles' hardware and for centralizing the development of hardware to interface new sensing devices.

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Research Group Information

(RG-LVT-Lisboa-750009-3447)

Designation: Signal and Image Processing Group

Principal Investigator: Isabel Maria Gonçalves Lourtie

Location of Group: Instituto Superior Técnico - Universidade Técnica de Lisboa

Keywords: Sensor Networks ,Image and Video Analysis ,Biomedical Engineering ,Underwater Acoustics

Funding, sources, dates

European Projects:

- ESONET (EU-FP6), Mar 2007- Feb 2011, 7.5 M€
- B-BONE (EU-FP6- IST-2003-507607), Feb 2004 - June 2006, 3.3 M€
- EXOCET/D (EU-FP6-GOCE-CT-2003-505342), Jan 2004 - Dec 2006, 2 M€

FCT Projects:

- PHITOM (PTDC/EEA-TEL/71263/2006), Dec 2007 - Nov 2010, 172 K€
- WEAM (PTDC/ENR/70452/2006), Nov 2007 - Oct 2010, 182.4 K€
- U-BOAT (PTDC/EEA-TEL/67066/2006), Oct 2007 - Sept 2010, 97 K€
- SIPM (PTDC/EEA-ACR/73749/2006), Oct 2007 - Sept 2010, 116 K€
- NCOR (PTDC/PSI/67381/2006), Oct 2007 - Sept 2010, 100 K€
- UAB (POCTI/MAR/59008/2004), Jan 2006 -Dec 2007, 72 K€
- RADAR (POCTI/CTA/47719/2002), Oct 2004 - Dec 2007, 72 K€
- NUACE (POSI/CPS/47824/2002), Jan 2004 - Sept 2007, 97.5 K€
- MC-CDMA (POSI/CPS/46701/2002), Dec 2003 - June 2007, 48 K€
- AMA (POSI/SRI/41561/2001), Oct 2002 - Oct 2005, 75 K€
- GEODIF (POSI/CPS/38775/2001), Feb 2002 - May 2005, 57 K€
- LTT (POSI/ CPS / 37844 / 2001), Jan 2002 - Dec 2005, 14 K€
- TRANS (POSI/32708/CPS/2000), Oct 2000 - Sept 2003, 67.3 K€
- OFDM (POSI/CPS/33205/2000), Oct 2000 - Oct 2003, 64.5 K€
- CONVEX (POSI/CPS/32948/2000), Oct 2000 - Oct 2003, 65.2 K€
- HEART3D (POSI/33726/CPS/2000), Jan 2000 - Dec 2003, 19 K€
- TMO (PRAXIS/P/EEI/12050/1998), Jan 1999 - Dec 2003, 15 K€

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Group Team

List of Researchers in the Group:

001. Sergio Manuel Machado Jesus (**Cat.:** Professor Catedrático **Gr. Acad.:** Agregação)
002. Victor Alberto Neves Barroso (**Cat.:** Professor Catedrático **Gr. Acad.:** Agregação)
003. Isabel Maria Gonçalves Lourtie (**Cat.:** Professor Associado **Gr. Acad.:** Doutoramento)
004. Johannes Martinus Hubertina du Buf (**Cat.:** Professor Associado **Gr. Acad.:** Doutoramento)
005. Jorge dos Santos Salvador Marques (**Cat.:** Professor Associado **Gr. Acad.:** Agregação)
006. Francisco Miguel P. S. Garcia (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)
007. João Manuel de Freitas Xavier (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)
008. João Miguel Raposo Sanches (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)
009. João Pedro Castilho Pereira Santos Gomes (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)
010. Maria Margarida Campos da Silveira (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)
011. Orlando Camargo Rodriguez (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)
012. Pedro Manuel Quintas Aguiar (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)

013. Rui miguel Henriques Dias Morgado Dinis (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)

014. Paulo Alexandre da Silva Felisberto (**Cat.:** Professor-Adjunto **Gr. Acad.:** Doutoramento)

015. Alessio Del Bue (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)

016. Marko Stosic (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)

List of Collaborators (w/PhD):

001. Pedro Miguel Torres Mendes Jorge (**Cat.:** Professor-Adjunto **Gr. Acad.:** Doutoramento)

002. Jacinto Carlos Marques Peixoto do Nascimento (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

003. Cristiano José da Palma Soares (**Cat.:** Outra **Gr. Acad.:** Doutoramento)

List of Collaborators (w/o PhD):

001. António João Freitas Gomes da Silva (**Cat.:** Professor-Adjunto **Gr. Acad.:** Mestrado)

002. Isabel Maria Cabrita Rodrigues (**Cat.:** Professor-Adjunto **Gr. Acad.:** Mestrado)

003. João Miguel Fernandes Rodrigues (**Cat.:** Professor-Adjunto **Gr. Acad.:** Mestrado)

004. Paulo Gustavo Martins da Silva (**Cat.:** Professor-Adjunto **Gr. Acad.:** Mestrado)

005. Paulo Jorge Maia dos Santos (**Cat.:** Professor-Adjunto **Gr. Acad.:** Mestrado)

006. Ricardo Miguel da Silva Teresa Ribeiro (**Cat.:** Professor-Adjunto **Gr. Acad.:** Mestrado)

007. Roberto Célio Lau Lam (**Cat.:** Professor-Adjunto **Gr. Acad.:** Mestrado)

008. Teresa Paula Soares de Araujo (**Cat.:** Assistente **Gr. Acad.:** Mestrado)

009. Augusto José Rabelo Almeida Santos (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Bacharelato)

010. Cesaltina Nabais Escarigo Ricardo (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)

011. Daniel Filipe Martins Guerreiro Rocha de Almeida (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)

012. João Filipe de Castro Mota (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Bacharelato)

013. João Renato Kavamoto Fayad (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Bacharelato)

014. José Carlos Rosa Seabra (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)

015. José Jerónimo Moreira Rodrigues (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Bacharelato)

016. Liliana Lourenço Caldeira (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)

017. Marko Beko (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)

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020. Nuno Miguel Barroso Monteiro (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Ensino Secundário)

021. Nuno Miguel Pinho da Silva (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)

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023. Pedro Miguel Ferreira de Oliveira Pedrosa (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)

024. Pinar Oguz Ekim (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)

025. Ricardo da Silveira Cabral (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Bacharelato)

026. Samuel Herculano Ramos Nunes (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)

027. Sílvia Quina Nobre (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Bacharelato)

028. Ana Margarida Pinto dos Santos (**Cat.:** Outra **Gr. Acad.:** Licenciatura)

029. Artem Khmelinskii (**Cat.:** Outra **Gr. Acad.:** Bacharelato)

030. Celestino Virtudes Dias Martins (**Cat.:** Outra **Gr. Acad.:** Licenciatura)

031. David Miguel Pêgas Afonso (**Cat.:** Outra **Gr. Acad.:** Bacharelato)

032. Filomena Maria Simões Patricio de Almeida Viegas (**Cat.:** Outra **Gr. Acad.:** Ensino Secundário)

033. Friedrich Hermann Zabel (**Cat.:** Outra **Gr. Acad.:** Licenciatura)

034. Gustavo André dos Santos Lopes (**Cat.:** Outra **Gr. Acad.:** Bacharelato)

035. Indira Brás Gomes Andrade (**Cat.:** Outra **Gr. Acad.:** Bacharelato)

036. Isabela Maria Montenegro da Silva (**Cat.:** Outra **Gr. Acad.:** Bacharelato)

037. Joana Maria Rosado da Silva Coelho (**Cat.:** Outra **Gr. Acad.:** Bacharelato)

038. José Manuel Monteiro Grilo Lema Santos (**Cat.:** Outra **Gr. Acad.:** Bacharelato)

039. José Miguel Heitor Machado Dores (**Cat.:** Outra **Gr. Acad.:** Bacharelato)

040. Pedro Daniel Correia Pires (**Cat.:** Outra **Gr. Acad.:** Bacharelato)

Objectives:

SIPG at IST broad areas of research are: Wireless Communications, Image and Video Processing, and Medical Image Analysis.

Wireless Communications

Wireless communications is the driving technology of existing and emergent key applications such as mobile cell phones for ubiquitous communication, GPS location systems, smart homes and indoor appliances, autonomous sensor networks, automated highways, underwater habitat monitoring and ecosystem mapping, etc. Our research focus on designing reliable, bandwidth efficient wireless links to enable these applications. This requires addressing a plethora of multidimensional signal processing challenges in order to cope with the space-time-frequency fading channels which support the data flow between the transmitter and receive multiple-antenna arrays.

Image and Video Analysis

The objectives in image and video analysis are the development of fundamental tools for inferring high level content from image sequences. These tools find applications in several fields. For example, in digital video, content-based representations, i.e., representations based on high-level content, rather than on pixels and images, enable powerful video editing and compression. Also, for surveillance applications, an automatic analysis in terms of human activity recognition, e.g., tracking pedestrians or recognizing human activities, is nowadays fundamental.

Medical Image Analysis

This is an emerging area in the SIPG which tries to capitalize previous experience in image and video analysis. The goal is to develop semi-automatic tools to improve medical diagnosis using several imaging modalities (ultrasound, C, MRI, fMRI). The work was focused in three goals: estimation of data volumes from ultrasound data (3D ultrasound), image pre-processing (noise reduction) and development of 2D and 3D models of organs using deformable models.

SIPG at UALG areas of research relate to underwater acoustic signal processing applications for ocean monitoring and forecasting, array processing, inverse problems in geoacoustics, source detection, localization and tracking and, more recently, underwater acoustic data communications. One of the distinctive characteristics is that we aim at integrating in depth scientific research with hardware system development and at sea testing. Specific elements of the equipment include marine electronics, telemetry units, acoustic sensor arrays, data acquisition and communications systems.

Main Achievements:

SIPG at IST

Wireless Communications

1. Theoretical foundations: new framework for analysing MIMO wireless channel estimators, based on Riemmanian geometry: the Cramér-Rao bound, AR processes and fast PCA tools were generalized to this setup
2. Single carrier systems: new space-time codebook design technique for noncoherent multiple-antenna receivers and new equalizers of underwater channels based on the time reversal principle
3. Multicarrier systems: new techniques for coping with nonlinearity in OFDM architectures.

Image and Video Analysis

One of our long term goals has been the automatic inference of 3D content from video. We proposed an original method, based on the factorization of a large observation matrix that is highly rank deficient. Other achievements in 3D video analysis are methods to infer 3D orientation directly from the statistics of the image intensities and to include priors in 3D reconstruction. We also proposed new algorithms for motion estimation and segmentation. We developed algorithms for adaptive shape analysis, using deformable models. For surveillance, we developed a new tracker, able to deal with multiple pedestrians in challenging situations, and algorithms for the recognition of human activities using stochastic dynamical models.

Medical Image Analysis

We developed a volume reconstruction system based on ultrasound images (3D ultrasound) as well as algorithms for the reconstruction of the carotid atherosclerotic plaque. We have also developed denoising algorithms using a novel approach (Lyapunov equation) and diagnosis methods using MRI images of the liver, heart, and brain and diagnosis methods for genetic diseases using cytogenic techniques. This was done in collaboration with the Institute of Molecular Medicine and St. Mary Hospital.

SIPG at UALG

Acoustic Oceanographic Buoy (AOB)

System to be deployed at sea, which interfaces with a remote user in real time. Applications: rapid environmental assessment, bottom profiling and exploration, submarine detection, localization, identification, communication with submerged targets.

Matched-field and vector sensor array signal processing

Multichannel underwater signal processing, with matched-field processing and inversion at low and high frequencies. Processing of vector sensor array data.

Sea trials

MAKAI Experiment, 9/09 - 4/10 2005.

MREA/BP 07, 20/04 - 2/05 2007.

RADAR07, 9/07 - 15/07 2007.

UAB07, 2/09 - 16/09 2007.

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Publications in peer review Journals (3000 ca.) (Up to a max of 10. Always indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language. DO NOT translate)

[BXB07] M. Boko, J. Xavier and V. Barroso. Non-coherent communication in multiple-antenna systems: receiver design and codebook construction. In IEEE Transactions on Signal Processing, 55(12):5703-5715, 2007.

[GTDE07] A. Gusmão, P. Torres, R. Dinis, and N. Esteves. A Reduced-CP Approach to SC/FDE Block Transmission for Broadband Wireless Communications. In IEEE Transactions on Communications, 55(4):801-809, 2007.

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[DS06] R.Dinis and P.Silva, Analytical Evaluation of Nonlinear Effects in MC-CDMA Signals. In IEEE Transactions on Wireless Communications, 5(8):2277-2284, 2006.

[NM05] Jacinto C. Nascimento and Jorge S. Marques. Adaptive Snakes Using the EM Algorithm, In IEEE Transactions on Image Processing, 14(11):1678-1686, 2005.

[AM05] Pedro M. Q. Aguiar and José M. F. Moura. Figure-Ground Segmentation from Occlusion. In IEEE Transactions on Image Processing, 14(8):1109-1124, 2005.

[MAF05] André T. Martins, Pedro M. Q. Aguiar, and Mário A. T. Figueiredo. Orientation in Manhattan: Equiprojective Classes and Sequential Estimation. In IEEE Transactions on Pattern Analysis and Machine Intelligence, 27(5):822-827, 2005

[SM03] João M. Sanches and Jorge S. Marques. Joint image registration and volume reconstruction for 3D ultrasound. In Pattern Recognition Letters, Special Issue on Ultrasonic Image Processing and Analysis, 24(4-5):791-800, 2003.

[AM03] Pedro M. Q. Aguiar and José M. F. Moura. Rank 1 Weighted Factorization for 3D Structure Recovery: Algorithms and Performance Analysis. In IEEE Transactions on Pattern Analysis and Machine Intelligence, 25(9):1134-1149, 2003

Other publications National (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

[MS07] Margarida Silveira and Jorge S. Marques. Segmentation with multiple snakes. In 13ª Conferência Portuguesa de Reconhecimento de Padrões, 2007.

[MPMS07] Ricardo Martins, Pedro Pina, Jorge S. Marques, and Margarida Silveira. A Boosting Algorithm for Crater Recognition. In 13ª Conferência Portuguesa de Reconhecimento de Padrões, 2007.

[ASH07] David M. Afonso, João M. Sanches and Martin H. Lauterbach (MD). Physiologically Based Hemodynamic Model of neural tissues. In 13ª Conferência Portuguesa de Reconhecimento de Padrões, 2007.

[FFTS07] Filipa Ferro, Edgar C. Fernandes, Teodoro Trindade and João M. Sanches. Chemical species and chemical transitions estimation from laminar premixed flame spectrum and applications. In 13ª Conferência Portuguesa de Reconhecimento de Padrões, 2007.

[CSL07] Liliana L. Caldeira, João Sanches and F. Lopes da Silva (MD). Optimization of Mutual Information Based Registration for DCE-MRI Liver Perfusion Analysis. In 13ª Conferência Portuguesa de Reconhecimento de Padrões, 2007.

[MFA07] André Martins, Mário A. T. Figueiredo, and Pedro M. Q. Aguiar. Kernels and similarity measures for text classification. In 6th Conference on Telecommunications (ConfTele'07), 2007

[FX06] R. Ferreira and J. Xavier. Hessian of the Riemannian squared-distance function on connected locally symmetric spaces with applications. In 7th Portuguese Conference on Automatic Control (Controlo 2006), special session on control, optimization and computation, 2006

[GB03] J. Gomes and V. Barroso. QR-RLS adaptation of modular multichannel lattice filters. In 4th Conference on Telecommunications (ConfTele'03), 2003.

[OB03] Paulo M. Oliveira and Victor Barroso. Numerical Differentiation of Discrete-Time Sequences. In 4th Conference on Telecommunications (ConfTele'03), 2003.

[BB03] Sebastien Bausson and Victor Barroso. Estimation of a Rank-One Signal Subspace in Small Sample Regime. In 4th Conference on Telecommunications (ConfTele'03), 2003.

Other publications International (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

[SJG07] A. Silva, S. Jesus, and J. P. Gomes. Physics-based Passive Time Reversal Equalizer using Shallow Water Waveguide Invariant Properties. In proceedings of OCEANS'07, 2007.

[SaNM07] João M. Sanches, Jacinto C. Nascimento, Jorge S. Marques. An Unified Framework for Bayesian Denoising for Several Medical and Biological Imaging Modalities. In 29th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 2007.

[SiNM07] Margarida Silveira, Jacinto Nascimento, Jorge S. Marques. Automatic segmentation of the lungs using robust level sets. In 29th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 2007.

[GB07] J. Gomes, V. Barroso. A CORDIC-based QR-RLS multichannel lattice filter. In Proceedings of the 15th European Signal Processing Conference (EUSIPCO'07), 2007.

[SSP07] José C. Seabra, João M. Sanches and Luis M. Pedro (MD). Carotid Plaque 3D Compound Imaging and Echo-Morphology Analysis: a Bayesian Approach. In 29th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 2007.

[XM06] J. Xavier and Jonathan H. Manton. On the generalization of AR processes to Riemannian manifolds. In IEEE International Conference on Acoustics, Speech

and Signal Processing (ICASSP'06), 2006.

[BLA06] A. Del Bue, X. Llado and L. Agapito. Non-Rigid Metric Shape and Motion Recovery from Uncalibrated Images Using Priors. IEEE Conf. on Computer Vision and Pattern Recognition (CVPR), 2006.

[JAM05] Pedro M. Jorge, Arnaldo J. Abrantes, Jorge S. Marques. Tracking with Bayesian Networks. Extension to Arbitrary Topologies. In IEEE Int. Conf. on Image Processing (ICIP), 2005.

[NFM05] Jacinto Nascimento, Mário Figueiredo, Jorge S. Marques. Recognition of Human Activities Using Space Dependent Switched Dynamical Models. In IEEE Int. Conf. on Image Processing (ICIP), 2005.

[XB05] J. Xavier and V. Barroso. Intrinsic variance lower bound (IVLB): an extension of the Cramer-Rao bound to Riemannian manifolds. In IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP'05), 2005.

Master and Ph.D. thesis completed (3000 ca.)

Ph.D. Thesis

[Jor07] Pedro Mendes Jorge. Seguimento de Pessoas e Grupos em Sinais de Vídeo com Redes Bayesianas. IST, 2007.

Supervisor: Jorge S. Marques (ISR) & Arnaldo J. Abrantes (Instituto Superior de Engenharia de Lisboa – ISEL).

[GSi07] Jorge Gomes da Silva. Motion Tracking on Manifolds. IST, 2007.

Supervisor: Jorge S. Marques (ISR) & J. Miranda Lemos (Instituto de Engenharia de Sistemas e Computadores Investigação e Desenvolvimento – INESC-ID)

[Soa07] C. Soares. Broadband Matched-Field Tomography using Simplified Acoustic Systems. University of Algarve, 2007.

Supervisor: Sérgio Jesus.

[Sil06] João Silva. Capacity Enhancements for W-CDMA Systems. IST, 2006. Supervisor: Francisco Cercas (Instituto de Telecomunicações – IT) & Rui Dinis (ISR).

[Sou06] Nuno Souto. Turbo Processing Techniques for WCDMA Systems. IST, 2006.

Supervisor: Francisco Cercas (IT) & Rui Dinis (ISR).

[Lok06] Robert Edward Loke. Progressive visualization of incomplete sonar-data sets. Technical University of Delft (The Netherlands) – TUD, 2006.

Supervisor: Hans du Buf (ISR) & F.W. Jansen (TUD).

[Fel05] P. Felisberto. Data Assimilation Applied to Ocean Acoustic Tomography. University of Algarve, 2005.

Supervisor: Sérgio Jesus.

[Nas03] Jacinto Nascimento. Robust Shape Estimation and Tracking in the Presence of Clutter. IST, 2003.

Supervisor: Jorge S. Marques.

[San03] João Sanches. 3D Bayesian Reconstruction from Ultrasound Sequences. IST, 2003.

Supervisor: Jorge S. Marques.

Master Thesis

[Gus07] Rui Gusmão. Modem flexível baseado em DSP: Conversão de frequências realizada em FPGA. IST, 2007.

Supervisor: João Pedro Gomes.

[Ped07] Pedro Pedrosa. Técnicas de Estimção/Deteção para Transmissões por Blocos em Canais Fortemente Dispersivos com Desvio na Frequência da Portadora. IST, 2007.

Supervisor: Rui Dinis (ISR) & Fernando Duarte Nunes (Instituto das Telecomunicações – IT).

[Afo07] David Afonso. Detection of Brain Activated Regions from Functional MRI, fMRI, and Fusion with structural MRI Information. IST, 2007.

Supervisor: João Sanches.

[Khm07] Artem Khmelinskii. Emparelhamento de Cromossomas para Efeitos de Cariotipagem. IST, 2007.

Supervisor: João Sanches.

[Cal07] Liliana Caldeira. Liver Tumor Assessment from DCE-MRI: Registration and Perfusion Quantification. IST, 2007.

Supervisor: João Sanches.

[Gue04] Rui F. C. Guerreiro. Modelos 3D Densos a Partir de Imagens com Sobreposição Parcial: Factorização com Dados Desconhecidos. IST, 2004.

Supervisor: Pedro Aguiar.

[Lop04] Paulo Lopes. Bayesian signal reconstruction in wireless communication systems with spatial diversity. IST, 2004.

Supervisor: João Xavier.

[Pat03] Tiago Patrão. Tracking a mobile binary source in wireless systems with spatial diversity. IST, 2003.

Supervisor: João Xavier.

Patents/propotypes (2000 ca.)

Patents

[SDC+06] N. Souto, J. Silva, F. Cercas, R. Dinis, A. Correia, and A. Rodrigues. Detecção Iterativa e Estimação de Canal para Sistemas WCDMA que Utilizam Constelações QAM Hierárquicas (Iterative Detection and Channel Estimation for WCDMA Systems Employing Hierarchical QAM Constellations), Patent No. PT103527, July 2006.

[AM04] Pedro M. O. Aguiar and José M. F. Moura. System and Method for Generating a Three-dimensional Model from a Two-dimensional Image Sequence. US Patent and Trademark Office, S.N. 6,760,488

July 6, 2004.

Prototypes

[AOB1] Under project LOCAPASS we fully developed a prototype of a light sonobuoy for source localization, acoustic tomography and underwater communications. The AO-Buoy (Acoustic Oceanographic Buoy) is part of a new concept of network tomography, where a number of free-drifting buoys are simultaneously deployed either from ship or aircraft to collect acoustic and oceanographic data at GPS known locations. The data is transmitted to a base station via a wireless lan network for massive processing and inversion/localization/communications. The AO-Buoy autonomy is set to 10 hours. When they are recovered, data transfer and battery recharge takes a few hours and the AO-Buoy network is ready for redeployment. The AO-Buoy prototype has been tested at sea for shallow water acoustic tomography during the MREA03 sea trial, from June 18 - 26, 2003 in the area north of Elba Island (Italy) and during the MREA'04 sea trial from 2 - 10 April, 2004 off the west coast of Portugal.

[AOB2] Our involvement in project RADAR later led to the development of a second version of the AOB with improved characteristics: compact hardware based on the PC104 standard, data acquisitions up to 32 channels at sampling of 50 kHz/channel, small size and lighter, same autonomy and on board DSP based processing for data reduction, band shift and underwater communications channel equalization. The AOB2 was tested during the MakaiEx sea trial in September/October 2005 and later on used in the RADAR'06 and BP'07 sea trials.

Organization of conferences (2000 ca.)

SIPG was responsible for the organization, in Portugal, of the following international conferences:

IEEE Workshop on Signal Processing Advances in Wireless Communications (SPAWC'04), Lisbon, Portugal, July 2004:

- General Chair
- National Organizing Committee: Publications Chair and Treasurer
- International Technical Committee

Iberian Conference on Pattern Recognition and Image Analysis (IbPRIA'05), Estoril, Portugal, June 2005:

- General Chair
- National Organizing Committee
- International Program Committee

8th European Conference on Underwater Acoustics (ECUA'06), Carvoeiro, Portugal, June 2006:

- National Organizing Committee
- International Program Committee

Researchers from SIPG participated, as Program Committee Members, in the organization of several international meetings:

- Energy Minimization Methods in Computer Vision and Pattern Recognition, 2003.
- Iberoamerican Congress on Pattern Recognition (CIARP), 2003.
- International Workshop on Pattern Recognition in Information Systems (PRIS), 2003.
- IEEE International Conference on Image Processing (ICIP), 2004
- IEEE International Workshop on Multimedia Signal Processing, 2004
- International Conference on Image Analysis and Recognition (ICIAR), 2004
- Iberoamerican CIARP, 2004.
- International Workshop on Structural and Syntactic Pattern Recognition, 2004.
- Ibero-American Symposium on Computer Graphics and Image Processing, 2004
- International Workshop PRIS, 2005
- IEEE ICIP, 2005
- ICIAR, 2005
- IEEE International Conference on Computer Vision, 2005
- IEEE ICIP, 2006
- 1st ACM International Workshop on Underwater Networks (WUWNet), 2006
- ICIAR, 2006
- Iberoamerican CIARP, 2006.
- International Workshop on Statistical Techniques in Pattern Recognition, 2006

- Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), 2006
- IEEE ICIP, 2007
- IEEE/OES Oceans'07 - Europe Conference, 2007
- 2nd ACM International WUWNet, 2007
- ICIAR, 2007
- International Workshop on Underwater Sensors and Systems, 2007
- Conference of the IEEE EMBC, 2007.
- Iberoamerican CIARP, 2007.

Government/Organization contract research (2000 ca.) (Include here work carried out by the group that resulted in a publication or report. Of particular importance are those involved in public policy advice)

The Wave Energy Acoustic Monitoring (WEAM) is a partnership between the WEC - Wave Energy Center (which is the project's coordinator) and CINTAL - Centro de Investigação Tecnológica do Algarve. As a contract research the objectives of the WEAM project are the following:

- To characterize noise generation by wave energy prototypes and farms in order to understand their contribution to the background noise at the site and, if this is significant, to identify the parts to the wave energy converters that contribute more to the generated noise, in particular in the frequency range with impact on marine animals.
- To develop a plan or guideline to perform acoustic monitoring of wave energy farms, including the type of monitoring equipment to be used, its location and monitoring duration and conditions and data analysis and output.
- To develop a fixed hydrophone calibrated system for long time series noise measurements including the spatial and time distribution of the underwater generated acoustic noise.

Internationalization (2000 ca.)

(Collaborative publication, Research, Graduate Training Networks or other forms of participation of the Research Group at the international level)

- Participation in projects

- B-BONE, which involves the collaboration of: PT Inovação, ISCTE, Univ. of Cyprus, Athens Univ. of Economics and Business, Greece Aristotle Univ. of Thessaloniki, Greece Motorola UK, Alcatel Germany.

- ESONET, which represents an European Network of Excellence involving over 50 European institutions during 4 years.

- EXOCET/D project which involves the collaboration of 13 European partners.

- AO-Buoy in collaboration with NURC (Nato Undersea Research Center), UALG, Instituto Hidrográfico, Univ. de Bruxelles and Royal Netherlands Naval College.

- High Frequency Initiative, in collaboration with NURC, UALG, SPAWAR (San Diego – USA), Univ. of Delaware (USA), HLS Research (USA).

- Collaboration with

- Broadband Commun. and Wireless Syst. Centre, Carleton Univ., Canada (Prof. David Falconer).

- INRIA/Paris Sud Univ., France (Prof. Gilles Celeux)

- Evolutionary Developmental Biology Lab. of Yale Univ.

- Supervision of students

- Gershon Dublon, Yale Univ., June/July 2007

- Eleni Damianou, Imperial College of London, July/August 2007.

- Collaboration in the preparation of the partnership IST/EPFL in the Biomedical field.

- Participation in the creation of a new International Conference (IbPRIA) sponsored by IAPR.

- Visiting professor at Universitat Autònoma and Computer Vision Center, Barcelona.

- Invited lectures at

- 7th IEEE Inter. Summer School on Biomedical Imaging, Berder, France, June 2006.

- Australian National Univ., Australia, June 2005.

- Melbourne Univ., Australia, June 2005.

- Imaging and Image Processing Conference, 2007.

- Assoc. Ed. of

- Statistics and Computing Journal, Springer.

- Intern. J. of Pattern Recogn. and Artif. Intellig. (IJPRAI)

- Reviewers for international journals, such as

IEEE T. Image Proc.

IEEE T. Information Theory

IEEE T. Signal Processing

IEEE T. Multimedia

IEEE T. Circuits and Systems

IEEE T. Medical Imaging

IEEE T. Image Processing

IEEE T. Robotics

IEEE T. Communications

IEEE J. Selected Areas in Communications

IEEE J. Oceanic Engineering

IEEE Signal Processing Letters

Kluwer Int. Journal of Computer Vision

Springer Journal of Mathematical Imaging and Vision

ELSEVIER Computer Vision and Image Understanding

Wiley Journal of Microscopy Research and Technique

EURASIP Image Communication

J. of the Acoust. Soc. of America

IEE/IET Electronics Lett.

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Future Research

Objectives:

SIPG at IST

The future research of SIPG at IST will be organized along four areas: a horizontal area that deals with fundamental problems of signal and image processing and three other areas that build the path to more application-driven research (Sensor Networks, Image and Video Analysis, and Biomedical Engineering), where results emerging from the area of Fundamentals may be applied.

Fundamentals

Research on fundamental theoretical problems will be pursued along two main lines:

- Signal processing on manifolds: key to many emergent applications involving curved spaces. We plan to complete our preliminary work in three topics: performance bounds for estimators, principal component analysis, and statistical models on manifolds;
- Nonconvex optimization: important applications in signal and image processing require solving nonconvex optimization problems, e.g., analysis of video sequences with missing data. We plan to solve certain classes of nonconvex problems by explicitly constructing the convex hull of their epigraph. Important instances that arise in video analysis are quadratic problems over the Stiefel manifold.

Sensor Networks

The advent of small processors with sensing/communication capabilities have spurred the interest into sensor networks for monitoring critical infrastructures. In these large-scale systems, the information between sensors and actuators is supported by a communication network with hard bandwidth constraints. We plan to develop novel algorithms for distributed detection and nonlinear parametric estimation, robust to quantization and random link failures. This research is also the focus of the CMU-PT program in which ISR participates.

Image and Video Analysis

Research on image and video analysis will continue to be motivated by fundamental limitations of current methods. In what respects to 3D video analysis, we plan to overcome limitations like the need to compute pointwise correspondences between different views, and the lack of robustness with respect to partial occlusion. Other fundamental problems in image analysis concern the recognition of objects from their shape. We plan to address fundamental issues like shape representation and recognition. In what respects to human activity recognition for surveillance applications, we plan to develop new representations for human motion and activity recognition trying to overcome the limitations of current ones.

Biomedical Engineering

Current activities in medical image analysis using ultrasound and MRI images will continue.

Three new directions will be followed at three distinct levels:

- Brain and nervous system: diagnosis of Alzheimer's disease and mild cognitive impairment using PET images; identification of sleep disorders and development of models for the autonomic nervous system using control theory.
- Cell analysis: cell analysis based on confocal microscopy in collaboration with Institute of Molecular Medicine
- Genomic signal processing: ISR is committed to expanding this area of research. Work is already being conducted on problems of DNA sequencing and spectral analysis.

SIPG at UALG

The objectives for the incoming three years can be stated as follows:

- development of robust underwater communication systems;
- development of robust and efficient array processing techniques;
- development of robust models for high-frequency propagation with either two or three dimensional scalar/vector sensor arrays;
- development of robust self-recording (if required) electronic systems for underwater applications (high-frequency sources, integrated thermistor-hydrophone systems, drifting arrays, etc.)

Funding, source, dates (indicate in full including amount of current and pending funding)

New funding can be expected to be kept based on financing from national and european research programs. Additional sources of financing can be expected from public and private contracts as the expertise of the group, both in IST and UALG, becomes more and more acknowledged within and outside Portugal.

The SIPG at UALG is preparing, as coordinator, a proposal for an EU FET-Open project (with about 10 partners) in the call for Cognitive Systems. Goal: to develop a completely autonomous service robot with stereo vision and audition plus speech communication.

It is also expected that ongoing FCT projects will lead to new FCT project proposals.

Ongoing projects:

- ESONET (EU-FP6), March 2007 – Feb 2011, 7.5 M€
- PHITOM (PTDC/EEA-TEL/71263/2006), Dec 2007 - Nov 2010, 172 K€
- WEAM (PTDC/ENR/70452/2006), Nov 2007 - Oct 2010, 182.4 K€
- U-BOAT (PTDC/EEA-TEL/67066/2006), Oct 2007 - Sept 2010, 97 K€
- SIPM (PTDC/EEA-ACR/73749/2006), Oct 2007 - Sept 2010, 116 K€
- SmartVision (PTDC/EIA/73633/2006), Jan 2008 - Nov 2010, 166 K€
- NCOR (PTDC/PSI/67381/2006), Oct 2007 - Sept 2010, 100 K€

Starting projects:

- UAN – Underwater Acoustic Networks (EU-FP7, ICT/Security), Oct 2008 – Sept 2011, 2.95 M€
- SIMBAD (FT7-ICT-2007-C, grant 213250), Apr 2008 - Mar 2011, 100 K€
- MODI (PTDC/EEA-ACR/72201/2006), Jan 2008 - Dec 2010, 130 K€
- DELKETI (PTDC/EEA-TEL/72572/2006), Jan 2008 - Dec 2010, 4 K€
- OAEEx – Ocean Acoustic Exploration (EU-FP7, IRSES, PEOPLE), Jan 2009 – Dec 2011, 182 K€

Previous publications in the area (5 in the last 5 years. If available you must indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language)

[MGX08] N. Monteiro, J. Gomes, and J. Xavier. Detection of statistical periodicities in DNA by conflict and entropy minimization methods. In Proceedings of the 16th European Signal Processing Conference (EUSIPCO'08). 2008.

[JR08] S. M. Jesus and O. C. Rodriguez. A Time-reversal Suboptimal Detector for Underwater Acoustic Barriers. In Proceedings of OCEANS'08, 2008.

[NFM08] J. C. Nascimento, M. A. T. Figueiredo, J. S. Marques. Independent Increment Processes for Human Motion Recognition. In Computer Vision and Image Understanding, 109:126–138, 2008

[SXS08] J. Seabra, J. Xavier, J. Sanches. Convex Ultrasound Image Reconstruction with Log-Euclidean Priors. In 30th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 2008.

[FXCB06] R. Ferreira, J. Xavier, J. P. Costeira and V. Barroso. Newton method for Riemannian centroid computation in naturally reductive homogeneous spaces, In IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP'06), 2006.

Special Requirements (equipment, facilities, staff or other special needs essential to carry out the future research program)

SIPG at IST

Post-doc grants:

- The project on human activity recognition is being done with the collaboration of the post-doc student J. Nascimento. The renewal of a post-doc grant for a student in this area is required.
- To expand the Genomic Signal Processing area of research, hiring post-doc researchers with a background in biology is required.

SIPG at UALG

As the group initiatives (national and abroad contacts and technological development, etc.) continue to develop further space will be required for the storage of equipment and the reception of undergraduate and graduate visitors and students. To maintain the continuity of the research we need to continue attracting the best students. This will be of the most importance in the near future given the present national trend of decreasing numbers of students and the given instability of the portuguese economy.

The group is also replacing old servers (8-node Beowulf cluster; 4-CPU Silicon Graphics Origin 200) with multi-core processor PCs (OpenMP programming) and the latest graphics boards (GPU thread processing).

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Research Group Information

(RG-LVT-Lisboa-750009-3503)

Designation: Mobile Robotics Laboratory - MRLab

Principal Investigator: Maria Isabel Lobato de Faria Ribeiro

Location of Group: Instituto Superior Técnico - Universidade Técnica de Lisboa

Keywords: Single and multiple robot navigation ,Environment representation and mapping ,Networked robotics systems ,Human-Robot interaction

Funding, sources, dates

- €114.723 RESCUE–Cooperative Navigation for Rescue Robots, FCT SRI/32546/99-00, Nov/2000 – Oct/2004 [+ VisLab +ISLab–Theme B]
- €40.000 SACOR–Semi-Autonomous Cooperative Robots, FCT POSI/SRI/40999/2001, Set/2001-Oct/2006
- €28.110 RAPOSA–Semi-Autonomous Robot for Rescue Operations, Agency for the Innovation+Lisbon City Hall, Mar/2003 – Sep/2004 [+ ISLab – under Theme B]; I.Ribeiro-director
- €32.000 Accurate Measurements of High Voltage Installations with Laser Range Scanners and GPS, LABELEC – Electricity of Portugal (EDP), Mar/2005-Nov/2005
- €400.000,00, Re-equipment, Aug/2005-Mar/2007 [+ ISLab+VisLab-Theme B]
- €56.181 RIOL–Robotic Inspection over Power Lines, FCT POSC/EEA-SRI/60775/2004, Set/2005-Aug/2008
- €12.237 Research Atelier on Network Robot Systems, European Robotics Research Network, 2006.
- €1.450 Swarm intelligence for cooperative control of multiple robots, Anglo-Portuguese Prog. for Joint Research - Windsor Treaty, 2007
- €237.043 URUS–Ubiquitous Networking Robotics in Urban Settings, FP6-EU-IST-045062, Dec/2006 – Nov/2009 [+ VisLab+ ISLab – Theme B]; J.Sequeira-IST coordinator
- €10.000 Power Line Modeling and Inspection, LABELEC–Electricity of Portugal (EDP), Oct/2007-Mar/2008

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Group Team

List of Researchers in the Group:

001. Maria Isabel Lobato de Faria Ribeiro (**Cat.:** Professor Catedrático **Gr. Acad.:** Agregação)
002. João Fernando Cardoso Silva Sequeira (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)

List of Collaborators (w/PhD):

001. Fernando Gómez Bravo (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)

List of Collaborators (w/o PhD):

001. Jorge Miguel Pereira Paiva (**Cat.:** Assistente **Gr. Acad.:** Licenciatura)
002. Alberto Manuel Martinho Vale (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)
003. Francisco António Chaves Saraiva de Melo (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)
004. Luís Miguel de Oliveira Tavares (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)
005. Nelson Filipe Ferreira Gonçalves (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)
006. Sérgio Luís Proença Duarte Guerreiro (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)
007. André Kolontai Ferreira Nunes Godinho (**Cat.:** Outra **Gr. Acad.:** Mestrado)
008. André Pires Vaz Gonçalves (**Cat.:** Outra **Gr. Acad.:** Mestrado)
009. Michael da Silva Salgueiro (**Cat.:** Outra **Gr. Acad.:** Licenciatura)
010. Miguel António Rodrigues Lombo (**Cat.:** Outra **Gr. Acad.:** Licenciatura)
011. Nuno Gonçalves Matos Pinto Ferreira (**Cat.:** Outra **Gr. Acad.:** Licenciatura)
012. Nuno Miguel Duarte Hagenfeldt (**Cat.:** Outra **Gr. Acad.:** Licenciatura)
013. Pedro Miguel Malveiro Godinho (**Cat.:** Outra **Gr. Acad.:** Licenciatura)

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Objectives & Achievements

Objectives:

The objective is to undertake research in the area of mobile robotics, with emphasis on the navigation of single and multi-robot systems and human-robot interaction. Our research is often driven by the applications, and combines theoretical and implementation issues with the design and assembly of real robots.

The navigation of mobile robots is addressed in structured and unstructured environments. Environment mapping, localization and navigation in outdoors scenarios are studied for single robots, using probabilistic approaches to deal with uncertainty. In multi-robot systems, focus is on learning and coordination using reinforcement learning techniques, and navigation strategies for cooperative localization.

Human-Robot Interaction is the external layer that encapsulates all other subsystems in a robot. It is likely that using human-based models, with formal descriptions of concepts that have been intensively studied in social sciences, will foster the development of social robots. The focus of our research is the mathematical modeling of concepts that can model human interactions and their extension to the modeling of human-robot and robot-robot interactions. Semantics is extensively used by humans and provides a typical example of such key concepts as it contains the mechanism for robots to engage socially with non-expert humans. Hybrid systems and nonsmooth calculus provide the main tools for modeling and analysis.

Applications, with robot or product development, include monitoring in hazardous/remote environments with a tele-operated robot, and power line inspection.

MRLab has regularly collaborated with the ISLab within the framework of the Theme B search and rescue deliverable, including the participation in the RESCUE project and Theme B deliverable, in the development of a search and rescue robot (RAPOSA), in the EU project URUS on networked robotics, and in the supervision of a PhD student on reinforcement learning methods. During 2007, the two labs retook a past joint collaboration in Remote Handling R&D in ITER (International Thermonuclear Experimental Reactor).

Main Achievements:

We extended the focus of mobile robot navigation to outdoors and unstructured scenarios. A novel approach for outdoors navigation was proposed (PhD thesis, 2005). Environment representation, localization and guidance are supported on a topological approach. A topological map, built from data from onboard laser scanner and video is the basis for the proposed topological localization and navigation.

Research on innovative human-robot interaction took place within COOPERA and SACOR projects. The focus was the identification of mathematical concepts able to model human interactions, e.g., as modeled by semiotics, and its application to develop social robots. Locomotion is of special interest. Math models able to capture motion features such as trajectories and uncertainties, where social concepts such as semantics can be identified, have been proposed in several papers.

Networked Robotic Systems integrated most activities and achievements in multi-robot systems. Reinforcement learning methods in cooperative navigation tasks was addressed in a PhD thesis (2007). We proposed new methods to address learning and coordination in problems with infinite state-spaces or with partial observability. Cooperative localization strategies have also been developed (one journal paper). Within the URUS project MRLab and ISLab have been developing middleware for robots to interact with people in urban areas. This middleware integrates information from a network of fixed cameras, distributed processing, and robots. High level decision strategies are being addressed using economic market models (ongoing PhD). This line of work seems particularly important in multiple robot applications to yield a team behavior as natural as that of a team of humans.

MRLab contributed to the development of robotic methodologies applied to power line inspection. It was involved in the development of a product to measure power line obstacle clearance based on laser scanning and performing on-line fault detection and classification during helicopter based normal inspections. In addition, the robot developed within the RIOL project, able to move on suspended cables and monitoring a variety of aspects, represents an alternative methodology for power line inspection. It received a national patent and corresponds to a significant effort to show that innovative university designs can be transported to the non academic world.

[Information accessed: 06-11-2008 15:37:03 on www.fct.mctes.pt]

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Group Productivity

Master and Ph.D. thesis completed (3000 ca.)

----- PhD Thesis-----

Title: Mobile Robot Navigation in Outdoor Environments: A Topological Approach

PhD Student: Alberto Vale

Advisor: Isabel Ribeiro

Conclusion: June 2005

**

Title: Reinforcement Learning in Cooperative Navigation Tasks

PhD Student: Francisco Melo

Advisor: Isabel Ribeiro

Conclusion: November 2007

----- MASTER Thesis (2 years degree)-----

Title: Reorganização Dinâmica de Processos Face a Situações de Crise: Aplicação em Exemplos Robóticos e Empresariais Simplificados

Master Student: Sérgio Guerreiro

Advisor: João Sequeira

Conclusion: May 2003

Title: Inspeção e Manutenção Robótica em Linhas de Transporte de Energia Eléctrica de Alta Tensão

Master Student: José Inácio Rocha

Advisor: João Sequeira

Conclusion: September 2005

Patents/propotypes (2000 ca.)

- RAPOSA (prototype): robot for Search and Rescue (SAR) operations, designed to operate in outdoors hazardous environments, and developed within a consortium project with the ISR spinoff SME IdMind and the Lisbon Fire Department. The robot is tele-operated but is capable of carrying out short tasks autonomously. During task execution, the robot sends the information on environmental data from different sensors to the remote command station. The robot was designed to allow it to negotiate standard sized stairs and sewer pipes. The most innovative contribution of RAPOSA is the tether remote docking, which can be accomplished remotely by using the visual feedback of a web cam installed in the back side of the robot, and a remotely-controlled door latch. The tether supplies power and acts as a wireless access point. The robot was tested successfully in several scenarios of the Lisbon Fire Fighters school, as well as during an earthquake drill, performed at Sicily, Italy, joining several European Civil Protection institutions, at EUROSOT 2006. RAPOSA was also selected for participation in ELROB 2006 and 2007. A license for technology, mark and intellectual rights usage by IdMind, under the payment of royalties, is under negotiation.

- RIOL (prototype+patent): Robot able to move on suspended cables monitoring a variety of aspects, e.g., faulty insulators in electric power lines, wildlife, and environmental variables. Suspended cables, namely electric power lines, are a common infrastructure in most developed regions and provide a structured media that crosses all sorts of terrains. The specific task of electric power lines inspection is commonly executed using helicopters. The inspection requirements, namely the close distance the helicopters have to fly from the line, make this task highly dangerous and economically costly. A prototype able to illustrate the locomotion was developed under this project. The complete robot will be able to carry a generic payload and will be fully autonomous. A long term goal for this project is to deploy a number of robots over the electric power line infrastructure that would autonomously act as a cooperating team in a wide range of missions. A patent request was submitted to the national authorities, INPI, by Oct. 2007 and was granted May 2008.

Publications in peer review Journals (3000 ca.) (Up to a max of 10. Always indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language. DO NOT translate)

[MCA+07] - Carlos Marques, João Cristóvão, Paulo Alvito, Pedro Lima, João Frazão, Isabel Ribeiro, Rodrigo Ventura, "A Search and Rescue Robot with Tele-Operated tether Docking System", Industrial Robot, the International Journal of Industrial and Service Robots, Emerald Publishing Company, Vol.34, No.4, pp.332-338, 2007

[BVR07] -Fernando Gomez Bravo, Alberto Vale, Isabel Ribeiro, "Navigation Strategies for Cooperative Localization based on Particle Filters". Integrated Computer-Aided Engineering, Vol. 14:3, pp. 263-279 IOS Press 2007

[SR06a] - João Sequeira, Isabel Ribeiro, "A Semiotic Approach to the Control of Semi-Autonomous Robots", International Journal of Systems Science, Taylor & Francis, Vol. 37, N. 6, pp. 361-376, 2006.

[SR05] - J. Sequeira, I. Ribeiro, "Robot Team Control: A Geometric Approach", Journal of Robotics and Autonomous Systems, (53):59-71, 2005

Organization of conferences (2000 ca.)

----- General Chair-----

Isabel Ribeiro

- RobotMat2007 - Workshop on Robotics and Mathematics, Portugal, 2007 (with H.Araújo).(40 participants)
- 5th IFAC/EURON Symposium on Intelligent Autonomous Vehicles, Portugal, 2004. (220 participants)

-----National Organizing Committee - Member -----

Isabel Ribeiro

- 7th Portuguese Conf. on Automatic Control, Portugal, 2006.
- 3rd Portuguese Festival of Robotics, Portugal, 2003.

João Sequeira

- RoboCup 2004, Lisbon, Portugal, 2004.

-----Congress Technical Editor-----

- 17th IFAC World Congress, Seoul, Korea, July 2008

-----International Program Committee - Member -----

- ICAR - IEEE Int. Conf. on Advanced Robotics: Portugal, 2003; USA , 2005; Korea,2007.
- ETFA - IEEE Int. Conf. on Emerging Technologies and Factory Automation: Portugal, 2003; Italy, 2005.
- IAS - Conf. on Intelligent Autonomous Systems, Netherlands, 2004.
- IROS - IEEE/RSJ Int. Conference on Intelligent Robots and Systems: Japan, 2004; China, 2006.
- ICINCO - Int. Conf. on Informatics in Control, Automation and Robotics, Portugal, 2004; Spain, 2005; Portugal, 2006, France 2007.
- 7th Int. Symp. on Distributed Autonomous Robotic Systems, DARS2004, France, 2004.

- ICRA-2005 Workshop on Cooperative Robotics, Spain, 2005.
- ICRA - IEEE Int. Conf. on Robotics and Automation: Spain, 2005; USA, 2006.
- IFAC World Congress , Czech Republic, 2005.
- IEEE Conf. on Decision and Control and European Control Conference, CDC-ECC2005, Spain, 2005.
- IFAC Workshop in Multi-Vehicle Systems, Brasil, 2006.
- 7th IFAC Conf. on Maneuvering and Control of Marine Craft, Portugal, 2006.
- 8th Int. Symp. on Distributed Autonomous Robotic Systems, DARS2006, USA, 2006.
- 6th Portuguese Conf. on Automatic Control, Portugal, 2004.
- Scientific Meeting of the Portuguese Robotics Festival, Portugal 2003 to 2007.

Industry contract research (2000 ca.)

Company: LABELEC –group EDP (Electricity of Portugal)

Title: INFRANET I - Accurate Measurements of High Voltage Installations with Laser Range Scanners and GPS

Duration: 8 months in 2005

ISR/IST received funds= 32.000€

Preventive detection of obstacle clearance infractions in power lines is important for electrical distribution and critical for transmission system operators. The project developed a prototype system to measure obstacle (in particular tree) clearance of high voltage electrical overhead lines based on laser scanning and performing on-line fault detection and classification.

Experiments were carried out with the sensors (Laser scanner, GPS, video camera) on board an all-terrain vehicle and on-board the helicopter that performs the normal inspection operations. The prototype demonstrated the feasibility of the concept and LABELEC contracted the product development.

The project involved 3 team members (J. Gomes-Mota from LABELEC; I.Ribeiro, A. Vale from ISR/IST).

Company: LABELEC –Group EDP (Electricity of Portugal)

Consultancy of the project: INFRANET II – Power Line Maintenance Inspection

Duration: 6 months, from Oct 2007

ISR/IST received funds = 10.000€

After INFRANET I, Gomes-Mota established his own company (Albatroz Eng.) and LABELEC contracted it to extend the results obtained so far into a ready-to-use product to be used by REN (National Electric Network) in the normal inspection and maintenance missions carried out in helicopters where obstacle clearance was visually carried out. This was INFRANET II project.

The product features a video-camera, a GPS-based geo-reference and a low-cost laser scanner with a one-dimension angle sweep, all installed in helicopter. The motion of the vehicle while the laser scans sweeps a three-dimensional volume around the overhead line, generating a cloud of 3D points that represent, the line, the poles and the nearest object to the laser on any scanned direction. The project developed an acquisition interface, a display interface, an algorithm to identify the line, the line supports and remaining obstacles from raw-range data and a procedure to detect abnormal situations (e.g., obstacles closer to the line than a given threshold).

In INFRANET II, ISR/IST was asked by LABELEC to provide scientific consultancy on the assessment of the developed product.

Other publications National (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

-----Chapters in Books

[R07] – Isabel Ribeiro, “Uma viagem ao mundo dos Robots”, in *Despertar para a Ciência: Novos Ciclos de Conferências*, pp.153-192, Gradiva, 2007.

-----Conference Proceedings

[MR07] - Francisco Melo, Isabel Ribeiro, “A POMDP approach to cooperative localization in sparse environments”, Proc. do Workshop on Robotics and Mathematics, RobotMat2007, Coimbra, Portugal, September 2007.

[AFS06] - P. Agostinho, M. Florêncio, J. Sequeira, “Automatic Parallel Parking of Car-Like Robots”, Proc. ROBOTICA 2006 – 6th Portuguese Robotics Festival, 2006, also selected for magazine *Robótica*, N°66.

[CFS05] - P. Cruz, R. Ferreira, J. Sequeira, “Modeling Two Classes of Stewart-Gough Platforms”, Proc. ROBOTICA 2005 – 5th Portuguese Robotics Festival, 2005.

[PACL+04] - V. Pires, M. Arroz, L. Custódio, P. Lima, I.Ribeiro, “Distributed Deliberative Decision System for a Multi-Robot”, Proc. ROBOTICA 2004 – 4th Portuguese Robotics Festival, 2004.

[ARL04] - Carlos Alfaro, M. Isabel Ribeiro, Pedro Lima, “Smooth Local Path Planning for a Mobile Manipulator”, Proc. ROBOTICA 2004 – 4th Portuguese Robotics Festival, 2004.

[PPLR03] - Carla Penedo, João Pavão, Pedro Lima, M. Isabel Ribeiro, “Markov Localization in the RoboCup Simulation League”, Proc. ROBOTICA 2003 – 3rd Portuguese Robotics Festival, 2003, also selected for magazine *Robótica*, *Robótica*, pp.16-21.

[MNL03] - Pedro Marcelino, Pedro Nunes, Pedro Lima, M. Isabel Ribeiro, “Improving object localization through sensor fusion applied to soccer robots” Proc. ROBOTICA 2003 – 3rd Portuguese Robotics Festival, 2003.

[CMR03] - Nuno de Castro, Rodrigo Matias, Isabel Ribeiro, “Target tracking using fuzzy control”, Proc. ROBOTICA 2003 – 3rd Portuguese Robotics Festival, 2003.

Other publications International (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

----- Chapters -----

[SR06b] - J. Sequeira, I. Ribeiro, “Human-Robot Interaction and Robot Control”, In *Robot Motion and Control: Recent Developments*, Springer Lecture Notes in Control and Information Sciences, Krzysztof Kozłowski (editor), 335:375-390, Springer Berlin/Heidelberg, 2006.

[MRL05] - Francisco A. Melo, Isabel Ribeiro, Pedro Lima, “Navigation Controllability of a Mobile Robot Population”, *Lecture Notes in Computer Science*, Volume 3276, Mar 2005, Pages 499 – 507.

----- Proceedings -----

[GSST+07] N.Gonçalves, M.Shanmugavel, J.Sequeira, A.Tsourdos, B. White, I.Ribeiro, “Indoor Active Surveillance”, *Proceedings of the 13th IEEE International Conference on Methods and Models in Automation and Robotics*, Szczecin, Poland, August 2007.

[MR07b] - Francisco Melo, Isabel Ribeiro, “Convergence of Q-learning with linear function approximation” *Proceedings of the European Control Conference, ECC2007*, Kos International Convention Centre, Kos, Greece, 2007, pp.2671-2678.

[TS07] – Luís Tavares, João Sequeira, “RIOL - Robotic Inspection Over Power Lines”, *Proceedings of the 6th IFAC Symposium on Intelligent Autonomous Vehicles, IAV 2007*, Toulouse, France, September 3-5, 2007.

[MCLF+06] - C. Marques, J. Cristovão, Pedro Lima, João Frazão, Isabel Ribeiro, Rodrigo Ventura, “RAPOSA: Semi-Autonomous Robot for Rescue Operations”, *Proc. of IROS2006 - IEEE/RSJ International Conference on Intelligent Robots and Systems*, Beijing, China, 2006.

[SR04] - João Sequeira, Isabel Ribeiro, “Hybrid control of semi-autonomous robots”, *Proceedings do IEEE/RSJ International Conference on Intelligent Robots and Systems, IROS2004*, September 2004, Sendai, Japan, pp.1838-1844.

[SR03] - João Sequeira, Isabel Ribeiro, “A Geometric Approach to Single and Multiple Robot Control”, *Proceedings do 7th IFAC Symposium on Robot Control, SYROCO 2003*, September 2003, Wroclaw, Poland, pp. 137-142.

[VR03] - Alberto Vale, Isabel Ribeiro, “Environment Mapping as a Topological Representation”, *Proceedings da 11th Int. Conf. on Advanced Robotics, ICAR03*, Coimbra, Portugal, June 2003, pp.29-34

[LCRV03] - Pedro Lima, Luis Custódio, M. Isabel Ribeiro, José Santos-Victor, “The RESCUE Project: Cooperative Navigation for Rescue Robots” *Proceedings do 1st International Workshop on Advances in Service Robotics, ASER'03*, Bardolino, Italy, March 2003, pp. 94-101.

Internationalization (2000 ca.)

(Collaborative publication, Research, Graduate Training Networks or other forms of participation of the Research Group at the international level)

- Organization of the course "Introduction to Robotics", included in the ATHENS program, Lisbon, March and November 2007 (31 European students)
- Foreign PhD student: José Miguel Lucas (Spain) (2003)
- Foreign Post-docs: Ognyan B. Manolov (2004, Bulgaria), Fernando Gomez Bravo (2005, Spain)
- Projects with MRLab/ISR/IST participation and partners abroad:
 - * URUS - Ubiquitous Networking Robotics in Urban Settings, FP6-EU-IST-045062: Institut de Robòtica i Informàtica Industrial (Spain), UPC (Spain), CNRS/LAAS (France), ETHZ (Switzerland), Asociación de Investigación y Cooperación Industrial de Andalucía (Spain), Scuola Superiore di Sant'Anna (Italy), Univ. de Zaragoza (Spain), Univ. Surrey (UK), Urban Ecology Agency of Barcelona (Spain), Telefónica I+D (Spain), RoboTech (Italy)
 - * EURON Research Atelier on Networked Robot Systems, RA-507728, IST/ISR (Portugal), Univ de Zaragoza (Spain), Scuola Superiore di Sant'Anna (Italy), Univ.of Surrey (UK), CNRS/LAAS (France), ETHZ (Switzerland), Asociación de Investigación y Cooperación Industrial de Andalucía/ AICIA (Spain) .
 - * Joint Action B-11/06, Anglo-Portuguese Programme for Joint Research - Windsor Treaty, IST/ISR (Portugal), Cranfield Univ. (UK).
- Invited talks
 - * I. Ribeiro, "Social and Ethic Problems in Search and Rescue Robots: questions for discussion," Euron Atelier on Robotethics, Italy, 2006
 - * J. Sequeira, "A New Perspective in Human-Robot Interaction", Macau University, China, 2006
 - * F. Melo – "Predictive State Representations" and "Guarantees for Value Function Approximation", MPI 2007: Workshop on Analytical Challenges in Reinforcement Learning, Germany, 2007.

• Reviewing in the journals:

IEEE Transactions on Robotics

IEEE Trans. on Robotics and Automation

IEEE Robotics & Automation Magazine

IEEE Transactions on Intelligent Transportation Systems

IEEE Control Systems Technology

Robotics and Autonomous Systems

International Journal of Systems Science

Scientia Iranica Journal

Elsevier Journal of Sound and Vibration

• J. Sequeira - member of one PhD thesis committee at Univ. of Macau

• I. Ribeiro - external reviewer of 4 PhD thesis committees at Spanish Universities

• I. Ribeiro – Vice-Chair [2003-2004] and Chair [2005-2008] of IFAC Technical Committee on Intelligent Autonomous Vehicles, Member of the Education Board of FP6 NoE EURON-II

Government/Organization contract research (2000 ca.) (Include here work carried out by the group that resulted in a publication or report. Of particular importance are those involved in public policy advice)

RAPOSA: robot for Search and Rescue (SAR) operations, designed to operate in outdoors hazardous environments, and developed within a consortium project with the ISR spinoff SME IdMind and the Lisbon Fire Department. The robot is tele-operated from a remote station but is capable of carrying out short tasks autonomously. During task execution, the robot sends the information on terrain conditions, temperature, dangerous gases, water or heat sources from different sensors (including a thermal cam) to the remote command station. The robot size was designed to allow it to negotiate standard sized stairs and sewer pipes.

The Lisbon City Hall (CML) that has direct responsibility on Lisbon Civil Protection Department considered that the project RAPOSA demonstrated the concept of an equipment of extreme importance and utility for the Civil Protection elements in case of an emergency (earth quake, building collapse) and provided IST (ISLab+MRLab) with a €4.000,00 grant aiming at pursuing search and rescue activities.

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Future Research

Objectives:

MRLab and ISLab have a past experience of collaboration in research projects, and graduate students supervision. Research staff in both labs share common scientific interests, and tackle complementary aspects in the area of intelligent mobile robots. The two groups will merge into a single one, the IRSLab (Intelligent Robots and Systems Lab), starting 2009, with the goal of fostering their collaboration and increasing the joint critical mass. The Future Research herein presented corresponds to the objectives of this new research group.

The new IRSLab will reinforce the research focus on some of the topics currently studied by ISLab and MRLab:

- i) the development of decentralized sequential decision making methods based on POMDP models (worldwide cited work, with considerable number of publications already in 2008);
- ii) using DES for multi-robot plan representation, analysis and synthesis, namely Petri nets based task modeling and temporal logic based multi-robot task specifications;
- iii) active cooperative perception and cooperative navigation in multi-robot teams using probabilistic approaches, where we expect to introduce novel methods and demonstrate results in unstructured scenarios;
- iv) systems integration, middleware and robot architecture for networked robot systems;
- v) exploring models of social behavior in human societies, inspired on semiotics, to devise alternative, human-like, strategies for interaction among robots and between humans and robots.

We are also exploring multidisciplinary, thought-provocative research topics, which have demonstrated potential for introducing breakthrough concepts in areas such as coordination of robot collectives based on concepts borrowed from the social and natural sciences, namely Economy and Biology. In the upcoming 3 years, it is our goal to strengthen those areas by increasing the collaboration with experts in related fields, and by increasing our critical mass in fields lying in the intersection of the contributing disciplines through recruitment of post-docs. Major ideas in these directions concern:

- exploiting the concept of institutional economy to further develop our awarded Institutional Robotics concept, namely its potential for interaction between robot collectives and humans;
- exploiting the immune system ability to detect anomalous situations and to trigger adequate responses, replicating its operation principles in teams of several robots with a large number of virtual sensors that can be reproduced, mutated or eliminated;
- addressing the problem of how a single robot can cope with an unstructured, unpredictable, and dynamic environment, by using bio-inspired cognitive architectures, such as ego-centered spatial representations of the environment, and motivational systems aiming at the sociability of the robot.

Regarding applications, we will extend our work in search and rescue to field robotics activities and applications, notwithstanding their relevance for public policies, and potential for innovative results on unstructured environments blending sound theory and technological developments. In addition, generic robotics applications, namely those including networked robot systems, will extend the contributions to the area of integration of complex systems that is being addressed in the URUS project.

The involvement in ITER Remote Handling activities will continue, extending the past contributions of the group, among them the design of the current reference model for ITER cask transportation systems.

Funding, source, dates (indicate in full including amount of current and pending funding)

- €107.916,00, DecPUCS: Decentralized Planning Under Uncertainty for Cooperative Systems, FCT PTDC/EEA-ACR/73266/2006, Oct/2007 – Sep/2010
- €237.043,37, URUS - Ubiquitous Networking Robotics in Urban Settings, FP6-EU-IST-045062, Dec/2006 – Nov/2009 [together with VisLab – under Theme B]
- €250.000,00 - Activities related to the development of an Air Transfer System prototype and Cask Transfer System Virtual Mockup - submitted (October 2008) to Fusion for Energy (within ITER) following the call F4E-2008- GRT-016 (MS-RH).
- €342.672,00 - Large Scale Dynamic Sensing and Actuation Ecosystem – 36 months, submitted (15 October 2008) to CMU-Portugal projects Call, in consortium with several national and CMU research groups (+VisLab, +SIPgroup + DSORLab)

Previous publications in the area (5 in the last 5 years. If available you must indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language)

- F. Oliehoek, M. Spaan, N. Vlassis, Optimal and Approximate Q-value Functions for Decentralized POMDPs, Journal of Artificial Intelligence Research, Vol. 32, pp. 289-353, 2008
- B. Lacerda, P. Lima, Linear-Time Temporal Logic Control of Discrete Event Models of Cooperative Robots, Journal of Physical Agents, Vol. 2, No. 1, Special Issue on Multi-Robot Systems, 2008
- João Sequeira, Isabel Ribeiro, "A Semiotic Approach to the Control of Semi-Autonomous Robots", International Journal of Systems Science, Taylor & Francis, Vol. 37, N. 6, pp. 361-376, 2006
- D. Milutinovic, J. Carneiro, M. Athans, P. Lima, "Modeling Dynamics of Cell Population Molecule Expression Distribution", Nonlinear Analysis: Hybrid Systems, Elsevier, Vol. 1, Issue 1, pp. 81-94, 2007
- R. Ventura, C. Pinto-Ferreira, Metric Adaptation and Representation Upgrade in an Emotion-based Agent Model, Proc. of ACII 2007 - 2nd Int. Conf. on Affective Computing and Intelligent Interaction, Lisbon, Portugal, 2007

Special Requirements (equipment, facilities, staff or other special needs essential to carry out the future research program)

- keep some funds for supporting the development of technology, such as new robots, sensors and integrated solutions, typically in consortium with external companies;
- provide funds to support long-needed lab technicians that can provide professional development and maintenance of existing and future software hardware, associated to test cases of increasing complexity: for this purpose we propose to contract 1-2 engineers;
- investigate the usage of quad-rotor helicopters as an alternative to blimps, to provide means for cooperation among heterogeneous aerial robots; the idea is to

include, in the envisaged scenarios, aerial robots which balance adequately control simplicity, power and payload autonomy;

- provide means to extend and upgrade the capabilities of the existing RIOL prototype and future evolutions of the concept
- upgrade/repair the existing RAPOSA land robot, namely replacing damaged mechanical parts of the articulated frontal body and docking mechanism, replacing all electronic boards by lighter and smaller SMD boards, upgrading the motherboard processor for enabling onboard computer vision, and new LiPo batteries for increased autonomy.

Here you can find the information submitted for each of the Research Groups.

[Information accessed: 06-11-2008 15:37:47 on www.fct.mctes.pt]

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Research Group Information

(RG-LVT-Lisboa-750009-3505)

Designation: Intelligent Systems Laboratory

Principal Investigator: Pedro Manuel Urbano de Almeida Lima

Location of Group: Instituto Superior Técnico - Universidade Técnica de Lisboa

Keywords: Multi-robot Systems ,Decentralized Estimation and Control ,Sequential Decision Making Under Uncertainty ,Cognitive Agent Architectures

Funding, sources, dates

FCT Projects:

€114.723,52, RESCUE – Cooperative Navigation for Rescue Robots, FCT SRI/32546/99-00, Nov/2000–Oct/2004 [+MRLab+VisLab–Theme B]

€87.187, SocRob – Society of Robots or Soccer Robots, FCT POSI/ROBO/43900/2002, Oct/2003 – Apr/2005

€28.110,00, RAPOSA-Semi-Autonomous Robot for Rescue Operations), Agency for the Innovation + Lisbon City Hall, Consortium Projects (POSI), Mar/2003

€107.916,00, DecPUCS: Decentralized Planning Under Uncertainty for Cooperative Systems, FCT PTDC/EEA-ACR/73266/2006, Oct/2007–Sep/2010[+MRLab+VisLab–Theme B]

€400.000,00, Re-equipment, Aug/2005-Mar/2007 [+MRLab+VisLab-Theme B+IN+]

European projects:

€167.085,00, HROSS - High Resolution Optical Satellite Sensors, EUCLID-RTP 9.09, Nov/2003 – Dec/2005

€161.774,16, FEMDS - Formation Estimation Methodologies for Distributed Spacecraft, ESA 17529/03/NL/LvH/bj, Jul/2003-Dec/2006

€237.043,37, URUS-Ubiquitous Networking Robotics in Urban Settings, FP6-EU-IST-045062, Dec/2006–Nov/2009 [+MRLab+VisLab–Theme B]

Large event organization:

€846.161,30, organization of RoboCup2004, support from FCT, Ciência Viva, and the RoboCup Federation, Sep 2003 - July 2004

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[FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Group Team

List of Researchers in the Group:

001. Pedro Manuel Urbano de Almeida Lima (**Cat.:** Professor Associado **Gr. Acad.:** Agregação)

002. Carlos Filipe Gomes Bispo (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)

003. Matthijs Theodor Jan Spaan (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)

List of Collaborators (w/PhD):

001. Carlos Alberto Pinto-Ferreira (**Cat.:** Professor Associado **Gr. Acad.:** Doutoramento)

002. Luis Manuel Marques Custodio (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)

003. Dan DUMITRIU (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

004. David Herrero-Pérez (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

005. Porfírio Simões de Carvalho e Silva (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

006. Sandra Pinto Clara do Carmo Gadanho (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

List of Collaborators (w/o PhD):

001. Sónia Maria Martinho marques (**Cat.:** Professor-Adjunto **Gr. Acad.:** Mestrado)

002. Pedro Viçoso Fazenda (**Cat.:** Assistente **Gr. Acad.:** Mestrado)

003. Rodrigo Martins de Matos Ventura (**Cat.:** Assistente **Gr. Acad.:** Mestrado)

004. ABDOLKARIM PAHLIANI (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)

005. Bruno Duarte Damas (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)

006. Gonçalo de Freitas Santos Neto (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)

007. Hugo Filipe Costelha de Castro (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)

008. João Carlos da Silva Santos (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)

009. João Pedro Estilista Antunes (Cat.: Não aplicável (bolseiro) Gr. Acad.: Licenciatura)

010. Marco Alexandre Fagulha Barbosa (Cat.: Não aplicável (bolseiro) Gr. Acad.: Mestrado)

011. Matteo Taiana (Cat.: Não aplicável (bolseiro) Gr. Acad.: Licenciatura)

012. Nelson Miguel Silva Ramos (Cat.: Não aplicável (bolseiro) Gr. Acad.: Mestrado)

013. Ana Maria Fonseca Esteves (Cat.: Outra Gr. Acad.: Licenciatura)

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[FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Objectives & Achievements

Objectives:

The driving theme of the Intelligent Systems Laboratory is the R&D on decentralized decision-making and control for multi-robot (networked, cooperative) systems (main focus), cognitive robots, human-robot interaction, and large-scale systems. Decentralization is a key issue, as the overwhelming amount of information that must be handled in modern systems, composed of a massive number of embedded sensors, actuators, processors, and wireless communication devices, together with the well-known weaknesses of centralized systems, call for novel approaches to decentralized decision-making at different levels of abstraction, using the "think local, act global" principle. Our research is often driven by practical applications, and the applications include monitoring and decision-making in hazardous/remote environments (e.g., space, contaminated areas, post-disaster scenarios), and services (e.g., ambient assisted living, helping people in public spaces, energy consumption in buildings).

Our distinctive feature is that we bring together people with a common background on systems theory, but different approaches to modelling, analysis and synthesis of intelligent systems, mainly coming from:

- artificial intelligence, with a focus on decentralized and distributed methods, and specific interest on planning under uncertainty, organizational issues, neurosciences-, biology- and social sciences-inspired robot architectures and methods;
- systems and control, with a focus on complex systems consisting of a large number of interconnected embedded systems, e.g., sensor and robot networks, institutional management systems, or biological systems, and specific interest on modelling, analysis and synthesis methods.

ISLab has regularly collaborated with the MRLab within the framework of the Theme B search and rescue deliverable, including the participation in the RESCUE project and Theme B deliverable, in the development of a search and rescue robot (RAPOSA), in the EU project URUS on networked robotics, and in the supervision of a PhD student on reinforcement learning methods. During 2007, the two labs retook a past joint collaboration in Remote Handling R&D in ITER (International Thermonuclear Experimental Reactor).

A more detailed description of the group activities can be found at <http://islab.isr.ist.utl.pt>

Main Achievements:

ISLab has been developing models and methods for single and multiple robot systems (cooperative) plan representation and analysis, based on discrete event systems (DES) concepts, tools and techniques. Such methods have potential to scale up from problems manually designed, with a limited number of behaviours, to realistic applications with automatically designed plans including a considerable number of behaviours, by enabling a systematic approach to plan design from specifications (several analysis tools for DES are available). Plan representation using Petri nets and mixing DES supervision with reinforcement learning are the subject of two running PhD theses. Similar concepts were also applied to the modelling of cell population dynamics, as well as probabilistic modelling and control of robot swarms, using stochastic hybrid automata, in one finished PhD thesis.

The inclusion of uncertainty in DES models leads naturally to problems of sequential decision-making under uncertainty. A significant part of our work has been devoted to extend Markov Decision Problems (MDPs) and Partially Observable MDPs (POMDPs) models and methods to multi-robot coordination problems, using decentralized decision-making (e.g., Dec-POMDPs).

Cooperative perception (CP) based on probabilistic approaches is another topic of research at the ISLab. We are using probabilistic models of sensor measurements and sensor localization, as well as fusion methods, for this purpose. When some of the sensors are mobile (e.g., carried out by a robot), the problem turns into active CP, as decisions can be taken to dispatch some of the sensors to locations where they reduce the team uncertainty about what is being perceived. This work is the subject of an ongoing PhD thesis and is partially being developed under the URUS project.

Control and state estimation of robot formations have also been subjects covered in this period. Formation feasibility given the robot kinematics and geometric constraints among the robots was studied in a journal paper, resulting from a PhD thesis finished in 2002. Novel low-communication, decentralized full-state formation estimation methods were developed and tested in a realistic multi-satellite simulator, under the ESA project FEMDS, and one PhD thesis awaiting defence.

Developed testbeds open to the AL and international communities:

- cooperative soccer robots;
- autonomous blimp hardware and realistic USARSim simulator

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Group Productivity

Publications in peer review Journals (3000 ca.) (Up to a max of 10. Always indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language. DO NOT translate)

João Pina, Pedro Lima, "A Glass Furnace Operation System Using Fuzzy Modelling and Genetic Algorithms for Performance Optimisation", Engineering Applications of Artificial Intelligence, Vol 16/7-8 pp 681-690, Elsevier, 2003.

Sandra Gadanho, "Learning Behavior-Selection by Emotions and Cognition in a Multi-Goal Robot Task", Journal of Machine Learning Research, JMLR 4(Jul):385-412, 2003.

P. Tabuada, G. Pappas and P. Lima, "Compositional Abstractions of Hybrid Control Systems", Journal of Discrete Event Dynamic Systems, April 2004, Volume 14, Issue 2

C. Marques, P. Lima, "Multi-Sensor Navigation for Non-Holonomic Robots in Cluttered Environments", IEEE Robotics and Automation Magazine, 11(3), September 2004

Tabuada P., Pappas G. and Lima P., "Motion Feasibility of Multi-Agent Formations", IEEE Transactions on Robotics, Vol. 21 (3), pp. 387-392, 2005

Lima P., Custódio L., Akin I., Jacoff A., Kraetzschmar G., Kiat Ng B., Obst O., Röfer T., Takahashi Y., Zhou C., "RoboCup 2004 Competitions and Symposium: A Small Kick for Robots, a Giant Score for Science", AI-Magazine, Vol. 6, N° 2, Summer 2005

D. Milutinovic, Pedro Lima, "Modeling and Optimal Centralized Control of a Large-Size Robotic Population", IEEE Transactions on Robotics, Vol. 22, Issue: 6, pp.1280-1285, 2006

Dan Dumitriu, Sónia Marques, Pedro Lima, J. C. Bastante, J. Araújo, L. F. Peñin, A. Caramagno, B. Udrea, "Optimal Guidance and Decentralised State Estimation Applied to a Formation Flying Demonstration Mission in GTO", IET Control Theory and Applications, Vol. 1, Issue 2, p. 443-552, March, 2007

C. Marques, J. Cristovão, P. Alvitto, Pedro Lima, João Frazão, M. Isabel Ribeiro, Rodrigo Ventura, "A Search and Rescue Robot with Tele-Operated Tether Docking System", Industrial Robot, Emerald Group Publishing Limited, Vol. 34, No.4, pp. 332-338, 2007

D. Milutinovic, J. Carneiro, M. Athans, P. Lima, "Modeling Dynamics of Cell Population Molecule Expression Distribution", Nonlinear Analysis: Hybrid Systems, Elsevier, Vol. 1, Issue 1, pp. 81-94, 2007

Other publications National (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

Carla Penedo, João Pavão, Pedro Lima, M. Isabel Ribeiro, "Markov Localization in the Robocup Simulation League", Proc. ROBOTICA 2003 – 3rd Portuguese Robotics Festival, Lisboa, Portugal, 2003, also selected for magazine Robótica, pp. 16-21, 2003

Miguel Arroz, Vasco Pires, Luis Custódio, "Logic based Distribution Decision System for a Multi-Robot Team", Actas do Encontro Científico do Robotica 2003 - Festival Nacional de Robotica, 2003.

Pedro Marcelino, Pedro Nunes, Pedro Lima, M. Isabel Ribeiro, "Improving Object Localization Through Sensor Fusion Applied to Soccer Robots", Actas do Encontro Científico do Robotica 2003 - Festival Nacional de Robotica, 2003.

Sousa, C., Custódio, L., "Aprendizagem por Reforço num Sistema Multi-Agente: Comunicação e Cooperação", Actas do Encontro Científico do Robotica 2005 - Festival Nacional de Robótica, 2005

G. Almeida, José Santos-Victor, Pedro Lima, "Controlo de um Manipulador Robotico Usando Visão", Proc. ROBOTICA 2005 - 5th Portuguese Robotics Festival, Coimbra, Portugal, 2005, also selected for magazine Robótica, No. 62, 2006

D. Cabecinhas, Jacinto Nascimento, J. Ferreira, P. Rosa, Pedro Lima, "Self-Localization Based on Kalman Filter and Monte Carlo Fusion of Odometry and Visual Information", Proc. ROBOTICA 2006 - 6th Portuguese Robotics Festival, Guimarães, Portugal, 2006, also selected for magazine Robótica, No. 65, 2006

Abdolkarim Pahlani, Pedro Lima, "Improving Self Localization and Object Localization by a Team of Robots Using Sensor Fusion", Proc. Controlo2006 - 7th Portuguese Conference in Automatic Control, Lisbon, Portugal, 2006

P. Afonso, J. Azevedo, C. Cardeira, B. Cunha, Pedro Lima, V. Santos, "Challenges and Solutions in an Autonomous Driving Mobile Robot Competition", Proc. Controlo2006 - 7th Portuguese Conference in Automatic Control, Lisbon, Portugal, 2006

Artem Khmelinskii, Rodrigo Ventura, João Sanches, "Chromosome Pairing for Karyotyping Purposes", Proc. of RecPad 2007 - 13ª Conferência Portuguesa de Reconhecimento de Padrões, Lisbon, Portugal, 2007

Nelson Ramos, Marco Barbosa, Pedro Lima, "Multi-Robot Systems Middleware Applied to Soccer Robots", Proc. of ROBÓTICA2007 - 7th Conference on Mobile Robots and Competitions, Paderne, Portugal, 2007

Other publications International (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

Dejan Milutinovic, Pedro Lima, "Cells and Robots - Modeling and Control of Large-Size Agent Populations - Modeling and Control of Large-Size Agent Populations", Springer Tracts in Advanced Robotics (STAR) Series, Vol. 32, 2007

Pedro Lima, Luís Custódio, "Multi-Robot Systems", Chapter I of Innovations in Robot Mobility and Control, S. Patnaik, S. Tzafestas (Eds.). Springer Verlag, Berlin, 2006

B. Damas, P. Lima, L. Custódio, "A Modified Potential Fields Method for Robot Navigation Applied to Dribbling in Robotic Soccer", RoboCup 2002 Book, Lecture Notes in Computer Science, Editors: Gal Kaminka, Pedro Lima and Raul Rojas, Springer-Verlag, Berlin, 2003.

G. Neto, H. Costelha, P. Lima, "Topological Navigation in Configuration Space Applied to Soccer Robots", RoboCup-2003: Robot Soccer World Cup VII, Lecture Notes in Computer Science, Springer Verlag, Berlin, 2004

H. Lausen, J. Nielsen, M. Nielsen, P. Lima, "Model and Behavior-Based Robotic Goalkeeper", RoboCup-2003: Robot Soccer World Cup VII, Lecture Notes in Computer Science, Springer Verlag, Berlin, 2004

Oliveira e Sousa, C. and Custódio, L., "Cooperative Reinforcement Learning: exploring Communication and Cooperation Problems", Proceedings of the 6th IEEE International Symposium on Computational Intelligence in Robotics and Automation (CIRA), 2005.

Melo F., Ribeiro M. I., Lima P., "Navigation Controllability of a Mobile Robot Population", RoboCup-2004: Robot Soccer World Cup VIII, Lecture Notes in Computer

Science, Springer Verlag, Berlin, 2005

Valdinei Silva, A. Costa, Pedro Lima, "Inverse Reinforcement Learning with Evaluation", Proc. of ICRA2006 - IEEE International Conference on Robotics and Automation, Orlando, Florida, USA, 2006

C. Marques, J. Cristovão, Pedro Lima, João Frazão, M. Isabel Ribeiro, Rodrigo Ventura, "RAPOSA: Semi-Autonomous Robot for Rescue Operations", Proc. of IROS2006 - IEEE/RSJ International Conference on Intelligent Robots and Systems, Beijing, China, 2006

Hugo Costelha, Pedro Lima, "Modeling, Analysis and Execution of Robotic Tasks using Petri Nets", Proc. of IROS 2007 - IEEE International Conference on Intelligent Robots and Systems, San Diego, CA, USA, 2007

Master and Ph.D. thesis completed (3000 ca.)

PhD

(outside the evaluation period but not covered in previous reports):

Title: Hierarchies and Compositional Abstractions of Hybrid Systems

PhD Student: Paulo Tabuada

Advisor: Pedro Lima

Conclusion: January 2002.

Title: Stochastic Model of Micro-Agent Populations

PhD Student: Dejan Milutinovic

Advisor: Pedro Lima

Conclusion: September 2004.

Title: Robótica Institucionalista: as Ciências do Artificial como Ciências do Humano

PhD Student: Porfírio Silva

Advisor: Pedro Lima (co-advisor: Isabel Matos Silva, Faculdade de Letras, University of Lisbon)

Conclusion: October 2007.

MASTERS (pre-Bologna)

Title: Controlo de um Manipulador Robótico Usando Visão

Master Student: M. Graça Almeida

Advisor: José Santos-Victor and Pedro Lima

Conclusion: May 2004

Title: Concepção de um Sistema Multi-Agente para a Resolução de Problemas em Cadeias de Produção-Distribuição

Master Student: Rui Carvalho

Advisor: Luis Custódio

Conclusion: July 2004

Title: Sociedade de Agentes Autónomos – Aplicação de uma Arquitectura baseada em Emoções

Master Student: Márcia Maçãs

Advisor: Luis Custódio

Conclusion: April 2003

Title: Sistema de Decisão Distribuído Baseado em Lógica para uma Equipa Multi-Robot

Master Student: Vasco Pires

Advisor: Luis Custódio

Conclusion: April 2005

Title: Aprendizagem por Reforço de Sistemas com Múltiplos Objectivos: o Problema da Selecção de Acções

Master Student: Miguel Arroz

Advisor: Luis Custódio

Conclusion: February 2007

Title: Arquitectura de Aprendizagem e Decisão de um Agente Inspirado em Emoções

Master Student: Bruno Duarte Damas

Advisor: Luis Custódio

Conclusion: February 2006

Title: Plataforma de Desenvolvimento de Agentes de Busca e Salvamento

Master Student: Miguel Arroiz

Advisor: Luis Custódio

Conclusion: February 2007

Title: Aprendizagem por Reforço de Sistemas com Múltiplos Objectivos: o Problema da Selecção de Acções

Master Student: Constança d'Andrade de Oliveira e Sousa

Advisor: Luis Custódio

Conclusion: May 2006

plus 8 post-Bologna MSc theses

see list of dissertations and abstracts at <http://welcome.isr.ist.utl.pt/labs/islab/pub/>

Patents/propotypes (2000 ca.)

RAPOSA: robot for Search and Rescue (SAR) operations, designed to operate in outdoors hazardous environments, and developed within a consortium project with the ISR spinoff SME IdMind and the Lisbon Fire Department. The robot is tele-operated from a remote station but is capable of carrying out short tasks autonomously. During task execution, the robot sends the information on terrain conditions, temperature, dangerous gases, water or heat sources from different sensors (including a thermal cam) to the remote command station. The robot size was designed to allow it to negotiate standard sized stairs and sewer pipes. The most innovative contribution of RAPOSA is the tether remote docking, which can be accomplished remotely by using the visual feedback of a web cam installed in the back side of the robot, and a remotely-controlled door latch. The tether supplies power and acts as a wireless access point. The robot was tested successfully in several outdoors and indoors scenarios of the Lisbon Fire Fighters school, as well as during an earthquake drill, performed at Sicily, Italy, joining several European Civil Protection institutions, at EUROSOT 2006. RAPOSA was also selected for participation in ELROB 2006 and 2007. In 2007, it got the 6th place among 12 participants. A license for technology, mark and intellectual rights usage by IdMind, under the payment of royalties, is under negotiation.

OmnISocRob – 5 prototype robots especially designed to play soccer, with open hardware and software architectures, so that they can also be used for general research on mobile robotics, were designed, built and tested together with the ISR spinoff IdMind and the ServiLog Portuguese SMEs. The new robots have 3 omnidirectional wheels, driven by 3 MAXON DC motors. Most of their processing power is concentrated on a NEC FS900 laptop, with an INTEL Centrino 1.6 GHz processor. "Plug-and-play" connections of most peripherals to the laptop were used. The laptop includes wireless 802.11b, 3 USB 2.0 ports, and 1 mini-firewire port. Each robot is endowed with 1 AVT Marlin F-033C firewire camera, which is part of an omnidirectional dioptric vision sensor, based on a wide-angle (180°) lens; 16 sonars (SRF04 RangeFinder) ring; 1 500 CPR encoder per motor; 1 AnalogDevices rate-gyro XRS300EB; 2 packs of 9Ah NiMH batteries.

ISLab has developed over the years several other prototypes (e.g., differential drive and tricycle robots) and considerable experience with processing data acquired by cameras, laser, sonar, rate-gyro and other sensors, predominantly installed on mobile robots.

Organization of conferences (2000 ca.)

Gen. Chair

P.Lima, L.Custódio:

- RoboCup2004, Lisboa, Portugal, 2004

Int. Org. Com.

P.Lima:

- Invited PC Chair of 1st IFAC Wks. in Multi-Vehicle Systems, Salvador, Brazil, 2006
- 11th Int. Conf. on Adv. Robotics, ICAR 2003, Coimbra, Portugal, 2003

Nat. Org. Com.

P.Lima, L.Custódio:

- Portuguese Robotics Open, Lisbon, Portugal, 2003.

Int. Prog. Com.

- 2nd Int. Joint Conf. on Autonomous Agents and Multi-Agent Systems 2003, AAMAS 2003, Melbourne, Australia, 2003
- IEEE/RSJ Conf. on Intel. Robotics Systems, IROS 2003, Las Vegas, Nevada, USA, Oct
- 8th Conf. on Intel. Autonomous Systems (IAS-8), Amsterdam, the Netherlands, 2004
- 5th IFAC Symp. on Intel. Autonomous Vehicles (IAV 2004), Lisbon, Portugal
- IEEE/RSJ IROS 2004, Sendai, Japan
- IEEE/RSJ IROS 2005, Edmonton, Alberta, Canada.
- [Senior PC member] ICAR 2005, Seattle, Washington, USA
- IEEE Int. Conf. on Robotics and Automation (ICRA 2006) Poster, Orlando, FL, USA
- IEEE/RSJ IROS 2006, Beijing, China,
- IAS-9, Tokyo, Japan, 2006
- Poster Track of Int. Joint Conf. on Artificial Intelligence (IJCAI 2005), Edinburgh, Scotland
- RoboCup 2005 Symp., Osaka, Japan

- IAS-10, University of Tokyo at Kashiwa, Japan, 2006
- IJCAI 2007, Hyderabad, India, 2007
- RoboCup2006 Symp, Bremen, Germany, 2006
- [Associate Editor] IEEE/RSJ IROS 2008, Nice, France, 2008
- Europ. Conf. on AI 2008 (ECAI 2008), "Perception, Sensing and Cognitive Robotics" area, Patras, Greece, 2008
- Europ. Conf. on Artificial Life (ECAL 2007), Lisboa, Portugal, 2007
- ICAR 2007, Jeju, South Korea, 2007
- RoboCup 2007 Symp., Atlanta, GA, USA
- Robocomm, 1st Int. Conf. on Robot Comm. and Coordination, Athens, Greece, 2007
- 9th Iberoamerican Conf. on AI, IBERAMIA 2004, Nov2004
- Int. Conf. on Informatics in Control, Automation and Robotics, Aug 2004
- 3rd Int. Symp. "Affective Computational Entities", 17th Europ. Meeting on Cybernetics and Systems Research (EMCSR'04), Apr 2004.
- 2nd Int. Conf. on Informatics in Control, Automation and Robotics (ICINCO 2005)
- The 1st Int. Workshop on Multi-Agent Robotic Systems (MARS 2005)
- Intel. Robots & Systems track, IEEE Conf. on Emerging Technologies and Factory Automation (ETFA 2005)
- Multi-agent Sequential Decision Making in Uncertain Domains AAMAS08 Workshop, Estoril, Portugal, May 2008

Internationalization (2000 ca.)

(Collaborative publication, Research, Graduate Training Networks or other forms of participation of the Research Group at the international level)

Intern. St.: D. Milutinovic (PhD – Serbia), V. Silva, V. Odakura (PhD - Brazil), A. Pahlani (PhD, Iran), D. H. Perez (post-doc, Spain), D. Dumitriu (post-doc, Roumania), P. F. Palamara, M. Tajana (MSc, Italy), H. Lausen, J. Nielsen, M. Nielsen (MSc, Denmark), B. Vecht (MSc, Netherlands), A. Ahmad (BSc, India)

Projs:

o HROSS: Alenia Spazio (Italy), CSL, AMOS and MICROMEGA (Belgium)

o URUS: U. Polit. de Catalunya + several partners from Spain, LAAS (France), ETHZ (Switz.), Scuola Sup. Sant'Anna (Italy), U. Surrey (UK), RoboTech (Italy)

o EURON II Coop. Robotics SIG (coord.: A. Saffiotti and P. Lima),

Inv. talks:

o L.Custódio, Wks of the LTI, Escola U. S. Paulo, Brazil, 2004

o P.Lima,

• LAAS, Toulouse, 2005

• Rescue Robotics Camp, U. Rome "La Sapienza", 2005

• Multi-Robot Systems: Perception, Behaviors, Learning, and Action, Dagstuhl Sem. 06251, June 2006

• AASS Lab, U. Örebro, Sweden, 2007

• IEEE ICRA 2007 Wks on Collective Behaviors Inspired by Biological and Biochemical Systems, 2007

• SWIS Lab, EPFL, Lausanne, Switz., 2007

• Wks de Agentes Físicos 2007, Zaragoza, Spain, 2007

Board:

o P.Lima:

• Trustee - RoboCup Federation

• Port. repr. to the MG of the European Technological Platform on Robotics, EUROP

• Ed. Adv. Board – J. Adv. Robotic Systems, publ. by ARS

Journal rev.:

o IEEE Trans. on Fuzzy Systems

o Trans. on Systems, Man and Cybernetics – Parts B and C,

o Robotics and Automation Mag.

o Trans. on Robotics

o ARS Int. Journal of Adv. Robotic Systems

o Elsevier J. of Robots and Aut. Systems

o IEE Proc. on Control Th. and Appls.

o Springer-Verlag J. of Intel. and Robotic Systems

o Elsevier AI

o Journal of AI Research

o Wiley Journal of Field Robotics

o Operations Research

o European J. of Operational Research

o Elsevier Neurocomputing

Proj. Rev.

o P.Lima:

• EC (IST-2.4.8. Cognitive Systems), Apr 2005

• Austrian Science Fund, Jun 2005

• Dutch Technology Found. STW, Dec 2005

PhD theses ext. rev. / com. member

o P.Lima:

• Dip. di Informatica e Sistemistica, U. Rome "La Sapienza", Italy, 2004

• Inst. Nat. Polyt. de Toulouse, France, 2005

• U. Carlos III de Madrid, Spain, 2006

Awards

o 2nd place in the EURON's G. Giralt best European PhD thesis in 2005: D. Milutinovic's PhD thesis

Collab. publs.:

o G. Kaminka, P. Lima, R. Rojas (Eds.), "RoboCup 2002: Robot Soccer World Cup VI", LNCS, Vol. 2752, Springer Verlag, 2003

o Sp. issue on "Multi-Robots in Dynamic Environments" of the J. of Robotics and Aut. Systems, Vol 50/2-3, 2005, F. Groen and P.Lima (Eds.)

Promotion of Port. Robotics: "Robotics Educational Activities in Portugal: A Motivating Experience", P.Lima, IEEE Rob. and Autom. Mag., Vol. 14, No. 2, pp 16-17, Jun 2007

Government/Organization contract research (2000 ca.) (Include here work carried out by the group that resulted in a publication or report. Of particular importance are those involved in public policy advice)

RAPOSA: robot for Search and Rescue (SAR) operations, designed to operate in outdoors hazardous environments, and developed within a consortium project with the ISR spinoff SME IdMind and the Lisbon Fire Department. The robot is tele-operated from a remote station but is capable of carrying out short tasks autonomously. During task execution, the robot sends the information on terrain conditions, temperature, dangerous gases, water or heat sources from different sensors (including a thermal cam) to the remote command station. The robot size was designed to allow it to negotiate standard sized stairs and sewer pipes.

The Lisbon City Hall (CML) that has direct responsibility on Lisbon Civil Protection Department considered that the project RAPOSA demonstrated the concept of an equipment of extreme importance and utility for the Civil Protection elements in case of an emergency (earthquake, building collapse) and provided IST (ISLab+MRLab) with a €4.000,00 grant aiming at pursuing search and rescue activities.

Industry contract research (2000 ca.)

• €1.425,00 (Robo-Fut project) as the result of royalties regarding technology transfer from ISR to IdMind (ISR SME spinoff), concerning sales of soccer omnidirectional robots jointly designed between ISLab/ISR and IdMind

• €14.780,16 (Skysoft project) as the result of a protocol with the Portuguese SME Skysoft to support the salary of Mr. Bruno Nery, who worked on software for network monitoring and control of the GALILEO satellite positioning system, under the MDDN MNE project

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Future Research

Objectives:

ISLab and MRLab have a past experience of collaboration in research projects, and graduate students supervision. Research staff in both labs share common scientific interests, and tackle complementary aspects in the area of intelligent mobile robots. The two groups will merge into a single one, the IRSLab (Intelligent Robots and Systems Lab), starting 2009, with the goal of fostering their collaboration and increasing the critical mass. The Future Research herein presented corresponds to the objectives of this new research group.

The new IRSLab will reinforce the research focus on some of the topics currently studied by ISLab and MRLab:

i) the development of decentralized sequential decision making methods based on POMDP models (worldwide cited work, with considerable number of publications already in 2008);

ii) using DES for multi-robot plan representation, analysis and synthesis, namely Petri nets based task modeling and temporal logic based multi-robot task specifications;

iii) active cooperative perception and cooperative navigation in multi-robot teams using probabilistic approaches, where we expect to introduce novel methods and demonstrate results in unstructured scenarios;

iv) systems integration, middleware and robot architecture for networked robot systems;

v) exploring models of social behavior in human societies, inspired on semiotics, to devise alternative, human-like, strategies for interaction among robots and between humans and robots.

We are also exploring multidisciplinary, thought-provocative research topics, which have demonstrated potential for introducing breakthrough concepts in areas such as coordination of robot collectives based on concepts borrowed from the social and natural sciences, namely Economy and Biology. In the upcoming 3 years, it is our goal to strengthen those areas by increasing the collaboration with experts in related fields, and by increasing our critical mass in fields lying in the intersection of the contributing disciplines through recruitment of post-docs. Major ideas in these directions concern:

• exploiting the concept of institutional economy to further develop our awarded Institutional Robotics concept, namely its potential for interaction between robot collectives and humans;

• exploiting the immune system ability to detect anomalous situations and to trigger adequate responses, replicating its operation principles in teams of several robots with a large number of virtual sensors that can be reproduced, mutated or eliminated;

• addressing the problem of how a single robot can cope with an unstructured, unpredictable, and dynamic environment, by using bio-inspired cognitive architectures, such as ego-centered spatial representations of the environment, and motivational systems aiming at the sociability of the robot.

Regarding applications, we will extend our work in search and rescue to field robotics activities and applications, notwithstanding their relevance for public policies, and potential for innovative results on unstructured environments blending sound theory and technological developments. In addition, generic robotics applications, namely those including networked robot systems, will extend the contributions to the area of integration of complex systems that is being addressed in the URUS project.

The involvement in ITER Remote Handling activities will continue, extending the past contributions of the group, among them the design of the current reference model for ITER cask transportation systems.

Funding, source, dates (indicate in full including amount of current and pending funding)

€107.916,00, DecPUCS: Decentralized Planning Under Uncertainty for Cooperative Systems, FCT PTDC/EEA-ACR/73266/2006, Oct/2007 – Sep/2010

€237.043,37, URUS - Ubiquitous Networking Robotics in Urban Settings, FP6-EU-IST-045062, Dec/2006 – Nov/2009 [together with VisLab and MRL – under Theme B]

€250.000,00 - Activities related to the development of an Air Transfer System prototype and Cask Transfer System Virtual Mockup - 16 months project, submitted (October 2008) to Fusion for Energy (within ITER) following the call F4E-2008- GRT-016 (MS-RH)

€342.672,00 - Large Scale Dynamic Sensing and Actuation Ecosystem - 36 months project, submitted (15 October 2008) to CMU-Portugal projects Call, [+VisLab+SPLab+DSORLab] in consortium with several national and CMU research groups

Previous publications in the area (5 in the last 5 years. If available you must indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language)

F. Oliehoek, M. Spaan, N. Vlassis, Optimal and Approximate Q-value Functions for Decentralized POMDPs, Journal of Artificial Intelligence Research, Vol. 32, pp. 289-353, 2008

B. Lacerda, P. Lima, Linear-Time Temporal Logic Control of Discrete Event Models of Cooperative Robots, Journal of Physical Agents, Vol. 2, No. 1, Special Issue on Multi-Robot Systems, 2008

João Sequeira, Isabel Ribeiro, "A Semiotic Approach to the Control of Semi-Autonomous Robots", International Journal of Systems Science, Taylor & Francis, Vol. 37, N. 6, pp. 361-376, 2006

D. Milutinovic, J. Carneiro, M. Athans, P. Lima, "Modeling Dynamics of Cell Population Molecule Expression Distribution", Nonlinear Analysis: Hybrid Systems, Elsevier, Vol. 1, Issue 1, pp. 81-94, 2007

R. Ventura, C. Pinto-Ferreira, Metric Adaptation and Representation Upgrade in an Emotion-based Agent Model, Proc. of ACII 2007 - 2nd Int. Conf. on Affective Computing and Intelligent Interaction, Lisbon, Portugal, 2007

Special Requirements (equipment, facilities, staff or other special needs essential to carry out the future research program)

Keep some funds for supporting the development of technology, such as new robots, sensors and integrated solutions, typically in consortium with external companies;

Provide funds to support long-needed lab technicians that can provide professional development and maintenance of existing and future software hardware, associated to test cases of increasing complexity: for this purpose we propose to contract 1-2 engineers;

Investigate the usage of quad-rotor helicopters as an alternative to blimps, to provide means for cooperation among heterogeneous aerial robots; the idea is to include, in the envisaged scenarios, aerial robots which balance adequately control simplicity, power and payload autonomy;

Provide means to extend and upgrade the capabilities of the existing RIOL prototype and future evolutions of the concept

Upgrade/repair the existing RAPOSA land robot, namely replacing damaged mechanical parts of the articulated frontal body and docking mechanism, replacing all electronic boards by lighter and smaller SMD boards, upgrading the motherboard processor for enabling onboard computer vision, and new LiPo batteries for increased autonomy.

Here you can find the information submitted for each of the Research Groups.

[Information accessed: 12-01-2009 17:05:03 on www.fct.mctes.pt]

[FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Research Group Information

(RG-LVT-Lisboa-750009-3508)

Designation: VisLab - Computer and Robot Vision Laboratory

Principal Investigator: Jose Alberto Rosado Santos Victor

Location of Group: Instituto Superior Técnico - Universidade Técnica de Lisboa

Keywords: Computer and Robot Vision ,Cognitive Systems ,Humanoid Robots ,Bio-inspired vision and robots

Funding, sources, dates

- 400K€, SYSNET – Equipment, Aug05-Mar07, Theme B [VisLab +LRM +ISLab, IN+]
- 160K€, MIRROR – Mirror Neurons for Recognition, EU-FET-2000-28159, Sep01 – Sep 04.
- 594K€, ROBOT-CUB - ROBotic Open-architecture Technology for Cognition, Understanding, and Behaviour, EU- IST-2004-004370, Sep04 – Aug09.
- 380K€, CONTACT - Learning and Development of Contextual Action, EU- NEST-5010, Sep05–Aug08.
- 189K€ CAVIAR - Context Aware Vision using Image-based Active Recognition, IST-2001-37540, Oct02 – Sep05.
- 237K€, URUS - Ubiquitous Networking Robotics in Urban Settings, FP6-EU-IST-045062, Dec06– Nov09 [+ ISLab – and MRL under Theme B]
- 24K€ OMNISYS - Omnidirectional Vision for Navigation and Control, POSI/SRI/41506/2001, Sep02 – Aug05.
- 70K€ 3D Modeling from Video, FCT-POSI/SRI/34121/2000, 2001-2003.
- 138K€, DIG3D- Sistema Óptico de Digitalização Tridimensional para a Indústria de Moldes, POSI, Medida 1,3 Sep03-Dec05.
- 22K€, INTELTRAF – Monitorização Automática do Fluxo de Trânsito Automóvel e Detecção de Acidentes e Avarias em Auto-Estradas, POSI 1.3, Sep03–Oct 05.
- 25K€, VEMUCARV – Spatial validation of complex urban grids in virtual immersive environments, POCTI/AUR/48123/2002, May05–June08.
- 31K€, GESTINTERACT: Gesture Interpretation for the Analysis of Interactions Humans/Robots/Humans, FCT - POSI/EEA-SRI/61911/2004, Sep05–Aug08.
- 89K€, BIOLOOK: Biomimetic Oculomotor Control for Humanoid Robots, FCT - PTDC/EEA-ACR/71032/2006, Oct.07-Sep.2010.
- 80K€, MMCACC: Advanced Monte Carlo Algorithms for Computational Control, FCT - PTDC/EEA-ACR/ 70174/2006, Sep.07–Aug.10

[Information accessed: 12-01-2009 17:05:03 on www.fct.mctes.pt]

[FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Group Team

List of Researchers in the Group:

001. Joao Paulo Salgado Arriscado Costeira (**Cat.:** Professor Associado **Gr. Acad.:** Doutoramento)
002. Jose Alberto Rosado Santos Victor (**Cat.:** Professor Associado **Gr. Acad.:** Agregação)
003. Alexandre Jose Malheiro Bernardino (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)
004. Jose Antonio da Cruz Pinto Gaspar (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)
005. Luis Montesano (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)
006. Manuel Fernando Cabido Peres Lopes (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)
007. Giampiero Salvi (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Doutoramento)

List of Collaborators (w/PhD):

001. Francisco António Chaves Saraiva de Melo (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Doutoramento)
002. Nuno Ricardo Estrela Gracias (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Doutoramento)

List of Collaborators (w/o PhD):

001. Bruno Duarte Damas (**Cat.:** Assistente **Gr. Acad.:** Mestrado)
002. Cláudia Alexandra Magalhães Soares (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Mestrado)
003. Daniela Filipa Gonçalves Pamplona (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Mestrado)
004. Giovanni Saponaro (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Bacharelato)
005. Hugo Ricardo de Sousa Alves (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Mestrado)
006. Jonas Ruesch (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Mestrado)
007. Júlio Manuel Pires Gomes (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Mestrado)
008. Karl Jonas Patrik Hornstein (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Mestrado)
009. Luis António Bento Paulino Vargas (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Mestrado)
010. Manuel Ricardo de Almeida Rodrigues Marques (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Mestrado)
011. Matteo Taiana (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Mestrado)
012. Pedro Canotilho Ribeiro (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Licenciatura)
013. Plinio Moreno López (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Mestrado)
014. Ricardo Daniel Rita Beira (**Cat.:** Não aplicável (boseiro) **Gr. Acad.:** Mestrado)

015. Ricardo Jorge dos Santos Ferreira (Cat.: Não aplicável (bofeiro) Gr. Acad.: Mestrado)
016. Ricardo Vicente Raposo Crespo de Oliveira (Cat.: Não aplicável (bofeiro) Gr. Acad.: Mestrado)
017. Ricardo Jorge Duarte Nunes (Cat.: Outra Gr. Acad.: Ensino Secundário)

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Objectives & Achievements

Objectives:

The ultimate goal of our research is twofold: understanding (natural and artificial) vision and building systems/applications that "see". This research agenda requires a multidisciplinary approach, combining science, engineering, computer science, neuroscience, physiology and psychology, to name a few.

Through vision, one perceives the three-dimensional world encoded in two dimensional surfaces. Hence one of the key questions is that of understanding the underlying geometry, to develop image processing methods, parameter estimation, etc. Such an effort encompasses research in 3D reconstruction from video, video tracking, image matching, camera modelling/design, feature extraction, object recognition and categorization, etc.

Understanding vision requires going beyond geometrical modelling. As current technology affords researchers with unique possibilities in terms of processing power and storage, the vision community is now exploring massive amounts of data for extracting useful information from images. One example is detecting events from video, e.g. human activity recognition. Understanding this type of events requires working with camera networks and to develop innovative calibration and tracking techniques as well as learning and adaptation over time and to different contexts. Another challenging aspect in this domain is the balance between bottom-up and top-down processes concurring for a specific visual routine. How much does context bias the solution of a given problem and to what extent can visual understanding be purely data driven?

Can vision be addressed separately from other processes? We know that human infants for instance learn about objecthood not only through vision information but also by interacting with the physical world. Hence, the analysis or synthesis of vision systems whose ultimate purpose is to understand the world and/or allow an embodied system to act, implies a much more general analysis than thinking about vision alone. That is the case of e.g. human(oid)s where vision and learning are studied together with motor control, attention, interaction and other cognitive processes, which is one of the strong research lines in the laboratory.

Most of this research is carried out in the context of large-scale multidisciplinary international projects.

Main Achievements:

The work at VisLab includes the development of new methodologies and applications (a source for new challenges) in a multidisciplinary approach with close links to biology, neuroscience or psychology. The lab has been involved in large-scale, ambitious projects with international partners (e.g. EU). The group regularly hosts international post-doc, doctoral or visiting students.

Some of the main achievements over the past few years are listed below:

Feature selection and object recognition – We have developed models for feature detection and selection based on Gabor filters, whose responses resemble that of cells in the human visual system.

(Omnidirectional) camera design and camera networks – We proposed new designs for the geometry of omnidirectional cameras, yielding simplified image properties or observation geometries. This approach includes the fusion/analysis of information between multiple (heterogeneous) cameras.

3D Matching and reconstruction - Imposing world rigidity as a prior model, we developed a multi-view matching algorithm, producing pixel assignments among images. By introducing a multidimensional assignment structure we were able to tackle this combinatorial problem in an efficient way.

Human activity analysis - computer vision systems can now go beyond geometry & tracking and provide an interpretation of the observed scenes. We developed learning approaches for recognizing human activity from video in different scenarios.

Anthropomorphic robotic platforms – We designed several anthropomorphic robots, including the head of the iCub, the most sophisticated humanoid robot currently under development that will be duplicated and used world wide.

Computational Neuroscience –We developed a model for action recognition using motor information and visuomotor maps, supporting the hypothesis that action execution and (visual) recognition are performed by the same brain circuitry, as suggested by the discovery of the mirror neurons in the primate's brain.

Motor learning and developmental robotics – Inspired after the cognitive and motor development of human infants, we provided models and an implementation for the different stages of development of a humanoid robot: sensorimotor coordination, learning about objects and interaction with humans.

Modelling object affordances – we developed a stochastic model that captures the interplay between observed objects, actions and action outcomes, used for learning in humanoid robotics.

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Group Productivity

Publications in peer review Journals (3000 ca.) (Up to a max of 10. Always indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (nº C=). Give title and full citation in original language. DO NOT translate)

[LV07] M. Lopes, J. Santos-Victor, "A Developmental Roadmap for Learning by Imitation in Robots", IEEE Transactions on Systems, Man and Cybernetics, Part B: Cybernetics, Vol.37, No.2, April 2007

[OXC07] R. Oliveira, J. Xavier,JP Costeira, Multi-view correspondence by enforcement of rigidity constraints , Image and Vision Computing Vol: 25 Issue: 6 pp: 1008-1020 Elsevier, June 2007.

[MNBV06] J. Melo, A. Naftel, Alexandre Bernardino, José Santos-Victor, "Detection and Classification of Highway Lanes Using Vehicle Motion Trajectories", IEEE Transactions on Intelligent Transportation Systems, Vol. 7, Issue 2, 2006.

[BV06] A. Bernardino, J. Santos-Victor, "Fast IIR Isotropic 2D Complex Gabor Filters with Boundary Initialization", IEEE Transactions on Image Processing, Vol. 15, Issue 11, pp. 3338-3348, 2006.

[CVR06] R. Carelli, J. Santos-Victor, F. Roberti, S. Tosetti, "Direct visual tracking control of remote cellular robots", Journal of Robotics and Autonomous Systems, Elsevier, 54, pp. 805-814, 2006.

[MMV06] J. Minguez, L. Montano, José Santos-Victor, "Abstracting Vehicle Shape and Kinematic Constraints from Obstacle Avoidance Methods", Autonomous Robots, Vol. 20, pp. 43-59, 2006.

[GV05] E. Grossmann and J. Santos-Victor, "Least-squares 3D reconstruction from one or more views and geometric clues", Computer Vision and Image Understanding, vol 99, no 2, Pages 151-174, August 2005.

[LV05] M. Lopes and J. Santos-Victor, "Visual Learning by Imitation With Motor Representations", In IEEE Transactions on System Man and Cybernetics - Part B: Cybernetics, vol 35, no. 3, June 2005.

[GZBV03] N. Gracías, S. van der Zwaan, A. Bernardino, J. Santos-Victor, "Mosaic Based Navigation for Autonomous Underwater Vehicles", IEEE Journal of Oceanic Engineering, October 2003.

[MC03] J. Maciel and J. P.Costeira, "A Global Solution to Sparse Correspondence Problems", IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol. 25 (2), February 2003.

For a complete list of publications and PDF downloading please check

<http://vislab.isr.ist.utl.pt/publications.html>

Internationalization (2000 ca.) (Collaborative publication, Research, Graduate Training Networks or other forms of participation of the Research Group at the international level)

- International students

- o POST-DOC

- o V.Traver, F. Pla, U. Jaume I, ES, 2003, 2004.

- o Ph.D (8)

- o R.Vassallo, R.Freitas, U. Fed. Espirito Santo, BR, 2003-2004, 2004-06

- o C.Deccó, U. São Paulo, BR, 2003

- o J.Ruesh, U. Zurich, CH, Jun-Jul 2007

- o S.Noje, U. Cali, CO, 2005-2006

- o L.Montesano, U. Zaragoza, ES, 2004

- o M.Marín, U. Granada, ES, Jul-Oct 2006

- o M.Sc

- o V.Krunic, U.Belgrade, CS, Oct 2007-

- o J.Perez, U. Jaume I, ES, 2004-2005

- o J.Grande, U. Jaume I, ES, 2006

- o Matteo Tajana, Politecnico Milano, IT, 2006-2007

- o Lorenz Gerstmayr, U. Tübingen, DE, 2004

- o M.Sc Summer internship

- o Jorge Peña, UPM, ES, 2007

- o Bartosz Tworek, U.Tech. & Science Krakow, PO, 2007

- o Jurgen Leitner, U.Vienna, AT, 2007

- o Miguel Realpe, ESPOL, Guayaquil, EC, 2005-06

- o B.Sc.

- o Vaibhav Bansal, IIT Guwahati, IN, May-Jul 2006

- o Anshul Sao, IIT Karagphur, IN, May-Jul 2006

- Partners in International Projects

- o U.Vancouver (CA), EPFL, ETH-Zurich, U. Zurich (CH), UPC, U.Seville, U.Zaragoza, (ES), CNRS/LAAS, INRIA (FR), SSSA, U. Ferrara, U. Genova (IT), U. Uppsala U. Stockholm, (SE) , U. Edinburgh, U.Hertfordshire, U.Salford, U. Surrey (UK);

- o RoboTech, Telerobot S.r.l. (IT), Urban Ecology, Telefónica (ES),

- Invited talks abroad:

- o Annual Meeting Brazilian Societies Experimental Biology, São Paulo, BR, 2005.

- o CEDI – Spanish Congress Informatics, Granada, ES, 2005.

- o X Simposio de Señales, Imágenes y Visión Artificial, U. del Valle, Cali, CO, 2005 (videoconf.).

- o AERFAI Summer School Action and Object Classification Techniques in Digital Images, Granada, ES, 2006.

- o AMDO-Conf. Articulated Motion and Deformable Objects, Andratx, Mallorca, 2006.

- o EU-Cognition: General Meeting, Munich, DE, 2007.

- TC memberships, Editorial Boards, other boards of scientific organizations:

José Santos-Victor

- o National Delegate, Aurora Board of Participants (ESA)

- o Associate Editor, IEEE T. Robotics.

- Journal reviewing:

- o Adaptive Behavior,

- o Advanced Robotics,

- o Autonomous Robots,

- o IEEE T. Biomedical Eng, Circuits and Systems, Circuits and Systems for Video Technology, Image Processing,

- Intelligent Transportation Systems, PAMI, Robotics, Robotics & Automation, Signal Processing, System Man & Cybernetics.

- o Intl. Journal Comp. Vision

- o Intl. Journal Humanoid Robotics

- o Real-Time Imaging

o Robotics & Auton. Systems

o Pattern Analysis & Applications

o Signal Processing

• Foreign thesis and projects reviewing

PhD Thesis Committee (12)

o Roland Bunschoten, U. Amsterdam, NL, 2003

o Xavier Lladó, Radu Orghidan, U. Girona, ES, 2004, 2006.

o Raquel Vassallo, U. Fedl Espírito Santo, BR, 2004

o Anthony Remazeilles, Nicolas Mansard, U. Rennes, FR, 2004, 2006.

o Diego Ortin, Luis Montesano, U. Zaragoza, ES, 2005, 2006

o Jaume Vergès, Teresa Vidal, U. Politecnica Catalunya, ES, 2005, 2007

o Toon Goedemé, K.U. Leuven, BE, 2006.

o Chen Xin, U. Macau, 2007.

Project Reviewing/Evaluation

o José Santos-Victor – Evaluator, EU-FET Project Proposals.

• Misc.

o Participation in the CMU-Portugal proposal

o IST-EPFL Joint Doctoral initiative, Focus Area “Distributed and Cognitive Robotics”.

o ATHENS Course, Robotics, Learning, Vision.

Other publications National (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

[AV06] G. Almeida, José Santos-Victor, Pedro Lima, “Controlo de um Manipulador Robotico Usando Visão”, Robótica, No. 62, 2006.

[RVGV06] M. Realpe, B. Vintimilla, J. Gaspar, J. Santos-Victor, “Localización y Mapeo Simultáneo con Imágenes 3D a Color” (in Spanish), Revista Tecnológica ESPOL, Vol. 19, N. 1, 99-106, (Oct, 2006)

[RGV07] L. Ruivo, J. Gaspar, J. Santos Victor, “Mosaicing the Interior of Tubular Shapes: 3D-model Fitting”, Proc. of RecPad 2007 - 13ª Conferência Portuguesa de Reconhecimento de Padrões, Lisbon, Portugal, 2007

[VG07] J. Vitorino, J. Gaspar, “Panoramic Mosaics Minimizing Overlappings in the Azimuthal Field-of-View”, Proc. of RecPad 2007 - 13ª Conferência Portuguesa de Reconhecimento de Padrões, Lisbon, Portugal, 2007

[FX06] R. Ferreira, J. Xavier, “Hessian of the Riemannian squared-distance function on connected locally symmetric spaces with applications”, Proc. Control2006 - 7th Portuguese Conference in Automatic Control, special session on control, optimization and computation, Lisbon, Portugal, 2006

[FB06] J. Ferreira, A. Bernardino, “Acquisition of 3D Regular Prismatic Models in Urban Environments from DSM and Orthoimages”, Symposium on Computational Modelling of Objects Represented in Images: Fundamentals, Methods and Applications, Coimbra, Portugal, October 2006.

[GFBC04] R. Garcia, M. Farracha, A. Bernardino, J. Costeira, “Recognition and Reconstruction of tri-dimensionsl objects within urban meshes”, VIRTUAL (ISSN:0873-1837) – special edition on “Advances in Computer Graphics in Portugal”, 2004

[GFBC03] R. Garcia, M. Farracha, A. Bernardino, J. Costeira, “Identificação e reconstrução 3D de objectos numa malha urbana através de nuvens de pontos georeferenciados”, Actas do 12º Encontro Português de Computação Gráfica (EPCG), Porto, Outubro 2003

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<http://vislab.isr.ist.utl.pt/publications.html>

Other publications International (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

[LMBV07] L. Montesano, M. Lopes, A. Bernardino, J. Santos-Victor, “Affordances, development and imitation”, IEEE - International Conference on Development and Learning (ICDL'07), London, UK, July, 2007

[TGNB07] M. Tajana, J. Gaspar, J. Nascimento, A. Bernardino, “On the Use of Perspective Catadioptric Sensors for 3D Model-Based Tracking with Particle Filters”, 2007 IEEE/RSJ International Conference on Intelligent Robots and Systems, San Diego, USA, October 2007

[RMV07] P. Canotilho Ribeiro, P. Moreno and J. Santos-Victor, “Boosting with temporal consistent learners: an application to human activity recognition”, 3rd International Symposium on Visual Computing, Lake Tahoe, Nevada, USA, 2007

[MLVC06] N. Mansard, M. Lopes, J. Santos-Victor, F. Chaumette, “Jacobian Learning Methods for Tasks Sequencing in Visual Servoing”, Proc. IROS2006 - IEEE/RSJ International Conference on Intelligent Robots and Systems, Beijing, China, October 2006.

[OFC06] R. Oliveira, R. Ferreira, J. Paulo Costeira, “Optimal Multi-Frame Correspondence with Assignment Tensors”, Proc. ECCV 2006 – 9th European Conference on Computer Vision, Graz, Austria, 2006

[HLVL06] J. Hörnstein, M. Lopes, J. Santos-Victor, F. Lacerda, “Sound localization for humanoid robots - building audio-motor maps based on the HRTF”, Proc. IROS2006 - IEEE/RSJ International Conference on Intelligent Robots and Systems, Beijing, China, October 2006.

[BLPVBBS06] R. Beira, M. Lopes, Miguel Praça, J. Santos-Victor, A. Bernardino, G. Metta, F. Becchi, R. Saltarén, “Design of the Robot-Cub (iCub) Head”, Proc. ICRA2006 - IEEE International Conference on Robotics and Automation, Orlando, USA, May 2006.

[RV05] P. Ribeiro and J. Santos-Victor, “Human Activity Recognition from Video: modeling, feature selection and classification architecture”, HAREM 2005 - BMVC Workshop on Human Activity and Modelling, Oxford, UK, September 2005.

[OCX05] R. Oliveira, J. Costeira and J. Xavier, “Optimal Point Correspondence through the Use of Rank Constraints”, CVPR - IEEE Conference on Computer Vision and Pattern Recognition, San Diego, USA, June 2005.

[LV03] M. Cabido Lopes, J. Santos-Victor, “Visual Transformations in Gesture Imitation: what you see is what you do”, ICRA - IEEE International Conference on Robotics and Automation, Taiwan, September 2003.

For a complete list of publications and PDF downloading please check

Master and Ph.D. thesis completed (3000 ca.)

PhD

Title: A Developmental Roadmap for Learning by Imitation in Robots

PhD Student: Manuel Lopes

Advisor: José Santos-Victor

Conclusion: May 2006

Title: Uso de Mapeamentos Visuomotores com Imagens Omnidireccionais para Aprendizagem por Imitação em Robótica

PhD Student: Raquel Frizera Vassallo

Advisor: José Santos-Victor

Conclusion: Setembro 2004

Title: Binocular Head Control with Foveal Vision : Methods and Applications

PhD Student: Alexandre Bernardino

Advisor: José Santos-Victor

Conclusion: April 2004

Title: Mosaic-based Visual Navigation for Autonomous Underwater Vehicles

PhD Student: Nuno Gracias

Advisor: José Santos-Victor

Conclusion: June 2003

Title: Omnidirectional Vision for Mobile Robot Navigation

PhD Student: José Gaspar

Advisor: José Santos-Victor

Conclusion: May 2003

MASTERS

Title: Mechanical Design of an Anthropomorphic Robot Head

Master Student: Ricardo Beira

Advisor: José Santos-Victor

Conclusion: Dec. 2007

Title: Recognizing speech with anthropomorphic Models for Voice Synthesis: applications to humanoid robots

Master Student: Cláudia Soares

Advisor: Alexandre Bernardino

Conclusion: Nov. 2007

Title: 3D model-based tracking with one omnidirectional camera and particle filters

MasterrStudent: Matteo Taiana (IST & Politecnico di Milano)

Advisor: Alexandre Bernardino

Conclusion Oct. 2007.

Title: PREDGRAB - Predição de Trajectórias de Alvos Móveis - Aplicação ao controlo de um braço robot.

Master Student: Paulo Carreiras

Advisor: Alexandre Bernardino

Conclusion: Set. 2007.

Title: Stereo Reconstruction of a Submerged Model Breakwater and Interface Estimation

Master Student: Ricardo Ferreira

Advisor: João Paulo Costeira

Conclusion: April 2006

Title: Visual Tracking of Articulated Objects: an application to the Human Hand

Master Student: Ricardo Marranita

Advisor: José Santos-Victor

Conclusion: November 2005

Title: Um Sistema de Realidade Aumentada sem Calibração

Master Student: Alpeshkumar Narotam Ranchordas

Advisor: José Santos-Victor

Conclusion: June 2004

Title: Controlo de um Manipulador Robótico Usando Visão

Master Student: Maria da Graça Vieira de Brito Almeida

Conclusion: September 2004

For a complete list of M.Sc. and Ph.D. theses and downloading the dissertations please see

<http://vislab.isr.ist.utl.pt/theses.html>

Patents/protopypes (2000 ca.)

- **BALTAZAR:** With the purpose of conducting research in several aspects concerning vision, learning and cognition, we have designed and built a humanoid robot torso, consisting of a binocular head and an articulated arm/hand. It is composed of a total of 19 motors and 25 degree of freedom (some underactuated). In addition to cameras, the robot is equipped with force/torque, inertial and auditory sensors.
- **iCub Robot:** The iCub is the humanoid robotic platform being developed in the context of the EU Project RobotCub. It is the most complete humanoid robotic platform being developed worldwide. In the consortium there will be platforms available at the University of Genova, VisLab/ISR/IST and EPFL. The robot has the proportions of a 3-year old infant, contains 54 degrees of freedom and will be able to crawl and do fine object manipulation.
- **iCub Head (2):** In addition to the work in vision, learning and cognition, the VisLab/ISR team was responsible for the design of the head, now being used in Italy, Switzerland and Japan. The head is the most sophisticated with this size worldwide, in terms of sensors (inertial, cameras, audition) and degrees of freedom (6).
- **Vizzy** is a mobile humanoid platform being designed at VisLab/ISR. It will have two articulated arms/hands a binocular agile head and will be mounted on a mobile basis, this being able to explore the environment. The mechanical part is built and the electronics are currently being integrated. This platform has already attracted the attention of other research groups who would be interested in having a similar platform/head.
- **TOBII System:** Gaze tracking system that allows measurements of the human gaze direction. This setup is used for research in human visual attention.
- **Mobile robots:** the Lab is equipped with several mobile platforms (LabMate, Pioneer) where different cameras have been installed.
- **Cameras:** we have designed a number of omnidirectional catadioptric cameras with the aim of obtaining specific, pre-specified image formation properties.

Organization of conferences (2000 ca.)

General Chair/co-chair

José Santos-Victor:

- RoboCup Symposium 2004 co-chair, Lisboa, PT, June 2004
- HAREM'2005, Oxford, UK, September 2005
- ECCV, Prague, CZ, May 2004, Area-Chair.
- 6th IEEE PETS2004, Prague, CZ, May 2004, Co-Chair.
- IEEE Wshop Omnidirectional-Vision, Madison, WI, US, June 2003.
- ICAR, Coimbra, PT, May 2003. Session on Vision

International Organizing Committee - Member

A. Bernardino, J.P. Costeira, J. Santos-Victor

- IAV2004, - 5th Symp. Intelligent Autonomous Vehicles, IST Jul 2004.

A. Bernardino, M.Lopes, J.Santos-Victor

- 4th Intl. Symposium on Imitation in Animals and Artifacts, AISB'07 Convention, Newcastle upon Tyne, UK, April 2007.

J.P. Costeira

- 2nd Iberian Conf. on Pattern Recognition and Image Analysis

International Program Committee - Member

A. Bernardino:

- Intl. Symp. Imitation in Animals & Artifacts, AISB'07 Convention, UK, April 2007.
- Intl. Conf. Image Analysis & Recognition, ICIAR, 2006, 2007
- Intl. Conf. Computer Vision Theory & Applications, VISAPP, 2007, 2008
- Intl. Conf. Epigenetic Robotics: Modeling Cognitive Development in Robotic Systems, EPIROB, 2005, 2006
- HAREM – BMVC Wshop Human Activity Recognition & Modelling, Oxford, UK, Sep 2005

José Santos-Victor

- IEEE Intl. Conf. Robotics and Automation, ICRA 2005-2007.
- IEEE Conf. Computer Vision and Pattern Recognition, CVPR 2004-2007.
- IEEE ICIAR 2006, Intelligent Robots and Systems, IROS 2006, 2007.
- IEEE Intl. Workshop Performance Evaluation of Tracking and Surveillance, VS-PETS, 2004, 2005.
- European Conference on computer Vision, ECCV, 2004, 2006
- Robotics: Science and Systems 2006.
- HAREM Intl. Wshop human Activity Recognition and Modeling, Oxford, UK, Sept 2005.
- 5th Wshop on Omnidirectional Vision, Camera Networks and Non-classical cameras, Omnivis, Prague, May 2004.
- IFAC Symp. Intelligent Autonomous Vehicles, IAV2004, Lisbon, June 2004.
- RoboCup Symposium, ROBOCUP2004, Lisbon, June 2004.
- British Machine Vision Conference

João Costeira

- European Conference on Computer Vision ECCV 2004-2006
- International Conf. on Image Analysis and Recognition ICIAR 2006-2007

Luis Montesano

- Robotics: Science and Systems 2006.

Industry contract research (2000 ca.)

Over the years, students of the lab have been involved in startup companies: (i) Observit is a company working in video surveillance and (ii) Reverse that is working in 3D sensing with stereo and active illumination.

The lab has been involved in several projects aiming and the transfer of technology through projects, funded by the portuguese Innovation Agency (AdI), in consortia with companies, including those spinoff companies created by the VisLab former students.

INTELTRAF: This project was developed together with BRISA SA, the main highway operator and owner in Portugal and Observit, a startup company. The goal of the project consisted in developing intelligent highway surveillance systems with the capability of tracking cars, detecting abnormal maneuvers and measuring traffic statistics.

DIG3D was developed together with Iberomoldes, a major player in the mould industry and Reverse, with the goal of developing a system for 3D reconstruction for the manufacturing industry.

Government/Organization contract research (2000 ca.) (Include here work carried out by the group that resulted in a publication or report. Of particular importance are those involved in public policy advice)

Participation in the committee for the definition of the Portuguese Electronic Passport. Role: Scientific advising, definition of requirements and selection of the image capture device which produces de electronic face photo.

National delegate to the European Space Agency, Mars Exploration Program (AURORA).

[Information accessed: 12-01-2009 17:05:03 on www.fct.mctes.pt]

[FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Future Research

Objectives:

The research in the lab will take a holistic perspective toward the problems of computer and robot vision, with a strong multidisciplinary research. The following main lines of research will be pursued

a) Basic areas:

- Computer vision: we will carry on work on camera calibration, reconstruction, feature extraction, tracking and recognition.
- Camera Design and camera networks: investigate the design of special cameras, often with biological inspiration to meet specific image formation geometric properties. Camera networks can be seen as a generalization of such a framework where the image surface (plane) is no longer unique but, instead, results from a combination of multiple surfaces.
- Learning: having access to massive amounts of data (visual or from other sensors, actuators), we will develop learning methodologies for exploring these data

b) Networked robots and surveillance: the advent of ubiquitous sensing and generous computational and memory resources, have raised the interest of scenarios involving an infrastructure with networked cameras sensors and where robots may be part of the infrastructure and play the role of (powerful) mobile nodes (see the EU-Project URUS developed together with the MRLab and ISLab). In this context, research will be conducted in the following domain:

- Multi-camera calibration and tracking
- Detection of video events and human activity recognition from video.
- Gesture recognition and human-robot interfaces
- Navigation with a combination of proprioceptive (onboard) and exteroceptive information.

c) Cognitive Vision and Robots: for about 7 years now we have conducted multidisciplinary research in vision, robotics and cognition with international partners in neuroscience and developmental psychology. The lab will soon have two extremely rich and sophisticated experimental platforms: the iCub robot, developed in the context of the EU-Project Robotcub which is the most sophisticated humanoid robotic platform currently available worldwide and Vizzy, a humanoid torso-head developed in the VisLab. These platforms will potentiate research in many aspects related to cognition as well as the collaboration at a large scale with other groups and centers in Portugal or internationally. The following aspects will be object of research:

- Cognitive development and computational neuroscience
- Visual attention
- Sensorimotor coordination and motor learning
- Affordance-based learning, grasping and imitation
- Social interaction and communication

Part of this work will be done in collaboration with other groups at ISR in the context of the Thematic Area B. One idea to explore in the future is the creation of a training center in cognitive and humanoid robots to take advantage of the available resources (experimental platforms). Such center would allow the collaboration with other R&D units in Portugal who could plan for short-term visits to the lab to learn about operating such sophisticated systems and have some assistance as how to plan or run their own experiments or algorithms.

Similar efforts can be found internationally, e.g. the France-Japan Humanoid Robot Lab, based in Toulouse runs a HRP-2 humanoid robot that is used by research teams from all over France.

Finally, this effort would allow in contact the different groups in Portugal with interests in this area, providing a forum for discussing ideas as well as for conducting joint experiments

Funding, source, dates (indicate in full including amount of current and pending funding)

EU-Projects

- €748.546, HANDLE - Developmental pathway towards autonomy and dexterity in robot in-hand manipulation, EU-IP ICT-231640, Feb. 2009 – Jan 2013.
- €594,000, ROBOT-CUB - ROBotic Open-architecture Technology for Cognition, Understanding, and Behaviour, EU- IST-2004-004370, Sep 2004 – Aug 2009.

- €380.000, CONTACT - Learning and Development of Contextual Action, EU- NEST-5010, Sep 2005 – Feb. 2009.

- €237.043, URUS - Ubiquitous Networking Robotics in Urban Settings, FP6-EU-IST-045062, Dec 2006 – Nov 2009 [+ISLab and MRL – Theme B]

National Projects

- €89.058, BIOLOOK: Biomimetic Oculomotor Control for Humanoid Robots, FCT - PTDC/EEA-ACR/71032/2006, Oct. 2007 - Sep. 2010.

- €80.000, MMCACC: Advanced Monte Carlo Algorithms for Computational Control, FCT - PTDC/EEA-ACR/ 70174/2006, Sep. 2007 - Aug. 2010

- €25.000, VEMUCARV – Spatial validation of complex urban grids in virtual immersive environments, POCTI/AUR/48123/2002, May 2005 – June 2008.

- €30.940, GESTINTERACT: Gesture Interpretation for the Analysis of Interactions Humans/Robots/Humans, FCT - POSI/EEA-SRI/61911/2004, Sep 2005 – Aug 2008.

Previous publications in the area (5 in the last 5 years. If available you must indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language)

[MLBV08] L. Montesano, M. Lopes, A. Bernardino, J. Santos-Victor, Learning Object Affordances: From Sensory Motor Maps to Imitation, IEEE Transactions on Robotics, Special Issue on Bio-Robotics, Vol 24(1) Feb 2008

[GGO08] E. Grossmann, J. Gaspar and F. Orabona, Calibration from statistical properties of the visual world, European Conference on Computer Vision, Marseille, France, October 2008

[LV07] M. Lopes, J. Santos-Victor, "A Developmental Roadmap for Learning by Imitation in Robots", IEEE Transactions on Systems, Man and Cybernetics, Part B: Cybernetics, Vol.37, No.2, April 2007

IF= 1.353 (2007)

[MNBV06] J. Melo, A. Naftel, Alexandre Bernardino, José Santos-Victor, "Detection and Classification of Highway Lanes Using Vehicle Motion Trajectories", IEEE Transactions on Intelligent Transportation Systems, Vol. 7, Issue 2, 2006.

IF= 1.689 (2007)

[BV06] A. Bernardino, J. Santos-Victor, "Fast IIR Isotropic 2D Complex Gabor Filters with Boundary Initialization", IEEE Transactions on Image Processing, Vol. 15, Issue 11, pp. 3338-3348, 2006.

IF= 2.463 (2007)

Special Requirements (equipment, facilities, staff or other special needs essential to carry out the future research program)

The work done in the past few years was often carried out in the context of large EU grants that, in spite of being extremely demanding and competitive, provide the resources necessary for this type of multidisciplinary research. In order to consolidate the work developed so far and support the developments envisaged for the future the following human and material resources are necessary:

- Human resources:

It is vital to maintain and strengthen the size and quality of the involved research team. Some of the team members (both post-doctoral researchers and technicians) have been directly funded by EU project grants. To consolidate the structure, experience and know-how of the group; alleviate the pressure on fund raising and allow for long-term planning; we need additional funding for one post-doc researcher and two technicians to cover both SW and HW needs.

- Equipment

The re-equipment project allowed the construction of early humanoid-type platforms. The new platforms – iCub and Vizzy – were developed in the context of EU grants or internal funding. The creation of the training center will require additional spending in consumables (e.g. sensors, parts or other components) and the (full or partial) duplication of the experimental platforms that would be accessible to the community at large.

- Training costs:

to fully explore the potential of these special experimental platforms, it is important to organize training sessions/summer/winter schools, involving participants from national and international R&D units. Hence, securing funding for this type of activities will help developing the community in these domains as well as to give visibility to the area and R&D units involved.

These requirements represent a small but critical contribution to the overall effort, when considering both the development and component costs of the experimental platforms under consideration. These platforms are unique in Portugal and very few are available worldwide.

Here you can find the information submitted for each of the Research Groups.

[Information accessed: 06-11-2008 15:38:57 on www.fct.mctes.pt]

[FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Research Group Information

(RG-LVT-Lisboa-750009-3583)

Designation: Laboratory for Energy and Environmental Studies at IN+ Center for Innovation, Technology and Policy Research

Principal Investigator: Paulo Manuel Cadete Ferrao

Location of Group: Instituto Superior Técnico - Universidade Técnica de Lisboa

Keywords: Engineering systems ,Energy nd Environment ,Management of Technology ,Technology policy

Funding, sources, dates

PROJECT AREA FUNDING SOURCE DATES FUNDING(€)

Automobile Private companies and Ministry of Economy 2003 301,988

Residues Management Ministry of Environment 2003-2007 576,275

Product development Industrial Association of Aveiro and Min. of Economy 2003-2005 137,979

Fluid mechanics FCT 2003-2004 74,820

Forest Fires Ministry of Agriculture and Banks 2005-2007 119,901

Industrial Symbiosis Municipality of Chamusca and Ministry of Environment 2005-2007 190,000

Residues valorisation Regional Government of Azores 2006-2007 40,000

Industrial Ecology Tools European Union 2005-2007 36,000

FCT basic Funding FCT- Ministry of Science and Technology 2004-2007 275,269

Sustainable Energy Systems FCT- Ministry of Science and Technology 2007 200,000

Forest Carbon Balance European Union 2003-2007 205,200

TOTAL FUNDING 2,157,432

[Information accessed: 06-11-2008 15:38:57 on www.fct.mctes.pt]

[FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Group Team

List of Researchers in the Group:

001. Paulo Manuel Cadete Ferrao (**Cat.:** Professor Associado **Gr. Acad.:** Agregação)
002. Gabriel Paulo Alcantara Pita (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)
003. Tiago Morais Delgado Domingos (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)
004. Ana Sofia Luis Rodrigues (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)
005. Cristina Maria Marta Rosa Pedroso (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)
006. Gonçalo José Monteiro Marques (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)
007. joao Filipe Dias Rodrigues (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)
008. João Miguel de Oliveira Silva Parente (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)
009. Samuel Pedro de Oliveira Niza (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)
010. Tânia Alexandra dos Santos Costa e Sousa (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)
011. Christos Ioakimidis (**Cat.:** Ciência 2007 **Gr. Acad.:** Doutoramento)
012. Helena Margarida Guerra Pinheiro Vieira Reis (**Cat.:** Ciência 2007 **Gr. Acad.:** Doutoramento)

List of Collaborators (w/PhD):

(no researchers were found...)

List of Collaborators (w/o PhD):

(no researchers were found...)

[Information accessed: 06-11-2008 15:38:57 on www.fct.mctes.pt]

[FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Objectives:

The objective is to undertake multidisciplinary research aiming at developing and evaluating emerging and alternative complex engineering systems promoting sustainability, namely in terms of the needs to secure socio-economic development and the quality of the environment, creating a more prosperous and sustainable society. Enabling technologies were developed and assessed under a systems view, namely the analysis of advanced systems under the context of Industrial Ecology, the analysis of the global carbon bio-geochemical cycle and of material flows in the economy, including product and material life cycle management through reuse, remanufacturing, and recycling. Main research areas include:- Development of fundamental sustainability theory, linking thermodynamics, ecology and economics, - Environmental modelling,- Carbon cycle,- Eco-design for sustainability in industrial, domestic and agricultural applications,- Total life-cycle energy chain and environmental impact assessment,- Economic tools in environmental and sustainability assessment,- Flows of materials in the economy from raw-materials extraction to final integration in the natural environment,Energy systems: buildings and urban , -Carbon Capture and sequestration, - Environmental policy.

Main Achievements:

The activities developed within this topic were multidisciplinary, linking basic and applied research to technology development, and focused on the issues of sustainability, namely in terms of the needs to secure the quality of the environment, together with the management of energy resources and economic development.

In this context, the Laboratory of Environmental Systems has been able to:

- Development of the "National policy for Residues Management" in a close cooperation with the Ministry of the Environment, including the design and implementation of the national web portal for residues and the characterisation and analysis of a set of key indicators.
- Design and support the implementation of all the new and innovative companies for organizing products end-of-life take back and recycling, created as a result of national and EU laws, namely for products such as automobiles(Valorcar), electric and electronic products(Amb3E), lubricants(Sogilub), pesticide packaging(Valorfito) and tires(ValorPneu). This resulted in new business opportunities related with the environment.
- Promote the IST Design Studio, which aimed at strengthening research and education in engineering design to improve manufacturing competitiveness and innovation.
- Develop major methodologies and tools that bring together economy and environment in the assessment and the design of new products (Eco-design tools, in particular a new software) and new policies (e.g.: National Integrated framework for Residues Management, Hybrid Economic Input-Output-Life Cycle Assessment or Life Cycle Activity Analysis) (Amaral and Ferrão, 2006, Behrens et al., 2007).
- Develop a far indicator of environmental pressure, combining consumer and producer responsibility (Rodrigues and Domingos, 2008).
- Support entrepreneurial initiatives in Industrial Ecology in Portugal, such as the design of a variety of new companies aimed at recycling and further processing end-of-life products or the design and implementation of an Eco-Industrial park at Chamusca.
- Create a network for sustainability in Portuguese agriculture, comprising close to 100 farmers, occupying 0.7% of Portugal, and close to 30 partners, including universities, NGOs and private firms.
- Obtain significant results on carbon and water dynamics in forests and grasslands (Granier et al., 2007, Luyssaert, 2007, Pereira et al. 2007).
- Provide support to Portuguese public policy on the use of natural carbon sinks.
- Develop a formalised theory for organisms (Sousa et al., 2008).

[Information accessed: 06-11-2008 15:38:57 on www.fct.mctes.pt]

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Group Productivity

Publications in peer review Journals (3000 ca.) (Up to a max of 10. Always indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language. DO NOT translate)

Amaral, J., P. Ferrão (2006). Design for recycling in the auto industry: new approaches and new tools. *Journal of Engineering Design*, 17(5), 447-462. IF=0.844, n° C=3.

Behrens, A., Giljum, S., Kovanda, J., Niza S. (2007). The material basis of the global economy: Worldwide patterns in natural resource extraction and their implications for sustainable resource use policies. *Ecol. Econ.*, 64: 444 – 453. IF=1.549, n° C=0.

Ferrão, P., J. Amaral (2006). Assessing the economics of auto recycling activities in relation to European Union Directive on End of Life Vehicles. *Technol. Forecast Soc.*, 73, 277-289. IF=0.88, n° C=4.

Ferrão, P., P. Nazareth and J. Amaral (2006). Strategies for meeting EU end-of-life vehicles re-use/recovery targets. *J. Ind. Ecol.*, 10(4), 77-93. IF=1.962, n° C=1.

Dijkema, G.P.J., P. Ferrão, P.M. Herder and M. Heitor (2006). Trends and opportunities framing innovation for sustainability in the learning society. *Technol. Forecast Soc.*, 73, pp. 215-227. IF=0.88, n° C=2.

Granier, A.*, (...), J. Mateus, (...), Pita, J. et al. (2007), Evidence for soil water control on carbon and water dynamics in European forests during the extremely dry year: 2003. *Agr. Forest Meteorol.* 143, 123–145. IF = 2.323, n° C=12.

Luyssaert, S., (...), J. Mateus, (...), G. Pita, et al. (2007). The CO₂-balance of boreal, temperate and tropical forests derived from a global database, *Global Change Biol.* 13, 1–29. IF=4.786; n° C=1.

Pereira J.S., Mateus J.A., Aires L.M., Pita G., Pio C., David J. S., Andrade V., Banza J., David T. S., Paço T. A., Rodrigues A. (2007). Net ecosystem carbon exchange in three contrasting Mediterranean ecosystems – the effect of drought. *Biogeosciences*, 4, 791-802. IF = 2.813; n° C=3.

S. Niza and P. Ferrão (2006) "A transitional economy's metabolism: The case of Portugal". *Resources, Conservation and Recycling*, 46, pp.265-280. doi:10.1016/j.resconrec.2005.08.001 . IF=1.270; n°C=0

Canas, A., Ferrão, P. and Conceição, P. (2003) "A new environmental kuznets curve? Relationship between direct material input and income per capita: evidence from industrialized countries". *Ecological Economics*, 46 (2), pp.217-229. IF=1.549, n° C=11.

Other publications National (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

P. Ferrão, P. Ribeiro, P. Silva (2005). A ecologia industrial e a embalagem de produtos alimentares em Portugal". Celta Editores (441 páginas, 600 exemplares). ISBN: 972-774-213-0.

P. Ferrão, M. Águas (2004) "Energia e Ambiente", in: Engenharia em Portugal no Século XX. Coord. J. Brito, M. Rollo, M. Heitor. Dom Quixote.

A. Abrunhosa, I. Costa (2006) "Os desafios da Indústria Portuguesa de Calçado" in A Inovação e Produtividade na Indústria Portuguesa de Calçado, Centro Tecnológico do Calçado.

Ferrão, P., Ribeiro, P., Silva, P. (2004) "A ecologia industrial e a embalagem de produtos alimentares em Portugal". Celta Editores, Oeiras, 2005, 441 pp.

Ferrão, P., Niza, S. & Rosado, L. (2007) Matriz dos Materiais de Lisboa. Lisboa E-Nova – Agência Municipal de Energia-Ambiente de Lisboa. Câmara Municipal de Lisboa.

Ferrão, P., Ribeiro, P., Costa, I. (2004) "Os RSU em Portugal: Evolução num contexto Europeu". GoldenBook Resíduos Sólidos. Edição Ambiente Qualidade.

S. Cerasoli, E. Breia, J. Mateus, G. Pita, M. Chaves, J. Santos Pereira (2005) "Eficiência de Uso da Água e Discriminação para o ¹³C em Folhas de Eucalyptus Globulus", IX Congresso Luso-Espanhol de Fisiologia Vegetal, 18-21 Setembro de 2005; Évora, Portugal.

P. Correia (...), Pita, M. et al (2005) "Balanço de Carbono no Eucalipto: Comparação entre o Fluxo turbulento de CO₂ e a estimativa do modelo CO₂Fix V3.1", 5º Congresso Florestal Nacional, 2005; Viseu, Portugal.

R. Santos, H. Vilar (2005), "Property rights and agrarian contracts in Southern Portugal, 14th-20th centuries, XXV Conferência da APHES, Évora, Portugal.

A. Correia, (...), G. Pita et al. Influência das alterações climáticas na cultura do eucalipto: cenários possíveis. In "O Eucalipto em Portugal", Impactes Ambientais e Investigação Científica. Editores A. Alves, J. Pereira, J. Silva, ISA Press.

Other publications International (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

Santos, E., Ferrão. P., DfR and DfD Applied to Electrical and Electronic Equipments Resulting Environmental Life Cycle Performance – A Case Study for Portugal, Proceeding of Ecodesign 2005: 4th International Symposium on Environmentally Conscious Design and Inverse Manufacturing, Tokyo, December 2005

Mota, R., T. Domingos (2007). Welfare effects of green tax reforms in one sector and two sector dynamic economies. Proceedings of the 14th Ulvön Conference on Environmental Economics.

Panão, M., Gonçalves H., Ferrão, P. (2006). "Air Flow Exchange Velocity of Urban Canyon Cavities due to Thermal Spatial Differences". PLEA2006 - The 23rd Conference on Passive and Low Energy Architecture, Geneva, Switzerland.

Panão, M., Gonçalves, H., Ferrão, P. (2006). "Heating and Cooling Urban Structures Natural Capacity: Optimization of the Urban Layout" in Proceedings de HB 2006, Healthy Buildings, Vol. III, pp. 137-142. Lisboa, Portugal.

P. Ferrão (2006) "Economy's metabolism: Indicators, scales, and technology", in: Rethinking Science Systems and Innovation Policies. Edited by J. P. Contzen, D. Gibson and M.Heitor. Purdue University Press. (em edição).

Ribeiro, P., Niza, S., Ferrão, P. (2006). Material Flow Accounting and Waste Production Forecasting - A Tool for Decision Making, proceedings of the "9th International Conference on Technology Policy and Innovation, Science, Society and Sustainability", Santorini, Greece.

Ribeiro, P., Santos, Ferrão, P. (2007). Implementation of a WEEE management infrastructure in Portugal: technological and business challenges, Proceedings of The Fourth NIES Workshop on E-waste, National Institute for Environmental Studies (NIES), Tsukuba, Japan.

Rodrigues, J., T. Domingos (2007). The estimation of international inter-industry flows and embodied greenhouse gas emissions. Proceedings of the 16th International Input-Output Conference, Istanbul, Turkey.

Rodrigues, M.J., Ferrão, P. (2005) The Potential for GHG Emissions Reduction of Building-Integrated Photovoltaics – A Life Cycle Assessment Approach, Engineering Sustainability Conference, Pittsburgh, EUA.

Teixeira, R., T. Domingos, A. Simões, O. Rodrigues (2007). Local vs. global grain maize production: where should you get your maize from? Proceedings of the 7th International Conference of the European Society for Ecological Economics, Leipzig, Germany.

Master and Ph.D. thesis completed (3000 ca.)

PhD

Amaral, J. (2005). Ecodesign: o caso de estudo do automóvel (IST; supervision: P. Ferrão).

Horta, P. (2005), Concepção e modelação numérica de secador solar passivo para tratamento de efluente de processo de dessalinização (IST; supervision: P. Ferrão).

Niza, S. (2007). Uma avaliação do metabolismo da economia portuguesa através da contabilidade dos fluxos de materiais. (IST; supervision: P. Ferrão)

Sousa, T. (2007). Thermodynamics as a Substantive and Formal Theory for the Analysis of Economic and Biological Systems. (IST, Free University of Amsterdam; supervision: P. Ferrão, S. A. L. M., Kooijman).

Rodrigues, J. (2007). Environmental Responsibility: Theory and Measurement. (IST; supervision: T. Domingos).

Master

Santos, E. (2007). "Integration of Environmental Issues in Electrical and Electronic Product Design and Development: Environmental Improvement through Applied Ecodesign Strategies in the Context of Portugal" (IST; supervision: P. Ferrão).

Rosado, L. (2007). Learning from Public Use Bicycle Case Studies to Identify Main Design Guidelines for a Municipal Sustainable Mobility programme. (IST; supervision: P. Ferrão).

Costa, I. (2005): "O Ambiente como Factor de Inovação em Portugal: O Sector do Calçado", (IST; supervision: P. Ferrão, IST).

Nazareth, P. (2006), "Definição de uma estratégia industrial para o processamento de resíduos de fragmentação em Portugal" (IST; supervision: P. Ferrão).

Crespo, G. (2007). "Desenvolvimento de uma Bicicleta Assistida Electricamente" (IST; supervision: P. Ferrão, IST)

Teixeira, R. (2007), "Production of Reinforced Composites With Natural Fibers For Automotive Applications", (IST; supervision: P. Ferrão, IST)

Mota, R. (2008), Welfare and Sustainability Measures in Dynamic Economies: Green Accounting for Portugal 1992 – 2004 (ISEG; supervision: V. Martins, T. Domingos).

Valada, T. (2007). Análise ambiental e económica da afectação de área agrícola à produção de milho para bioetanol. (IST; supervision: T. Domingos, R. Teixeira).

Teixeira, R (2008), Economic Incentives for Carbon Sequestration in Grassland Soils: An Offer You Cannot Refuse. (ISEG; supervision: M. St. Aubyn, T. Domingos).

Patents/protopypes (2000 ca.)

Quadro de bicicleta reversível adaptável a diferentes configurações a partir da disposição e montagem ordenada dos componentes, Silva, L. Rosado, L., Crespo, G. Número, PT 103419, 12/01/2006, IST.

Organization of conferences (2000 ca.)

International Seminar – Portugal and UK - "Towards Sustainable Agriculture" and "Bioenergies" (together with the British Embassy), Instituto Superior Técnico, Lisboa, 29th November, 2007.

Workshop "Fostering Photovoltaic International Knowledge Networks", held in Centro Cultural de Belém, Lisboa, 23 November 2006.

"INDUSTRIAL ECOLOGY FOR A SUSTAINABLE FUTURE"

International Society For Industrial Ecology – Conference 2003

Ann Arbor, USA, June, 29th- July, 2nd, 2004.

8th SAC Seminar on "Bio-Fuels in Clean Power Production & Transport"

ISTC-International Science and Technology Center

Moscow, November 29th & 30th, 2005

Transatlantic Conference in Renewable Energies

A joint European Parliament and U.S.A. Senate conference

Terceira, Azores, December 8th & 9th, 2006

Industry contract research (2000 ca.)

“Formação Avançada – CEIIA”

IST, 2003/2005

Project Coordinator: Heitor, M. Ferrão, P.

Funding Agency: Centro para a Excelência e Inovação na Indústria Automóvel, de Engenharia e Desenvolvimento do Produto

FIVE - Implementação da fachada Fotovoltaica – Carris

IST, 2004/2005

Project Coordinator: Heitor, M. Ferrão, P.

Funding Agency: Companhia Carris de Ferro de Lisboa

“Deusa – Desenvolvimento Sustentável em Aveiro”

IST, 2003/2005

Project coordinator: Paulo Ferrão

External Partners: Abimota, AIDA, Aia, Apifer

Funding Agency: IAPMEI

“APCV”

IST, 2005/2005

Project coordinator: Paulo Ferrão

Funding Agency: Associação Portuguesa de Produtores de Cervejas

“Biotec – Biotecnologia e inovação na indústria portuguesa: estudo de oportunidades tecnológicas e de mercado”

IST, 2005/2006

Project coordinator: Paulo Ferrão and Nuno Arantes e Oliveira

External Partners: Associação Empresarial para a Inovação

Funding Agency: Associação Empresarial para a Inovação

“FATEC – Fábrica de Alta Tecnologia para a Fileira do Calçado”

IST, 2002/2005

Project Coordinator: Heitor, M. Ferrão, P.

External Partners: Centro Tecnológico do Calçado

Funding Agency: IAPMEI

“Formação Avançada - GALPENERGIA

IST, 2004/2005

Project Coordinator: Heitor, M. Ferrão, P.

External Partners: INTELI, Innovagency

Funding: GALPENERGIA

Evaluation and compensation of environmental impacts of EDP's electricity consumption receipts

Funding: EDP – Energias de Portugal (€13,500.00 in 2007).

Protocol IST/Ecoprogresso for the compensation of carbon emissions

Funding: Ecoprogresso (€1,500.00 + VAT).

Sustainability of irrigation agriculture in the Lezíria do Tejo and Vale do Sorraia regions

Funding: Ribatejo Farmers' Association (€6,000.00 + VAT in 2007).

Government/Organization contract research (2000 ca.) (Include here work carried out by the group that resulted in a publication or report. Of particular importance are those involved in public policy advice)

“INR 2004”

IST, 2004/2005

Project coordinator: Paulo Ferrão

External Partners: Instituto dos Resíduos

Funding: Instituto dos Resíduos

“UNESP – Contribuição das fibras naturais para o ecodesign automóvel”

IST, 2003/2006

Project coordinator: Paulo Ferrão

External Partners: UNESP – Universidade Paulista

Funding: GRICES/CAPES-2003

“Reequipamento IN+ - Promover uma agenda de investigação em sistemas, política tecnológica e ciências da gestão”.

IST, 2005/2006

Project coordinator: Paulo Ferrão

External Partners: Universidade Católica Portuguesa

Funding: Fundação para a Ciência e a Tecnologia

“INR 2005”

IST, 2005/2006

Project coordinator: Paulo Ferrão

External Partners: Instituto dos Resíduos

Funding: Instituto dos Resíduos

“BM Lisboa – Balanço de materiais do concelho de Lisboa”

IST, 2005/2006

Project coordinator: Paulo Ferrão

External Partners: Lisboa E-Nova

Funding: Lisboa E-Nova

FIVE – Observatório do QCA III

IST, 2005/2005

Project Coordinator: Manuel Heitor / Paulo Ferrão

External Partners: Observatório do QCA III.

Funding: Direcção do Desenvolvimento Regional

“EPI Chamusca”

IST, 2006/2006

Project Coordinator: Paulo Ferrão

Funding: Câmara Municipal da Chamusca/Comissão Coordenadora da Região de Lisboa e Vale do Tejo

Ex-Ante Evaluation and Strategic Environmental Evaluation of the Rural Development Plan 2007-2013.

Funding: Ministry of Agriculture. €82,330.00 +VAT (2006 and 2007). Dates: 2006-2007.

Internationalization (2000 ca.)

(Collaborative publication, Research, Graduate Training Networks or other forms of participation of the Research Group at the international level)

“Calcas”

IST, 2006/2008

Project Coordinator: Paulo Ferrão

Funding: Ente per le Nuove Tecnologie, L'Energia e L'Ambiente

[Information accessed: 06-11-2008 15:38:57 on www.fct.mctes.pt]

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Future Research

Objectives:

The future research activities will maintain the global objective of undertaking multidisciplinary research aiming at developing and evaluating emerging and alternative complex systems promoting sustainability, strengthening major areas under the global framework of ENGINEERING SYSTEMS:

- 1) Fundamental Sustainability Theory
- 2) Industrial Ecology
- 3) Sustainable Energy Systems
- 4) Sustainable Agricultural Systems
- 5) Carbon Sinks in Natural Systems

The main objectives for the future development of these areas are as follows:

1) FUNDAMENTAL SUSTAINABILITY THEORY

Work on the development of the fundamental theoretical tools for sustainability will continue, thermodynamics (Gibbs-Tisza-Callen formalism, finite-time thermodynamics and non-equilibrium thermodynamics), ecology (based on DEB – Dynamic Energy and Mass Budgets theory) and economics (standard neo-classical microeconomics and behavioural economics).

2) INDUSTRIAL ECOLOGY

Industrial Ecology will be developed to promote a holistic view of engineering systems which requires the development of a set of tools to bridge different scales, from site or product specific analysis to the whole economy and from the economic to the socio-environmental dimension, thus resulting in a multi-disciplinary set of analytical tools, the "Industrial ecology toolbox", whose development and extension will be a continuous goal for the future. These tools will be used to design and promote new policy instruments that may contribute to improve the environmental performance of products and services through their life-cycles, as well as more efficient Economic Metabolisms at different scales.

3) SUSTAINABLE ENERGY SYSTEMS

The future activities in this scientific domain are intended to promote leadership in sustainable energy systems, by promoting high level international scientific and industrial partnerships, with emphasis on:

- Energy Planning Including Economics

This research area will build upon energy and environment values and economic domains, at the level of energy systems analysis and design. This will be based on a strong modelling framework capacity, including the analysis of the dynamics of energy demand (behavioural economics theory) and of local and regional renewable energy resources.

- Sustainable Built Environment

Development of a spatially comprehensive and temporally broad physical accounting of resource consumption of urban centres, emphasising energy consumption in buildings and new and innovative solutions to promote the concept of "Sustainable Buildings".

4) SUSTAINABLE AGRICULTURAL SYSTEMS

Work on this area will continue the development of sustainability assessment in agriculture, and its application to public policy and farmer counselling.

5) CARBON SINKS IN NATURAL SYSTEMS

Work on carbon sinks in natural system will continue, analysing carbon dynamics in forests and grassland. This will be based on experimental work using carbon flux measurements (eddy-covariance) and direct measurements of carbon pools, and modelling work, using conventional models and DEB-based models.

Funding, source, dates (indicate in full including amount of current and pending funding)

Funding (2008): €49,927.00; source: European Commission; Dates: 2003-2008.

Funding (2008-2010): €97,956.00; source: FCT; Dates: 2007-2010.

Funding (2008-2010): €48,510.00; source: FCT; Dates: 2007-2010.

Funding (2008): €9,300.00; source: FCT; Dates: 2005-2008.

Funding (2007-2009): €12988 for the three years of the project. Source: FCT.

Previous publications in the area (5 in the last 5 years. If available you must indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language)

Amaral, J., P. Ferrão (2006). Design for recycling in the auto industry: new approaches and new tools. *Journal of Engineering Design*, 17(5), 447-462. IF=0.844, n° C=3.

Behrens, A., Giljum, S., Kovanda, J., Niza S. (2007). The material basis of the global economy: Worldwide patterns in natural resource extraction and their implications for sustainable resource use policies. *Ecol. Econ.*, 64: 444 – 453. IF=1.549, n° C=0.

Granier, A.*, (...), J. Mateus, (...), Pita, J. et al. (2007), Evidence for soil water control on carbon and water dynamics in European forests during the extremely dry year: 2003. *Agr. Forest Meteorol.* 143, 123–145. IF = 2.323, n° C=12.

Luyssaert, S., (...), J. Mateus, (...), G. Pita, et al. (2007). The CO₂-balance of boreal, temperate and tropical forests derived from a global database, *Global Change Biol.* 13, 1–29. IF=4.786; n° C=1.

Rodrigues, J., T. Domingos (2008). Consumer and producer responsibility: Two approaches. *Ecological Economics* 66(2-3): 533-546 (accepted 12.12.2007). IF=1.549; n° C=2.

Sousa, T., T. Domingos, S. A. L. M. Kooijman (2008). From empirical patterns to theory: A formal metabolic theory of life. *Philosophical Transactions of the Royal Society of London B* 363: 2453–2464. IF=5.529, n° C=0 (accepted 20.11.2007).

Special Requirements (equipment, facilities, staff or other special needs essential to carry out the future research program)

Here you can find the information submitted for each of the Research Groups.

[Information accessed: 06-11-2008 15:39:45 on www.fct.mctes.pt]

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Research Group Information

(RG-LVT-Lisboa-750009-3584)

Designation: Laboratory of Thermofluids, Combustion and Energy Systems, at IN+ Center for Innovation, Technology and Policy Research

Principal Investigator: Antonio Luis Nobre Moreira

Location of Group: Instituto Superior Técnico - Universidade Técnica de Lisboa

Keywords: Combustion ,Energy ,Pollutants ,Fluid mechanics

Funding, sources, dates

n/a70000€, "Advanced Intermittent Spray Cooling Systems"

Project PTDC/EME-MFE/69459/2006 sponsored by FCT (2007-2010)

70000€, "Dynamic behaviour of cryogen spray cooling"

Project POCTI/EME/57944/2004 sponsored by FCT (2005-2008)

50000€, "Fluid-Particle correlations in Non-homogeneous Turbulent Two-Phase Flows"

Project POCTI/2001/EME/38082 sponsored by FCT (2002-2005)

70000€, "Flow and heat transfer characteristics of evaporating impinging sprays"

Project POCTI/1999/EME/32960 sponsored by FCT (2001-2004)

10000€, DIME: "Direct Injection engine Spray Processes – Mechanisms to Improve Performance"

ENK6-CT-2000-00101 sponsored by FP5 (2000 – 2003)

134798€, FlexHeat- Flexible Premixed Burners for Low-Cost Domestic Heating Systems

INCO-FP6-2002- INCO-WBC -1

20000€, "MinKnock - Improving Engine Performance and Efficiency by Minimisation of Knock Probability".

Energie4-G2,Key Action 6, Contract No. ENK6-CT2002-00643.

152300€, "EUFIRESLAB: Euro-Mediterranean Wildland Fire Laboratory, a 'wall-less' Laboratory for Wildland Fire Sciences and Technologies in the Euro-Mediterranean Region" <http://www.eufirelab.org/> EVR1-CT-2002-40028

151700€, Fire Star: a decision support system for fuel management and fire hazard reduction in Mediterranean wildland urban interfaces - EVG1-CT-2001-00041 (2002 2004)

88500€, An innovative approach of integrated wildland fire management regulating the wildfire problem by the wise use of fire: solving the Fire Paradox - FP6-018505 (2006 2010)

14000€, 2001/2007... "PivNet 2 - A European collaboration on development, quality assessment, and standardization of Particle Image Velocimetry for industrial applications".EU Growth, Contracto No.

11725€, 2003/2007....-Investigação Experimental da Interação Vaporização / Radiação na Combustão de Combustíveis Líquidos. FCT/ POCTI/EME/45676/2002

60000€, " Desenvolvimento da técnica de quimiluminiscência para a detecção directa da composição de misturas de combustíveis em chamas laminares.

FCT- PDTC/EME/-MFE/68830/2006

55000€, "Chamas incidentes-modelação matematica e experimental do seu comportamento instável"

FCT-PDTC/EME-NFE/68829/2006

198649.35€, "Aether" Aertothermal Acoustic Instabilities, Marie Curie Program MRTN-CT-2006-035713-Aether

43500€, "Mobidays- Sustainable Mobility Days", TSA6-CT-2006-044602, UE

239000€, HOST-Human Orientated Surface Transport, CT-2005-12555

[Information accessed: 06-11-2008 15:39:45 on www.fct.mctes.pt]

[FCT - Avaliação de Laboratórios Associados 2008 | Form locked: False]

Group Team

List of Researchers in the Group:

001. Antonio Luis Nobre Moreira (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)

002. Edgar Caetano Fernandes (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)

003. João Miguel Pires Ventura (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)

004. José Miguel Carrusca Mendes Lopes (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)

List of Collaborators (w/PhD):

001. Sergei Shtork (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)

List of Collaborators (w/o PhD):

001. Miguel Rosa Oliveira Panao (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Mestrado)

002. Robert Edward Leandro (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Mestrado)

003. Teodoro Jose Pereira Trindade (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Mestrado)

004. Filipa Maria Sereno Ferro (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)

005. Nuno Manuel Rolo Creado (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)

[Information accessed: 06-11-2008 15:39:45 on www.fct.mctes.pt]

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Objectives & Achievements

Objectives:

The core goal of fundamental research is the innovation of new engineering concepts and is addressed as a driving force for new technologies. Fundamental research builds the scientific knowledge necessary to give function a sustainable and human-oriented form, thus harmonizing technology with the environment, at the same time that application studies chase the functionality of advanced technologies and their results (products and services) from a user perspective. In this context, research at the Laboratory of Thermofluids, Combustion and Energy Systems Design is aimed at improving knowledge in advanced fields of strategic technologies with emphasis on principles of thermodynamic transport phenomena. The final goal is to bring together multidisciplinary knowledge to develop new procedures and technologies, as well as to carry out research to gain the fundamental knowledge needed to solve new problems in the topic of system conversion energy.

The work essential covers the system optimization of input/output of energy and pollutant, ranging from large scale units to micro-systems with special emphasis on lean burning processes (for NOx control), ignition and instabilities aspects of flames, fundamentals of fluid atomization, enhanced heat transfer processes, and experimental and physical modelling of forest fire phenomena, covering interdisciplinary scientific fields, such as Thermal-fluid-dynamics, Combustion and Advanced Techniques for Flow Measurements, Control Engineering, Materials Engineering, Transport and Thermophysical Properties of Materials, Electronics and Microsystems.

The activities are organized on the basis of projects which provide the necessary external funding, namely from national and international funding agencies and/or private companies from which research areas emerge.

Main Achievements:

The work essential covered the system optimization of input/output of energy and pollutant, ranging from large scale units to more recently micro-systems with special emphasis on lean burning processes (for NOx control), ignition and instabilities aspects of flames, fundamentals of fluid atomization and enhanced heat transfer processes, covering interdisciplinary scientific fields. In general the main achievements can be resumed as

-International collaborative research – e.g. University of Rome, Belgrade, Imperial College of Science and Technology, Institute of Physics and Mathematics-Russia, and a large consortium (over 50 institutions) on forest fire research

-Publications in high score ranking journals and book chapters

-Active participation in large international symposia

-Invitation for keynote lectures (Moreira, Von Karman Institute Lecture series)

-International collaboration at the student graduation level (Graduation-University of Ancona/Italy)

-Research contracts with Industry on the special topics of Low NOx burner, flame ignition process and flame noise analysis (2008/...)

[Information accessed: 06-11-2008 15:39:45 on www.fct.mctes.pt]

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Group Productivity

Publications in peer review Journals (3000 ca.) (Up to a max of 10. Always indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language. DO NOT translate)

"Modeling and experimental validation of unsteady impinging flames" (2006), E.C. Fernandes and R.E. Leandro, Combustion and Flame, Volume 146, Issue 4, pp. 674-686. IF=2.184,NC=1

"Heat Transfer at Multiple-Intermittent Impacts of a Hollow Cone Spray" (2006) M. R. O. Panão and A. L. N. Moreira, Journal of Heat and Mass Transfer, Vol. 49, issues 21-22, Pages 4132-4151. IF=1.5,NC=

"Drop Impacts onto Cold and Heated Rigid Surfaces: morphological comparisons, disintegration limits and secondary atomization" (2007), A. S. H. Moita and A. L. N. Moreira, To appear in the International Journal of Heat and Fluid Flow (Available online 22 December 2006) IF=1.283,NC=

"Coherent structures in unsteady swirling jet flow" (2006), C. E. Cala, E. C. Fernandes, M. V. Heitor and S. I. Shtork, Experiments in Fluids, Volume 40, Number 2 / February, 2006, pp. 267 – 276. IF=1.259,NC=8

"Flow characteristics of spray impingement in PFI injection systems" (2005), M. R. Panão and A. L. N. Moreira. Experiments in Fluids, Vol. 39, No 2, pp. 364 - 374.

IF=1.259,NC=

"Experimental study of the flow regimes resulting from the impact of an intermittent gasoline spray" (2004), M. R. O. Panão and A. L. N. Moreira, Experiments in Fluids, 37, 834 – 855. IF=1.259,NC=

"Acoustically excited air-assisted liquid sheets" (2003), V. Sivadas, E. C. Fernandes and M. V. Heitor, Experiments in Fluids, Volume 34, Number 6, pp. 736 – 743. IF=1.259,NC=2

"Swirl Flow structure and flame characteristics in a model lean premixed combustion", (2003) P.M. Anacleto, E.C. Fernandes, M.V. Heitor and S.I. Shtork, Combust., Sci. and Technology, 175, 1369-1388 IF=0.984,NC=16

"A Tank-to-Wheel Analysis Tool for Energy and Emissions Studies in Road Vehicles" (2006), Silva C, Gonçalves G A, Farias T, and Mendes-Lopes J, Science of the Total Environment, Vol.367, Issue 1, Pages 441-447. IF=,NC=

"Flame characteristics, temperature-time curves, and rate of spread in fires propagating in a bed of Pinus pinaster needles" (2003), Mendes-Lopes J M C, Ventura J M P, and Amaral J M P, Int. J. Wildland Fire, Vol. 12, N. 1, pp. 67-84. IF=,NC=

Other publications National (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

"Modelo para simulação do consumo e emissões de veículos rodoviários" (2005), Silva CM, Farias T L, and Mendes-Lopes J M C. 4º Encontro Nacional do Colégio de Engenharia Mecânica. 2-4 Junho, 2005.

Enciclopédia Activa Multimédia, Editora Lexicultural, 2004: João Ventura, Autoria das entradas sobre a) Fogo florestal, b) Incêndios urbanos e c) Acidentes industriais graves.

"O Fogo como Processo Físico-Químico e Ecológico", cap. 4 in "Incêndios Florestais em Portugal

- Caracterização, Impactes e Prevenção", João Ventura e Maria J. Vasconcelos, ISA Press, 2006.

"Avaliação do Risco de Incêndio do Edifício Grandela na Situação Imediatamente Anterior ao Incêndio do Chiado" Ventura, J., I. Cabrita Neves e J. Valente, Actas do 1º Encontro Nacional de Riscos, Segurança e Fiabilidade, IST, 11-13 de Maio de 2005.

"Incêndios que Afectaram o Património Cultural Europeu nas Últimas Décadas, Actas do 1º Encontro Nacional de Riscos, Segurança e Fiabilidade", Valente, J.C., I. Cabrita Neves e J. Ventura, IST, 11-13 de Maio de 2005.

"Medidas de Segurança contra Incêndio do Património Cultural: um Método para a Quantificação da sua Eficácia e Identificação de Prioridades", Neves, I. Cabrita, J. Ventura e J. Valente, Actas do 1º Encontro Nacional de Riscos, Segurança e Fiabilidade, IST, 11-13 de Maio de 2005.

Other publications International (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

"Modelo para simulação do consumo e emissões de veículos rodoviários" (2005), Silva CM, Farias T L, and Mendes-Lopes J M C. 4º Encontro Nacional do Colégio de Engenharia Mecânica. 2-4 Junho, 2005.

Enciclopédia Activa Multimédia, Editora Lexicultural, 2004: João Ventura, Autoria das entradas sobre a) Fogo florestal, b) Incêndios urbanos e c) Acidentes industriais graves.

"O Fogo como Processo Físico-Químico e Ecológico", cap. 4 in "Incêndios Florestais em Portugal

- Caracterização, Impactes e Prevenção", João Ventura e Maria J. Vasconcelos, ISA Press, 2006.

"Avaliação do Risco de Incêndio do Edifício Grandela na Situação Imediatamente Anterior ao Incêndio do Chiado" Ventura, J., I. Cabrita Neves e J. Valente, Actas do 1º Encontro Nacional de Riscos, Segurança e Fiabilidade, IST, 11-13 de Maio de 2005.

"Incêndios que Afectaram o Património Cultural Europeu nas Últimas Décadas, Actas do 1º Encontro Nacional de Riscos, Segurança e Fiabilidade", Valente, J.C., I. Cabrita Neves e J. Ventura, IST, 11-13 de Maio de 2005.

"Medidas de Segurança contra Incêndio do Património Cultural: um Método para a Quantificação da sua Eficácia e Identificação de Prioridades", Neves, I. Cabrita, J. Ventura e J. Valente, Actas do 1º Encontro Nacional de Riscos, Segurança e Fiabilidade, IST, 11-13 de Maio de 2005.

Master and Ph.D. thesis completed (3000 ca.)

"Mathematical Modelling and Experimental Validation of the Acoustic Behavior of Unsteady Impinging Laminar Flames". Robert E. Leandro, Master of Science Thesis presented in 2006 for the degree of MSc in Mechanical Engineering.

Nuno R. Creado, 2005, "Experimental characterization of flame-wall interaction", IST, Supervision: Prof. E.C. Fernandes.

Alexandre C. Duarte, 2005, "Experimental and numerical analysis of water-pump intakes" IST, Supervision: Prof. E.C. Fernandes; Co-Coordination: Profs. J.M. Silva and L.R.C. Eça.

"Influência dos Ciclos de Carga e Variações de Regime nas Emissões de Poluentes de um Motor de Explosão", Paulo Alexandre Carvalho, IST, Julho de 2006

"Experimental investigation of time resolved flame/solid interactions in laminar premixed combustion", Pedro C. A. Vidigal, MSc Thesis, IST, Outubro, 2007

"Optimização do rendimento volumétrico de um motor de explosão tendo em vista aplicações específicas" (Optimization of volumetric efficiency of a spark ignition engine having specific utilization in mind). João Francisco Romeiro da Fonseca Pereira. MSc – 2005

"Propagação de fogo em leitos de combustível florestal – interacção entre a propagação da chama e um tronco de árvore" (Fire propagation in forest fuel beds - mutual influence between a surface fire propagation and a pine trunk). Nuno Miguel Garcia dos Santos. MSc – 2007

"Estudo numérico da dinâmica, consumo e emissão de poluentes de veículos rodoviários equipados com motor de combustão interna" (Numerical study of the dynamic, fuel consumption and pollutant emissions of road vehicles equipped with internal combustion engines). Carla Alexandra Monteiro da Silva. PhD

Estudo da combustão na superfície de um líquido (Study of Liquid Fuel Surface Combustion) Joaquim Caetano Baptista de Sousa Miguel Mestrado em SHT - IST (2007)

Propagação da combustão num substrato sólido - Contribuição para o estudo do desenvolvimento do incêndio em superfícies horizontais (Combustion Propagation in a Solid Substrat - A Contribution to the Study of Fire Development in Horizontal Surfaces) Adalberto José Guerreiro da Silva Centenico Mestrado em SHT - IST (2007)

Definição de uma metodologia para a avaliação de riscos ambientais, no âmbito da Directiva Seveso II: Aplicação a um caso prático (Definition of an environmental risk assessment methodology, in the framework of the Seveso II directive - Application on a case study) Joana Nunes Baptista Cima de Velosa Mestrado em Eng. do Ambiente - IST (2007)

Organization of conferences (2000 ca.)

12th Int. Symposium on Applications of Laser Techniques to Fluid Mechanics, Lisbon, July 2004.

13th Int. Symposium on Applications of Laser Techniques to Fluid Mechanics, June 26-29, 2006, Lisbon, Portugal.

Lean Combustion Technology II: Promise and Practice, April 25—29, 2004 Tomar, Portugal

Scientific committee of 7th International Conference on Engines for Automobile, ICE 2005, Capri,

Internationalization (2000 ca.)

(Collaborative publication, Research, Graduate Training Networks or other forms of participation of the Research Group at the international level)

Publications:

"Evaluating models to estimate flame characteristics for free-burning fires using laboratory and field data" (2006), Anderson W, Pastor E, Butler B, Catchpole E, Dupuy JL, Fernandes P, Guijarro M, Mendes-Lopes JM, and Ventura J, 5th Int. Conf. Forest Fire Research, Figueira da Foz, Coimbra, paper S77, 27-30 November 2006.

"Secondary atomization of water and isooctane drop impacts on"Secondary atomization of water and isooctane drop impacts onto tilted heated surfaces" (2007). A. L. N. Moreira, A. S. Moita, E. Cossali, M. Marengo and M. Santini. To appear in Experiments in Fluids.

"Surface waves on liquid sheets emerging from air-assist atomizers", V. Sivadas and A. L. N. Moreira, Paper ID ICLASS06-269. 10th International Congress on Liquid Atomization and Spray Systems - August 27 - September 1, 2006, Kyoto, Japan.

"A study on the aerodynamic instability of attenuating liquid sheets" (2006), H. Lienemann, J. Shrimpton and E. Fernandes, Experiments in Fluids, Volume 42, Number 2, pp. 241 – 258.

"Secondary atomization of drop impactions onto heated inclined surfaces", A. L. Moreira, A. S. Moita, G. E. Cossali, M. Mareng and M. Santini, 13th International Symposium on Applications of Laser Techniques to Fluid Mechanics, 26 – 29 June 2006, Lisbon.

PhD-network

"Aether" Aerothermal Acoustic Instabilities, Marie Curie Program (2006-2009) MRTN-CT-2006-035713-Aether

IST: Prof. Edgar C. Fernandes

Invited lectures

-“Experimental Methods in Thermo-Acoustics”, E. C. Fernandes, 2007,in Basics of Aeroacoustics and Thermoacoustics of Lecture Series at Von Karman Institute for Fluid Dynamics- Lecture Series 2007-2009, Edited by J. Anthoine

Collaborative work

Collaborative research with University of Belgrade, Mechanical Dept, Topic: thermoacoustic instabilities of water heater units

Collaborative research with University of Brasilia, Mechanical Dept, Topic: instrumentation for combustion and fluid mechanics.

-University of Ancona- Final Year projects –

-Institute for Physics and Mathematics-Novirsibirsk-Russia : Topic: swirling flows

-Large consortium (over 50 institutions) on forest fire research (see, e.g., <http://www.eufirelab.org/>)

-Consortium with LMS International NV,The Chancellor, Masters and Scholars of the University of Cambridge,Technische Universiteit Eindhoven ("TU/e"),Katholieke Universiteit Leuven,Lulea Tekniska Universitet,TECHNISCHE UNIVERSITAET MUENCHEN,von Karman Institute for Fluid Dynamics,Centre Européen de Recherche et de Formation Avancée en Calcul Scientifique,Instituto Superior Tecnico,Rolls-Royce plc,ALSTOM AG,Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek,,Nederlandse Gasunie NV,ARCELOR STEEL BELGIUM NV. Topic: Aerothermal instabilities

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Future Research

Objectives:

The present knowledge on thermodynamic transport phenomena, with special emphasis on thermoacoustic oscillations, lean flames for low pollutant emission technology, liquid droplet formation (sprays technology) and heat transfer phenomena should now be directed towards the micro systems of distributed energy systems (mini-micro flames and combustion chambers with application for example in fuel cells), mini spray cooling technologies and heat transfer of micro devices with application to electronic devices cooling systems. The transfer of knowledge into these Microsystems is not a linear process, since fluid mechanic processes are changed, boundary conditions becomes of the same order of magnitude of the process itself and the size of the systems required a special

adaptation of the laboratory non-intrusive techniques (specially based on light emission and sound waves) need to be made. The objective is to improve fundamental knowledge and establish/reinforce international collaborative work in these new areas while contributing to the Industry in these topics.

Research on forest fire phenomena will continue mainly in two axes: creating a reliable database on flame propagation in forest fire fuel complexes, and physical modelling.

Funding, source, dates (indicate in full including amount of current and pending funding)

70000€, "Advanced Intermittent Spray Cooling Systems"

Project PTDC/EME-MFE/69459/2006 sponsored by FCT (2007-2010)

70000€, "Dynamic behaviour of cryogen spray cooling"

Project POCTI/EME/57944/2004 sponsored by FCT (2005-2008)

60000€, " Desenvolvimento da técnica de quimiluminiscência para a detecção directa da composição de misturas de combustíveis em chamas laminares. FCT-PDTC/EME/-MFE/68830/2006

55000€, "Chamas incidentes-modelação matemática e experimental do seu comportamento instável"

FCT-PDTC/EME-NFE/68829/2006

198649.35€, "Aether" Aertothermal Acoustic Instabilities, Marie Curie Program MRTN-CT-2006-035713-Aether

88500€, An innovative approach of integrated wildland fire management regulating the wildfire problem by the wise use of fire: solving the Fire Paradox - FP6-018505 (2006 2010)

Previous publications in the area (5 in the last 5 years. If available you must indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language)

Experimental characterization of rotating flow field in a model vortex burner, S.I. Shtork, C.E. Cala, E.C. Fernandes, Experimental Thermal and Fluid Science, Volume 31, Issue 7, July 2007, Pages 779-788

"Experimental study on fuel drop impacts onto rigid surfaces: Morphological comparisons, disintegration limits and secondary atomization" (2007). A. S. Moita and A. L. N. Moreira, Proceedings of the Combustion Institute, 31:2175-2183.

"Interpreting the influence of fuel spray impact on mixture preparation for HCCI combustion with port-fuel injection" (2007) M. R. O. Panão and A. L. N. Moreira, Proceedings of the Combustion Institute, vol. 31, pp. 2205-2213.

Shtork S. I., Cala C. E., Fernandes E. C., and Heitor M. V., Coherent Helical Structures in Swirl Flows. Technical Physics Letters, 2005, Vol. 31, Issue 8, pp. 660-662. (<http://scitation.aip.org/tpl/>)

"A functional correlation for the primary breakup processes of liquid sheets emerging from air-assisted atomizers", V. Sivadas, M.V.Heitor and R. Fernandes, Transactionsof ASME, Vol 129, February 2007.

Special Requirements (equipment, facilities, staff or other special needs essential to carry out the future research program)

- Laboratory technician
- One pulsed laser to substitute a damaged system (acquired in 90's) to allow PIV (Particle image velocimetry technique) to be used
- One Laser Doppler Velocimetry Counter processor unit to substitute a system that has a malfunction work and was acquired in 90's (a system that is no longer repairable)
- An image intensifier unit to be coupled with high speed CCD cameras to complement the spectroscopic system for the new fundamental research topic of flame spectroscopy, partially financed by a FCT project, to allow pollutant emission to be quantified with a non-expensive and non-intrusive technique.
- An infrared thermometry system to measure fuel, flames, and ashes temperatures in the laboratorial forest fire studies.
- Oscilloscopes and amplifiers signals

Here you can find the information submitted for each of the Research Groups.

[Information accessed: 06-11-2008 15:40:08 on www.fct.mctes.pt]

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Research Group Information

(RG-LVT-Lisboa-750009-3585)

Designation: Laboratory of Technology Policy and Management of Technology, at IN+ Center for Innovation, Technology and Policy Research

Principal Investigator: Rui Miguel Loureiro Nobre Baptista

Location of Group: Instituto Superior Técnico - Universidade Técnica de Lisboa

Keywords: Innovation ,Entrepreneurship ,Technological Change ,Public Policy

Funding, sources, dates

€ 110.000,00 – “Universidades e Criação de Empresas”, PTDC/ESC/71125/2006; Source: FCT; Date: 01/01/2008.

€ 199.074,00 – “Diversificação”, PTDC/GES/71174/2006; Source: FCT; Date: 01/09/2007.

€ 510.715,00 – “Mudança Tecnológica e Inovação”, CMU-PT/0014/2007; Source: FCT; Date: 01/01/2007.

€ 135.090,10 – “VPE - VECTOR E”, 130/7.2/ADI/LVT; Source: IST/AI; Date: 01/01/2007.

€ 22.500,00 – “Planos de Negócios IAPMEI”; Source: IAPMEI; Date: 07/11/2006.

€ 18.500,00 – “Technology Commercialization Executive Training Program”; Source: IST; Date: 01/11/2006.

€ 43.395,00 – “Empreendedorismo nas Escolas”, PDCT/ESC/61557/2004; Source: FCT; Date: 01/10/2006.

€ 46.394,60 – “AIP – Inovjovem”; Source: AIP; Date: 15/12/2005.

€ 8.400,00 – “Mestrado em Engenharia e Gestão de Tecnologia”; Source: IST; Date: 02/11/2005.

€ 34.304,00 – “Totta UTL: Universidade, I&D e Propriedade Intelectual”; Source: ISEG; Date: 01/11/2005.

€ 24.457,50 – “Lisbon Ideas Challenge: Designing With Photovoltaics - New Energy Concepts for The Built Environment”; Source: PMEI/DENA; Date: 01/03/2005.

€ 60.000,00 – “Mudança Tecnológica e Desenvolvimento Económico Regional: Há Uma Curva de Kuznets Dupla?” POCI/EGE/61558/2004; Source: FCT; Date: 01/03/2005.

€ 6.000,00 – “Empreendedorismo 2005”; Source: INTELI; Date: 01/03/2005.

€ 55.084,68 – “VECTOR E 2005”; Source: UCP/EFISA/PMEI/UA/UTL; Date: 01/03/2005.

€ 79.647,00 – “Compreender o Ensino Superior de Engenharia, Ciência e Tecnologia em Portugal: Perspectivas Para o Desenvolvimento Institucional”, POCI/ESC/56801/2004; Source: FCT; Date: 01/02/2005.

€ 107.500,00 – “Globelics Academy PhD School”; Source: FCT/ICGFLA/ISEG; Date: 01/02/2005.

[Information accessed: 06-11-2008 15:40:08 on www.fct.mctes.pt]

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Group Team

List of Researchers in the Group:

001. Rui Miguel Loureiro Nobre Baptista (**Cat.:** Professor Associado **Gr. Acad.:** Doutoramento)

002. Pedro Miguel Assis Ferreira (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)

003. Antonio Miguel Areias Dias Amaral (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)

004. Murat Karaöz (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)

List of Collaborators (w/PhD):

001. Carlos Manuel Pinho Lucas de Freitas (**Cat.:** Professor Auxiliar **Gr. Acad.:** Doutoramento)

002. Pedro Filipe Teixeira da Conceição (**Cat.:** Professor Auxiliar Convidado **Gr. Acad.:** Doutoramento)

003. antonino vaccaro (**Cat.:** Investigador Auxiliar **Gr. Acad.:** Doutoramento)

004. Pedro Morais Martins de Faria (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Doutoramento)

List of Collaborators (w/o PhD):

001. Carla Maria do Rosário Costa (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)

002. Eugenia Maria Bengalinha Ramiro (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Licenciatura)

003. Joana Serra da Luz Mendonça (**Cat.:** Não aplicável (bolseiro) **Gr. Acad.:** Mestrado)

[Information accessed: 06-11-2008 15:40:08 on www.fct.mctes.pt]

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Objectives & Achievements

Objectives:

The main objectives of the "Technology Policy and Management of Technology" Laboratory are:

- To develop and use advanced research methodologies for the analysis of techno-economic systems;
- To promote the exchange of knowledge in advanced technologies and the management of technology and innovation for the optimization of industrial processes, as a way to promote competitive advantages at the corporate level;
- To derive science and technology policies, and innovation and entrepreneurship strategies leading to socio-economic development.

The emphasis on innovation and entrepreneurship draws on recent conceptual approaches to economic growth in which the accumulation of knowledge and entrepreneurial activity are the fundamental driving forces behind growth. This fact is reflected in the trend in developed economies towards an increasing investment in advanced technology and the development of entrepreneurial capabilities. Concepts such as learning ability, creativity, and entrepreneurial human capital gain greater importance as guiding principles for the conduct of individuals, institutions, nations and regions. The research carried out focuses on a variety of issues surrounding the creation and diffusion of knowledge as well as of human capital capable of learning and developing commercial applications for that knowledge. These issues include:

- Systems and Policies for Knowledge Creation, Diffusion and Usage;
- Higher Education Policy and Management;
- The Learning Economy;
- Technology and Economic Inequality;
- The impact of Entrepreneurship on Regional and National Economic Development;
- Innovation and Firm Productivity;
- Technology Management and Collaborative Innovation;
- Education, Human Capital and Entrepreneurship;
- Globalization, Diversification and Technology Capacity in the Auto Parts Sector;
- Mobilizing Information and Communication Technologies: Implications for Regional Development.

Main Achievements:

The development of competencies in the areas of entrepreneurship, and science, technology and innovation policy has been carried out successfully according to the following main lines of development:

- i) The promotion of master degree programs in "Engineering Policy and Management of Technology" (from 1998) and in "Engineering Design" (from 2002), with the aims of training young engineering graduates in new areas of education, and promote new links with Portuguese companies;
- ii) The promotion of a new Ph.D. program in technological change and entrepreneurship (from 2007), developed jointly with Carnegie Mellon University (and leading to a dual degree by IST and CMU), with the aim of providing advanced training to young researchers, and developing international research projects involving students and faculty across the Atlantic;
- iii) Active participation by faculty and research students in international conferences and workshops, and the organization of the International Conferences on Technology Policy and Innovation, which were launched in July 1997 and are carried out in close collaboration with a number of leading research groups worldwide.
- iv) Activities promoting technology-based entrepreneurship through extra-mural programs of entrepreneurship education and new venture development, such as the VECTORE program, which has led to several technology-based start-ups.

The Laboratory has obtained funding for the development of research projects in a variety of fields related with its main objectives, including:

- Technological change and economic development;
- Education and Entrepreneurial Human Capital;
- Higher Education Policies;
- Universities and Technology-based Entrepreneurship;
- Innovation and Firm Productivity;
- Diversification and Entrepreneurial Entry by Small Firms.

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Group Productivity

Publications in peer review Journals (3000 ca.) (Up to a max of 10. Always indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language. DO NOT translate)

R. Baptista, A.R. Thurik, "The Relationship between Entrepreneurship and Employment: is Portugal an Outlier?", *Technological Forecasting and Social Change*, 74: 75-89, 2006. (IF=0.889) (Nr. C=0).

P. Conceição, M.V. Heitor. "Diversity and integration of science and technology policies". *Technological Forecasting and Social Change*, 74(1): 1-17, 2007. (IF=0.889) (Nr. C=0).

P. Conceição, M.V. Heitor, P. Vieira. "Are Environmental Concerns Drivers of Innovation? Speculating from the Community Innovation Survey for Portugal", *Technological Forecasting and Social Change*; 74(1): 1-17, 2007. (IF=0.889) (Nr. C=0).

P. Faria. Book Review, in Santarelli, E. (Ed.), *Entrepreneurship, Growth, and Innovation: The Dynamics of Firms and Industries*. *International Studies in Entrepreneurship*. XIII, 285 pp. Springer, Berlin–Germany 2006. Hardcover", *Journal of Economics*, 91(3):. 304-309, 2007. (IF=0.377) (Nr. C=0).

R. Baptista, V. Escária, P. Madruga, "Entrepreneurship, Regional Development and Job Creation: the Case of Portugal", *Small Business Economics*, 30(1): 49-58, 2008. (online version 2007). (IF=1.168) (Nr. C=0).

H. Horta, F. Veloso. "Opening the box: comparing EU and US scientific output by scientific field", *Technological Forecasting and Social Change*, 74, 1334-1356, 2007. (IF=0.889) (Nr. C=0).

A.M. Amaral. "Understanding Mobile ICT implementation in the Workplace: Knowledge vs. Traditional Users". *International Journal of Technology, Policy and Management*, Vol. 7, No. 3, pp. 322-338, 2007. (IF=0) (Nr. C=0).

J. Mendonça, R. Baptista, P. Conde, "A map of the knowledge bases for the chemical industry", *International Journal of Technology, Policy and Management*, 7, pp. 245-262, 2007. (IF=0) (Nr. C=0).

R. Baptista, M.T. Preto. "The dynamics of causality between entrepreneurship and unemployment", *International Journal of Technology, Policy and Management*, Vol. 7, No. 3, pp.215–224, 2007. (IF=0) (Nr. C=0).

H. Horta. "On improving the university research base: The Technical University of Lisbon case in perspective", *Higher Education Policy*, 21, 123-146, 2007. (IF=0) (Nr. C=0).

Other publications National (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

P. Conceição, M.V. Heitor, H. Horta. "Reflexões sobre o Ensino Superior em Portugal: Perspectivas para o Desenvolvimento Institucional" [Reflections over the Portuguese Higher Education system: perspectives for institutional development] in A. Amaral (Ed.), *Consolidação da legislação do ensino superior – Avaliação e Revisão da legislação em vigor*, Matosinhos: CIPES, 2003.

P. Conceição, M.V. Heitor, H. Horta. "Engenharia e desenvolvimento científico" [Engineering and scientific development] in Brito, J.M.B., Heitor, M.V., Rollo, M. F., (Eds) *Engenharia em Portugal no Século XX*, Lisboa, D. Quixote. (in Portuguese), 2004.

P. Conceição, M.V. Heitor, H. Horta. "Do Ensino Técnico ao Ensino da Engenharia em Portugal" [From technical teaching to the teaching of Engineering in Portugal] in Brito, J.M.B., Heitor, M.V., Rollo, M. F., (Eds) *Engenharia em Portugal no Século XX*, Lisboa, D. Quixote. (in Portuguese), 2004.

Other publications International (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

J. Moutinho, M. Heitor. "Building Human Centered Systems Based on Communication Infrastructures: Evidence from Portugal" in S. Marshall, W. Taylor, X. Yu, (Eds.), "The Encyclopaedia of Developing Regional Communities with ICT", Hershey, Idea Group, 2005.

P. Conceição, M.V. Heitor, H. Horta. "R&D funding in US universities: from public to private support or public policies strengthening diversification? I" in J. Enders, B. Jongbloed (Eds.), *Public-Private Dynamics in Higher Education: Expectations, Developments and Outcomes*, (CHEPS, University of Twente), 2005.

R. Baptista. "Can Policy be Imported? Cultural Differences and Economic Progress: Lessons from Portugal" in *The End of Sovereignty? A Transatlantic Perspective*, D. J. Eaton (Ed.), Lit Verlag, 2006.

R. Baptista, A. Van Stel, A.R. Thurik. "Entrepreneurship, Industrial Re-structuring and Unemployment in Portugal" in *Entrepreneurship, Growth, and Innovation: the Dynamics of Firms and Industries*, *International Studies in Entrepreneurship*, E. Santarelli (Ed.), Springer Verlag, 2006.

A.M. Amaral, R. Baptista. "Transitions from Paid-Employment into Entrepreneurship: An Empirical Study for Portugal" in *Empirical Entrepreneurship in Europe: New Perspectives*, M. Dowling and J. Schmude (Eds.), Edward Elgar, Cheltenham–UK, 2007.

A.M. Amaral, R. Baptista, F. Lima. "Entrepreneurial Exit and firm Performance". *Frontiers of Entrepreneurship Research* (Accepted for publication), 2007.

A.M. Amaral, R. Baptista, F. Lima. "Becoming an ex-entrepreneur: firm performance and the sell-or-liquidate decision". In *Entrepreneurship, RENT Anthology*. D. Smallbone, H. Landstrom, & D. Jones Evans (Eds.), Edward Elgar, Cheltenham–UK (Accepted for publication), 2007.

J. Mendonça, R. Baptista, F. Lima. "Creation of higher education institutions and entry of knowledge-based firms". In *Entrepreneurship, RENT Anthology*. D. Smallbone, H. Landstrom, & D. Jones Evans (Eds.), Edward Elgar, Cheltenham–UK (Accepted for publication), 2007.

R. Baptista, F. Lima, M.T. Preto. "Switching from paid employment to entrepreneurship: the effect on individuals' earnings". In *Entrepreneurship, RENT Anthology*. D. Smallbone, H. Landstrom, & D. Jones Evans (Eds.), Edward Elgar, Cheltenham–UK (Accepted for publication), 2007.

Master and Ph.D. thesis completed (3000 ca.)

PhD Thesis:

António Miguel Amaral, (2007). "The Dynamics of Entry, Exit and Re-entry into Entrepreneurship: A longitudinal analysis for Portugal", PhD. Thesis, Mimeo, Universidade Técnica de Lisboa - Instituto Superior Técnico.

Antonino Vaccaro (2007). "Information and Communication Technologies, Knowledge Based Processes and Firm Innovation". PhD. Thesis, Mimeo, Universidade Técnica de Lisboa - Instituto Superior Técnico.

Hugo Horta (2007). "Towards an Improved Knowledge Infrastructure: Funding, Diversity and Autonomy of Academic Research". PhD. Thesis, Mimeo, Universidade Técnica de Lisboa - Instituto Superior Técnico.

Pedro Faria (2008). "Knowledge Management and Innovation: Firm Level Evidence from Portugal" PhD. Thesis, Mimeo, Universidade Técnica de Lisboa - Instituto Superior Técnico.

MSc Thesis:

Pedro Faria, "Innovation and Productivity: What can we learn from the CIS III Results for Portugal?" MSc Dissertation, Mimeo Instituto Superior Técnico, Universidade Técnica de Lisboa, 2004.

António Miguel Amaral, "Understanding the Implementation of Mobile Technologies Within the Firm: Looking at Individual and Organisational Processes of Change in Selected Case Studies", (IST; supervision: Manuel V. Heitor, IST, DEM), 2004.

Joana Mendonça, "Determinants of Innovation in the Portuguese Chemical Industry", (IST; supervision: Manuel V. Heitor – IST-DEM; Pedro Conceição – IST; Rui Baptista – IST-DEG), 2004.

Miguel Preto, "Technology Diffusion and Economic Inequality in a Selection of OECD Countries: Does the Augmented Kuznets Hypothesis Help Explain Technology Adoption?", (IST; supervision: Pedro Conceição – IST; Beatriz Padilla – IST/IN+), 2004.

Nuno Ávila, Industry-Science Relationships: evidence from Portugal. (IST; supervision: M. Heitor, P Conceição), 2004.

Miguel Leocádio, "RAMS" – Reliability, Availability, Maintainability, Safety: Application to Railway Vehicles. (IST; supervision: M. Heitor, M Cruz), 2004.

Anastácia Deusdará Rodrigues, "Knowledge Management: the Case of the MIPIS Project", (IST; supervision: M.V. Heitor, M. M. Pinto and A. Filho, IST), 2005

João Paulo Fonseca da Silva, "Políticas de Telecomunicações: Gestão de Banda Larga - O Caso de Lisboa", (IST; supervision: J. Figueiredo, IST and R. Santos, FSCH/UNL), 2005

José Luis Moutinho Neto, "Digital Cities and the challenges for a Knowledge-Based View of the Territory: evidence from Portugal", (IST; supervision: M. V. Heitor, IST and R. Santos, FSCH UNL), 2005

Marco Ricardo Bravo da Silva, "Estratégias de Inovação Empresarial e Gestão de Tecnologia, Processos de Reengenharia e Gestão de Conhecimento - O Caso da CONTINENTAL em Comparação Internacional", (IST; supervision: M. V. Heitor, IST, F. Veloso, CMU, DEPP), 2005

Patrick Montgomery, "A Study into Next Generation Networks for Voice Services: History, Design and Policy Implications", (IST; supervision: M. V. Heitor and P. Ferreira, IST), 2005

Organization of conferences (2000 ca.)

"Entrepreneurship, Innovation and the Development of Regions" - 20th April, 2005

"Globelics Academy" - PhD School on National Systems of Innovation and Economic Development, 23rd May to 3rd June, 2005

"Science and Technology Based Entrepreneurship and Economic Development" - 8th June, 2005

"Firm level Innovation and the CIS – Is there a Common Story across EU Countries?" – 24th October, 2005

Workshop CLUSTER Meeting Lisbon - Task Force on Entrepreneurship and Innovation –January, 2007

Government/Organization contract research (2000 ca.) (Include here work carried out by the group that resulted in a publication or report. Of particular importance are those involved in public policy advice)

A.M. Amaral, R. Baptista, P. Faria, M. Karaöz, J. Mendonça & M. Preto (2005) "Inovação, Crescimento Económico e Emprego: o Desafio do Empreendedorismo" [Innovation, Economic Growth and Employment: the challenge of Entrepreneurship] in P. Ferrão, P. Conceição, and R. Baptista (Eds.), Preparar Portugal para um novo ciclo de fundos estruturais 2007-2013 [Preparing Portugal to a new cycle of European Framework funds – 2007-2013], Report presented to the Observatory for the Community Support Framework (CSF) III

Internationalization (2000 ca.)

(Collaborative publication, Research, Graduate Training Networks or other forms of participation of the Research Group at the international level)

REE - Europe, Roundtable on Entrepreneurship Education;

CLUSTER--Consortium Linking Universities of Science and Technology for Education and Research - Taskforce on Entrepreneurship & Innovation;

IPREG - Institute for Policy Research in Entrepreneurship and Growth;

UTEN - University Technology Enterprise Network, partnership UT-Austin-Portugal;

CINDA - Centro Interuniversitario de Desarrollo (Santiago de Chile), Research Project, with diverse European and South-American universities, aimed at designing a model for evaluating university-based start-ups.

Carnegie Mellon University / Portugal - Doctoral dual degree program in Technological Change and Innovation

Industry contract research (2000 ca.)

€ 6.000,00 – “Empreendedorismo 2005”; Source: INTELI; Date: 01/03/2005.

€ 46.394,60 – “AIP – Inovjovem”; Source: AIP; Date: 15/12/2005.

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Future Research

Objectives:

The Laboratory of Technology Policy and Management of Technology at IN+ plans to pursue the development of the main research lines it has established and solidified over the last few years. In particular, two principal lines of development are to be pursued:

I) The development of research in entrepreneurship, technological change and higher education, leading to new insights for practitioners and policy makers in science, technology, industry and higher education, and aiming to contribute to economic development, competitiveness and employment growth.

II) The development of activities promoting technology commercialization and technology-based entrepreneurship in a university environment, through entrepreneurship and technology transfer training, and new venture development.

Concerning the first line of development, research in a variety of topics, using diverse methodologies, is to be pursued. Some of the topics to be addressed are the continuation of already successful research streams, while other represent new challenges:

Systems and Policies for Knowledge Creation, Diffusion and Usage;

- Higher Education Policy and Management;
- The Learning Economy;
- The impact of Entrepreneurship on Regional and National Economic Development;
- Innovation and Firm Productivity;
- Technology Management and Collaborative Innovation;
- Education, Human Capital and Entrepreneurship;
- Spin-offs and the Pre-history of Entrepreneurs: analysis of specific forms of entrepreneurial human capital;
- The Post-history of Entrepreneurs: entrepreneurial experience and the internal labor markets of the firm;
- Universities and New Firm Creation: geographical proximity and technology-based entrepreneurship;
- Entrepreneurial Exit and Habitual Entrepreneurship.

Concerning the second line of development, the VECTORE program will remain a cornerstone of entrepreneurship training and new venture development in Lisbon, and new programs will be developed focusing on specific technologies in energy, the environment, ICTs, and bio-engineering.

Funding, source, dates (indicate in full including amount of current and pending funding)

€ 110.000,00 – “Universidades e Criação de Empresas”, PTDC/ESC/71125/2006; Source: FCT; Date: 01/01/2008.

€ 199.074,00 – “Diversificação”, PTDC/GES/71174/2006; Source: FCT; Date: 01/09/2007.

€ 510.715,00 – “Mudança Tecnológica e Inovação”, CMU-PT/0014/2007; Source: FCT; Date: 01/01/2007.

€ 135.090,10 – “VPE - VECTOR E”, 130/7.2/ADI/LVT; Source: IST/AI; Date: 01/01/2007.

€ 43.395,00 – “Empreendedorismo nas Escolas”, PDCT/ESC/61557/2004; Source: FCT; Date: 01/10/2006.

Previous publications in the area (5 in the last 5 years. If available you must indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language)

R. Baptista, V. Escária, P. Madruga, “Entrepreneurship, Regional Development and Job Creation: the Case of Portugal”, *Small Business Economics*, 30(1): 49-58, 2008. (online version 2007). (IF=1.168) (Nr. C=0).

R. Baptista, F. Lima, M.T. Preto. “Switching from paid employment to entrepreneurship: the effect on individuals’ earnings”. In *Entrepreneurship, RENT Anthology*. D. Smallbone, H. Landstrom, & D. Jones Evans (Eds.), Edward Elgar, Cheltenham–UK (Accepted for publication), 2007.

A.M. Amaral, R. Baptista. “Transitions from Paid-Employment into Entrepreneurship: An Empirical Study for Portugal” in *Empirical Entrepreneurship in Europe: New Perspectives*, M. Dowling and J. Schmude (Eds.), Edward Elgar, Cheltenham–UK, 2007.

J. Mendonça, R. Baptista, F. Lima. “Creation of higher education institutions and entry of knowledge-based firms”. In *Entrepreneurship, RENT Anthology*. D. Smallbone, H. Landstrom, & D. Jones Evans (Eds.), Edward Elgar, Cheltenham–UK (Accepted for publication), 2007.

P. Conceição, M. V. Heitor, (2005), *Innovation for All? Learning from the Portuguese path to technical change and the dynamics of innovation*. Westport and London: Praeger.

Special Requirements (equipment, facilities, staff or other special needs essential to carry out the future research program)

Here you can find the information submitted for each of the Research Groups.

[Information accessed: 06-11-2008 15:40:57 on www.fct.mctes.pt]

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Research Group Information

(RG-LVT-Lisboa-750009-3589)

Designation: Centre of Mineral Resources, Mineralogy and Crystallography of the Faculty of Science of Lisbon University (CREMINER)

Principal Investigator: Fernando José Arraiano de Sousa Barriga

Location of Group: Fundação da Faculdade de Ciências - Faculdade de Ciências da Universidade de Lisboa

Keywords: Natural Systems ,Marine Geology ,Mineral Resources ,Fluids in the Crust

Funding, sources, dates

The main sources of funding for the RG (2003 to 2007) have been provided by FCT, as i) Pluriannual+Programmatic funding (in the global amount of € 350 106) ii) 12 research projects (totalling € 883 925) and funding for reequipment (€ 655 000).

Contracts with industry, extremely significant as achievements, were another source of funding (€ 323 000).

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Group Team

List of Researchers in the Group:

001. Fernando José Arraiano de Sousa Barriga (Cat.: Professor Catedrático Gr. Acad.: Agregação)

002. Isabel Maria Silveira Ribeiro da Costa (Cat.: Professor Auxiliar Gr. Acad.: Doutoramento)

003. Jorge Manuel Rodrigues de Sancho Relvas (Cat.: Professor Auxiliar Gr. Acad.: Agregação)

004. Jorge Manuel Verdilhao Figueiras (Cat.: Professor Auxiliar Gr. Acad.: Doutoramento)

005. Luis Miguel Guerreiro Galla Gaspar (Cat.: Professor Auxiliar Gr. Acad.: Doutoramento)

006. Mário Abel Carreira Gonçalves (Cat.: Professor Auxiliar Gr. Acad.: Doutoramento)

007. Rita Maria Ferreira da Fonseca (Cat.: Professor Auxiliar Gr. Acad.: Doutoramento)

008. Diogo Raeymaekers Namorado Rosa (Cat.: Professor Convidado Gr. Acad.: Doutoramento)

009. Ana Filipa Alfaia Marques (Cat.: Investigador Auxiliar Gr. Acad.: Doutoramento)

010. Carlos José Paulino Rosa (Cat.: Investigador Auxiliar Gr. Acad.: Doutoramento)

List of Collaborators (w/PhD):

001. Carlos Manuel Cleriguiño Inverno (Cat.: Investigador Principal Gr. Acad.: Doutoramento)

002. Joao Manuel Farinha Ramos (Cat.: Investigador Auxiliar Gr. Acad.: Doutoramento)

003. Daniel Pipa Soares de Oliveira (Cat.: Outra Gr. Acad.: Doutoramento)

List of Collaborators (w/o PhD):

001. Isabel Maria Amaral Costa (Cat.: Professor Auxiliar Equiparado Gr. Acad.: Mestrado)

002. Raul Carlos Godinho Santos Jorge (Cat.: Assistente Gr. Acad.: Mestrado)

003. Ágata Sofia de Carvalho Marques Alveirinho Dias (Cat.: Não aplicável (bolseiro) Gr. Acad.: Mestrado)

004. Alvaro Manuel Madureira pinto (Cat.: Não aplicável (bolseiro) Gr. Acad.: Mestrado)

005. Ana Patrícia Marques De Jesus (Cat.: Não aplicável (bolseiro) Gr. Acad.: Mestrado)

006. Carlos Manuel Nunes de Carvalho (Cat.: Não aplicável (bolseiro) Gr. Acad.: Mestrado)

007. João Ricardo Silva Carvalho (Cat.: Não aplicável (bolseiro) Gr. Acad.: Licenciatura)

008. CÉLIA LEE (Cat.: Outra Gr. Acad.: Bacharelato)

009. Rute Maria Morgado Salgueiro (Cat.: Outra Gr. Acad.: Mestrado)

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Objectives & Achievements

Objectives:

Cremer is devoted to research and development in Earth and Space Sciences related to geochemical systems and to the genesis, evolution and use of crustal resources, from land and the ocean floors, with emphasis in fluid-rock interaction processes and Mineralogy and Crystallography and their applications, including environmental management.

Our research is focussed on four main topics as follows: i) New advances on understanding ore-forming processes based on a renewed look over current metallogenic models, assisted by modern analytical techniques, and taking advantage of the significant geodiversity of our territory, which hosts several different metallogenic provinces potentially interesting for a number of metals (e.g., Au, W, Sn, Cr, Ni, Zn, Cu), with emphasis on the Iberian Pyrite Belt and the world-class Neves Corvo deposit, and the outstanding submarine hydrothermal fields located South of Azores over the Mid-Atlantic Ridge; ii) Soils are another type of precious resource in great demand and great risk of destruction, because of erosion and over-erosion related to agriculture. Understanding the soil formation and destruction cycles can produce feasible solutions to this "silent crisis of the world economy" as shown by continuing studies in three continents; iii) Earth as a dynamic and complex system. Chemical elements exist in different forms and in different reservoirs therefore the study of their behaviour in the environment is of utmost importance in applications such as pollution dispersion, and use of natural materials for waste confinement.. Characterization of the different reservoirs and fluxes is fundamental to achieve a better understanding of the geochemical cycle of elements thus helping the sustainable use of natural resources; iv) Exploring our past through the geoaerchaeological record is a key example of how hard science can link with culture and contribute to evaluation of the anthropogenic impact on the geochemical cycle of elements and to improve remediation strategies promoting the development of green exploitation practices.

The development of engineering systems can and should be rooted in the understanding of natural systems. Sustainable development systems will respect nature and will simultaneously be inspired in natural systems.

Main Achievements:

The RG is acknowledged as a leading scientific team in seafloor hydrothermal studies, from the Atlantic Ocean to the Arctic Sea. The prominent and breakthrough activity of the group in this research field, justified the inclusion of two members among the co-proponents of IODP Proposal 584: TAG II, and attracted the interest for collaborative research of one of the world leading companies in oceanic exploration for metallic resources.

The group has also achieved internationally recognized success with its studies on ore-forming processes on land. These include different types of mineralization, with emphasis on the Iberian Pyrite Belt. The studies on the world-class Neves Corvo deposit, in particular, projected the name of the RG throughout the world as have led to several publications, two of which distinguished with a front cover of *Economic Geology*, the most prestigious journal in this field.

The group succeeds as well in terms of reaching recognition in experimental and geochemical modeling of low-temperature processes related with environmental impacts due to heavy metal contamination in landfills and old mining areas. A laboratory devoted to experiments of metal adsorption kinetics onto mineral surfaces was fully equipped and installed at FCUL. Some of these studies have led to management recommendations to national governmental organisms, and justified invited publications in international books.

A recent achievement of the RG is AMBITERRA, a new analytical laboratory for sediments and soils that resulted from a partnership between the RG and University of Évora. The Lab is equipped with state-of-the-art analytical facilities and properly trained personnel. The research spreads over various regions of the world and aims to define sustainable alternatives to increase the fertility of soils and improving the quality of water in artificial lakes.

The RG has also been active in isotopic studies. It must be stressed, in particular, the acquisition and on-going installation of a fully equipped laboratory for stable isotopes at FCUL (IRMS and LA-IRMS), and the international collaborative research on Cu isotopes.

More than 100 public outreach conferences, most by invitation, were addressed by RG members. The Director of the Mineralogical and Geological Museum of the National Museum of Natural History is a RG member. Several RG members are very much involved in different *Ciência Viva* activities, including the scientific coordination of two new *Ciência Viva* Centers, at Lousal and Viseu.

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Group Productivity

Publications in peer review Journals (3000 ca.) (Up to a max of 10. Always indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language. DO NOT translate)

Dias AS, Barriga FJAS (2006) Mineralogy and geochemistry of hydrothermal sediments from the serpentinite-hosted Saldanha hydrothermal field (36°34'N; 33°26'W) at MAR. *Marine Geology* 225: 157-175

Gonçalves MA, Nogueira JMF, Figueiras J, Putnis CV, Almeida C (2004) Base-metals and organic content in stream sediments in the vicinity of a landfill. *Applied Geochemistry* 19: 137-141

Jesus A, Munhá J, Mateus A, Tassinari C, Nutman AP (2007) The Beja Layered Gabbroic Sequence (Ossa-Morena Zone, Southern Portugal): geochronology and geodynamic implications. *Geodinamica Acta* 20: 139-157

Larson PB, Maher K, Ramos FC, Chang Z, Gaspar M, Meinert LD (2003) Copper isotope ratios in magmatic and hydrothermal ore-forming environments. *Chemical Geology* 201: 337-350

Marques, AFA, Barriga, FJAS, Scott, SD (2007) Sulfide mineralization in an ultramafic-rock hosted seafloor hydrothermal system: from serpentinization to the formation of Cu-Zn-(Co)- rich massive sulfides. *Marine Geology* 245:20-39

McConachy TF, Arculus RJ, Yeats CJ, Binns RA, Barriga FJAS, McInnes BIA, Rakau B, Sestak S, Sharpe R, Tevi T (2005) New hydrothermal activity and alkalic volcanism in the backarc Coriolis Troughs, Vanuatu. *Geology* 33: 61-64

Relvas JMRS, Barriga, FJAS, Ferreira, A, Noiva, PC, Pacheco, N, Barriga, G (2006) Hydrothermal alteration and mineralization in the Neves-Corvo volcanic-hosted massive sulfide deposit, Portugal: I. *Geology, Mineralogy, and Geochemistry. Economic Geology* 101-4: 753-790

Relvas JMRS, Barriga FJAS, and Longstaffe F (2006) Hydrothermal alteration and mineralization in the Neves-Corvo volcanic-hosted massive sulfide deposit, Portugal: II. Oxygen, Hydrogen and Carbon Isotopes. *Economic Geology* 101-4: 791-804

Rosa DRN, Romberger SB (2003) Fluid evolution in the Jales gold district, northern Portugal. *International Geology Review* 45(7): 646-658

Ribeiro A, Munhá J, Dias R, Mateus A, Pereira E, Ribeiro ML, Fonseca P, Araújo A, Oliveira JT, Romão J, Chaminé H, Coke C, Pedro JC (2007) Geodynamic evolution of the SW Europe Variscides. *Tectonics* 26: TC2009

Silva PF, Henry B, Marques FO, Mateus A, Madureira P, Lourenço N, Miranda J (2006) Variation of Magnetic Properties in Sedimentary Rocks Hosting the Fourn

Other publications National (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

Barriga FJAS (2003) Hidrotermalismo submarino e ambiente. Ambiente 21(11): 44-47

Barriga FJAS, 2004. Hydrothermal Activity at The Mid-Atlantic Ridge In The Azores Region: Lessons Concerning Old Massive Sulphide Deposits. Vulcânica 1: 1-6

Barriga, FJAS (2005). Aventuras da água do mar nos subterrâneos do oceano (p97-122). In *Despertar para a Ciência: As conferências de 2003*, Gradiva, 193 p, 1 DVD

Gonçalves MA, Figueiras J (2005) The surface properties of natural illites and the adsorption kinetics of Cu onto their surfaces. In: VIII Congresso de Geoquímica dos Países de Língua Portuguesa – XIV Semana de Geoquímica, Aveiro (Portugal): 513-518

Jesus A, Munhá J, Mateus A (2005) Critical features controlling the evolution of the Beja Layered Gabbroic Sequence; implications to ore-forming processes. In: VIII Congresso de Geoquímica dos Países de Língua Portuguesa – XIV Semana de Geoquímica, Aveiro (Portugal): 305-310

Mateus A (2006). A Geologia no limiar do século XXI: consolidação de um percurso, projectando o futuro. e.Ciência – A Revista da Ciência, Tecnologia e Inovação em Portugal, nº 112, Novembro, Vulcanologia e Geodiversidade, Marcas e Dinâmica da Geologia em Portugal: 13-20.

Matos JX, Ribeiro S, Moreira N (2005) Percursos Geoambientais como elementos de Valorização Cultural e Científica das Área Mineiras da Faixa Piritosa Ibérica. In: III Simpósio de Mineração e Metalurgia Históricas, SW Sudoeste Europeu, Univ. Porto.

Oliveira JT, Relvas JMRS, Pereira Z, Munhá J, Matos JX, Barriga F, Rosa C, 2006c. O Complexo vulcano-sedimentar de Toca da Moura (zona de Ossa-Morena); evolução tectono-estratigráfica e mineralizações associadas, in Dias R, Araújo A, Terrinha P, e Kulberg JC, eds., Geologia de Portugal no contexto da Ibéria, Universidade de Évora, Portugal: 181-194

Oliveira JT, Relvas JMRS, Pereira Z., Matos JX, Rosa C, Rosa D, Munhá J, Jorge R, Pinto A, 2006d. O Complexo vulcano-sedimentar da Faixa Piritosa: estratigrafia, vulcanismo, mineralizações associadas e evolução tectono-estratigráfica no contexto da zona Sul-Portuguesa, in Dias R, Araújo A., Terrinha P, e Kulberg JC, eds., Geologia de Portugal no contexto da Ibéria, Universidade de Évora, Portugal: 207-244.

Rosa D, Inverno C, Oliveira V, Rosa C (2005) Zircon and monazite saturation temperatures as tools for the recognition of VMS favorable environments: examples from the Iberian Pyrite Belt, Portugal, In: VIII Congresso de Geoquímica dos Países de Língua Portuguesa – XIV Semana de Geoquímica, Aveiro (Portugal): 89-93

Other publications International (3000 ca.) (Include only Books, chapters or full papers published in conference proceedings up to max of 10. Give title and full citation in original language)

Barriga FJAS, Santos RS (2003) The MOMAR Area: a prime candidate for development of a seafloor observatory. 3rd International Workshop on Scientific Use of Submarine Cables and Related Technology, Proceedings: 259-262

Binns, R.A., Barriga, F.J.A.S., and Miller, D.J., 2007. Leg 193 synthesis: anatomy of an active felsic-hosted hydrothermal system, eastern Manus Basin, Papua New Guinea. In Barriga, F.J.A.S., Binns, R.A., Miller, D.J., and Herzig, P.M. (Eds.), Proc. ODP, Sci. Results, 193: College Station, TX (Ocean Drilling Program), 1-17. doi:10.2973/odp.proc.sr.193.201.2007

Fonseca R, FJAS Barriga, S Theodoro, T Canário, M Morais (2007) – The Três Marias reservoir, a sink for sediments outcoming from over-erosion of soils in Minas gerais (Brazil). In: Gunkel G. & Sobral, M. (eds.) Reservoirs and River Basins Management: Exchange of Experience from Brazil, Portugal and Germany, p182-196. Technical University of Berlin, Berlin, 279p.

Fonseca RM, FJAS Barriga, WS Fyfe, 2003. Dam Reservoir Sediments as Fertilizers and Artificial Soils. Case Studies from Portugal and Brazil. Proc. International Symposium of the Kanazawa University 21st Century COE Program, pp 55-62

Gonçalves, M. A. (2005) (I) Background Concentration of Pollutants - Water Quality and Resource Development; (II) Geochemical Modeling – Computer Codes, (III) Geochemical Models - Ground Water; (IV) Metal–Organic Interaction in subtitle D - Landfill Leachates and Associated Groundwaters. In: Lehr, JH, Keeley, J (eds.) Water Encyclopedia, John Wiley & Sons, New York. – Book Sections –

Inverno CMC, Hutchinson RW (2006) Petrochemical discrimination of evolved granitic intrusions associated with Mount Pleasant deposits, New Brunswick, Canada. Transactions of the Institution of Mining and Metallurgy – Section B (Applied earth science) 115: B23-B39

Michel JL, M Klages, FJAS Barriga, Y Fouquet, M Sibuet, PM Sarradin, P Siméoni, JF Drogou, 2003. Victor 6000: design, utilization and first improvements. Proceedings Isope, I:7-14

Oliveira DPS, Robb LJ, Inverno CMC, Charlesworth EG (2004) The nature and origin of lode-gold mineralization in the São Martinho and Mosteiros prospects, Tomar Cordoba Shear Zone, eastern Portugal. Johannesburg, South Africa, Univ. of Witwatersrand, Economic Geology Research Institute-Hugh Allsop Laboratory, No. 379: 36 pp

Pinto AMM, Barriga FJAS, Scott SD (2004) Data report: sulfide and oxide mineral chemistry of an active backarc hydrothermal system: PACMANUS, ODP Holes 1188A, 1188F, 1189A, and 1189B. In: Barriga FJAS, Binns RA, Miller DJ, Herzig PM (eds.) Proceedings of the Ocean Drilling Program, Scientific Results 193:1-31

Theodoro S, RM Fonseca, FJAS Barriga, I Macedo, M Morais (2007) – The use of accumulated sediments in the Tucuruí and Três Marias dams to recuperate the degraded areas, p211-225. In: Gunkel G. & Sobral, M. (eds.) Reservoirs and River Basins Management: Exchange of Experience from Brazil, Portugal and Germany. Technical University of Berlin, Berlin, 279p.

Master and Ph.D. thesis completed (3000 ca.)

PhD

Gaspar M (2005) The Crown Jewel gold skarn deposit. PhD Thesis, Washington State University, USA: 325 pp

Gonçalves MA (2004) Heavy metal dispersion by landfill contaminated waters and fixation mechanisms on phyllosilicates: a combined field and experimental study. PhD Thesis, Univ. Lisboa: 212 pp

Marques AFA (2006) Geology and Genesis of Sulfide Mineralization in the Rainbow Ultramafic-hosted Seafloor Hydrothermal System. PhD Thesis, Univ. Lisboa: 300 pp (SFRH/BD/2978/2000)

Ribeiro da Costa I (2005) Serpentinization on the Mid-Atlantic Ridge: the Rainbow, Saldanha and Menez Hom sites. PhD Thesis, Univ. Lisboa: 444 pp

Rosa, CJP (2007) Facies Architecture of the Volcanic Sedimentary Complex of the Iberian Pyrite Belt, Portugal and Spain. PhD Thesis, University of Tasmania, Austrália. (SFRH/BD/5178/2001)

MSc

Martins R (2003) Caracterização de processos metassomáticos correlativos de recristalização e (re-)deposição de sulfuretos na Jazida de Enfermarias (Moura, Portugal). MSc Thesis, Univ. Lisboa: 179 pp

Entradas M (2005) Divulgação Científica em Ciências da Terra - Vulcanismo submarino nos Açores. MSc Thesis, Univ. Lisboa : 111 pp

Pinto, C. (2007). Caracterização geoquímica das fases aquosas e sólidas associadas aos processos geradores da drenagem ácida de minas (DAM), na zona envolvente às minas de Aljustrel. MSc Thesis, Univ. Lisboa.

Organization of conferences (2000 ca.)

ICAM 2004 – Brazil – 8th International Congress on Applied Mineralogy, September 19 – 22, 2004. (Organizing Committee - National Representative of Portugal)

International Workshop on Physical Volcanology of the Iberian Pyrite Belt, (July, 2004), University of Lisbon.

III MoMAR Workshop- International MoMAR Implementation Workshop, 7-9 April 2005 Lisbon, Portugal 2005 (Organizing Committee – Chair - Host)

Rocks for Crops 2004 (Brazil) International Meeting (Organizing and International Advisory Committee)

8th Biennial Meeting of the Society for Geology Applied to Mineral Deposits (SGA), August 2005, Beijing, China (Organizing Committee)

IODP (Integrated Ocean Drilling Program) – Operations Task Force Meeting, Lisbon, Portugal, March, 2005. (Organizing Committee)

Mining Rocks – Toronto 2005 (<http://www.cim.org/mce/toronto2005/>), organized by CIM/IMM – Mining Industry Conference and Exhibition (April, 2005, in Toronto, Canada. (Organizing Committee - field trip leader)

Short Course “Ore Microscopy” at INETI, Alfragide, in Nov. 2006. (Organizing Committee – Chair)

9th Biennial Meeting of the Society for Geology Applied to Mineral Deposits (SGA), August 17- 20, 2007, Dublin, Ireland (Organizing Committee)

Workshop: Produção de conteúdos científicos para o futuro Centro, (inc. Direção da Agência Nacional para a Cultura Científica e Tecnológica), Abril de 2007, CCV Lousal, Portugal (Organizing Committee).

Rocks for Crops 2007 (Kenya) International Meeting (Organizing and International Advisory Committee)

Industry contract research (2000 ca.)

The RG has a major contract with industry, with Lundin Mining Corporation, formerly with Sociedade Mineira de Neves Corvo, to provide ore characterization studies at the Neves Corvo mine to support hydrometallurgical operations at this major copper and zinc mine. The contract was signed in 2001 and presently is valued at 30000 € per year

The RG leads another major contract, between Fundação da Faculdade de Ciências da Universidade de Lisboa and Fundação Frederic Velge, to implement the science modules in a new Ciência Viva center, in Lousal (Grândola Municipality, South Portugal), in the amount of € 213000

Government/Organization contract research (2000 ca.) (Include here work carried out by the group that resulted in a publication or report. Of particular importance are those involved in public policy advice)

The single report which clearly stands out among the responsibilities of RG members is the participation of one Creminer RG member in Comissão Estratégica dos Oceanos, created under the leadership of the Prime Minister of Portugal, in 2003. A major political report was produced.

Another activity of great relevance was assessing Fundação para a Ciência e Tecnologia, upon request of the Minister of Science, Technology and Higher Education, on major investments in earth science equipment for research vessels.

Internationalization (2000 ca.)

(Collaborative publication, Research, Graduate Training Networks or other forms of participation of the Research Group at the international level)

The RG has developed many research collaborations with national and foreign institutions, that resulted in publications, namely: ETH - (Switzerland), National Oceanographic Centre (UK), IFREMER (France), KORDI (Korea), Washington State University (USA), universities of Oslo and Bergen (Norway), U. of Bath (UK), many Spanish universities (e.g., Oviedo, Salamanca, Complutense de Madrid, Huelva, Basque Country), in Germany (U. of Münster, Free University of Berlin) India (NIO, Goa), and Canada (U. of Quebec, Toronto, Western Ontario, Guelph, Saskatchewan and ROM). This collaborative research provided conditions for PhD students to learn how to work with many “state-of-the-art” equipments.

Researchers are members of the board or fellows of leading international associations- Thus two members of the RG are members of the International Advisory Committee of the Rocks for Crops international association. Two members of the RG are/were members of the Council of SGA (Society of Geology Applied to Mineral Deposits).

Members of the research group were invited to review eleven (11) articles submitted to journals of the ISI. Conversely, an article authored by two RG members received the Mineralium Deposita Best Paper Award in 2003.

The research group is involved in many international projects and researchers participate in several international working groups: e.g. the Geochemistry Working Group of the FOREGS (Forum of European Geological Surveys - “Geochemical Atlas of Europe, 2005”), Marine Board and Life in Extreme Environments (ESF), European Consortium for Ocean Research Drilling (Ecord), Steering Committee of the International Cooperation in Ridge-Crest Studies (InterRidge), and MoMAR

(Monitoring the Mid-Atlantic Ridge).

Researchers were invited to talk in relevant scientific meetings, research institutes. Some examples are The European Network of Mining Regions – INTERREG IIIC Project (2004); KORDI (Seoul, 2003); JAMSTEC in Yokohama, Japan (2003); Kanasawa University, Japan (2003); EGU 1st General Assembly, Nice, France (2004); X Encontro da Rede Luso-Brasileira de Estudos Ambientais, Recife (Pernambuco, Brasil, 2006); Free University of Berlin (2007).

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Future Research

Objectives:

Our RG will continue with the present objectives as very high priorities. Natural resources are presently subjected to extremely high demand, related mainly to expansion of emerging economies, namely those of the "sleeping giants". There is every reason to believe that such high demand will continue for years to come. Thus our well-established expertise in mineral deposits and soil science will continue to grow in social relevance. Science is the solid foundation for progress in fields such as mineral exploration, soil improvement and related environmental studies.

The number one terrain for future relevant discoveries, both purely scientific and with development potential, is unquestionably the sea floor. Our possibilities of studying the sea floor are growing, related to a large effort in re-equipment of the national research institutions. Creminer is a "recipient" and important user of several relatively large-scale infrastructures, many designed for marine studies. Among the infrastructures under the responsibility of Creminer RG we wish to mention the Stable Isotope Laboratory, the Mobile Lab and AmbiTerra. Other relevant facilities include a new electron microprobe microanalyser and reequipment of other units, both within and outside our Associate Laboratory. We will soon have access to ships equipped for earth science research, with multi-beam bathymetry, multi-channel seismics and specialised vehicles and samplers such as AUVs, ROV's and TV Grabs. The new possibilities created by the new tools cannot be overemphasised. We see a wealth of collaborative opportunities in the framework of LA-ISR, both for new projects and as opportunities to train young researchers.

Scientific subjects to be developed by the Creminer RG in the next few years include i) Geology of the Deep Biosphere, ii) The Carbon Cycle and CO₂ Sequestration and iii) Forensic Geology.

Geology of the Deep Biosphere results from one of the most significant discoveries of the last decades, that the porosity of sea floor rocks, down to depths over 1500 metres below sea floor is inhabited by microbes, in excess of 10⁶/cm³. What is the role of the deep biosphere in the early evolution of sea floor rocks? This field relates to our expertise in soil science and our ability to analyse low temperature rocks and soils for nutrients and pollutants. We hope to find essential links between the deep biosphere and rock evolution, from soft sediments to hard rock. We have hired a new postdoctoral researcher in this area.

The Carbon Cycle and CO₂ Sequestration is self explanatory, as most experts agree on the inevitability of widespread use of fossil fuels for decades to come. Without CO₂ sequestration this will have an unbearable environmental cost. Efficient CO₂ sequestration will imply the confinement of CO₂ produced in large industrial facilities, the refinement of sequestration models and the identification of suitable geological formations. The effort is multidisciplinary, both with engineering and geology expertise need. Our LA is uniquely positioned to produce answers. Few lines of research could be more relevant to our future as a species on Earth.

Forensic Geology is another field, like geoarchaeology, where the expertise of natural sciences can relate with social requirements to produce conclusive evidence, capable proving (or disproving) involvement and/or responsibility in crimes. This is largely a matter of use of analytical tools, both mineralogical and geochemical, thus intimately related to the quality and use of laboratories. This field has a large potential to attract young researchers. A new post-doctoral researcher will be hired in this area.

Funding, source, dates (indicate in full including amount of current and pending funding)

FCT- PTDC/CTE-GEX/65789/2001 - (01-01-2008) - €100.000.00

FCT - PTDC/GIN/67027/2006 - (01-09-2007) - €17.500.00

FCT - EUROMARC/0001/2007 - (01-09-2007) - €120.000.00

FCT - PTDC/ENR/70767/2006 - (21-12-2007) - €77.725.00

SOMINCOR - €38.000.00

Previous publications in the area (5 in the last 5 years. If available you must indicate at the end of the citation, impact factor of the journal (IF=) and number of citations (n° C=). Give title and full citation in original language)

Dias AS, Mills R A, Taylor R N, Ferreira P and Barriga F J A S , (2008). Geochemistry of a sediment push-core from the Lucky Strike hydrothermal field, Mid-Atlantic Ridge. *Chemical Geology*, 247(3-4): 339-351

Gaspar M., Knaack C., Meinert L.D., and Moretti, R., (2008). REE in skarn systems: A LA-ICP-MS study of garnets from the Crown Jewel gold deposit: *Geochimica et Cosmochimica Acta* 72:185-205

Ribeiro da Costa I., Barriga F.J.A.S., Taylor, R.N. (2008) – Late seafloor carbonate precipitation in serpentinites from the Rainbow and Saldanha sites (Mid-Atlantic Ridge). *European Journal Mineralogy* 20: 173-181

Ribeiro da Costa I., Barriga F.J.A.S., Viti, C., Mellini, M. Wicks, F.J. (2008) – Antigorite in deformed serpentinites from the Mid-Atlantic Ridge. *European Journal of Mineralogy* 20: 563-572

Rosa CJP, McPhie J, Relvas JMRS, Pereira, Z, Oliveira, T., Pacheco, N, 2008. Volcanic facies architecture hosting the Neves Corvo VHMS deposit, Iberian Pyrite Belt, Portugal. *Mineralium Deposita*, 43: 449-466

Special Requirements (equipment, facilities, staff or other special needs essential to carry out the future research program)

Our already existing capability to produce impeccable analytical results must be widely and formally recognised, through a process called "acreditação"

(certification) of our labs. This will require much effort, both at the lab benches and as administrative work, but is unavoidable, especially in fields such as Forensic Geology and soil characterization for legal purposes (pollutant levels, for example).

Another urgent need is to improve our ability to analyse minimal amounts of material (in the micro- to nanoscale). This is the only way to analyse the various components of complex rock systems, especially important for sea-floor (and extraterrestrial) samples.

These aims require both equipment and laboratory technicians. Priority equipment able to efficiently respond to multiple research areas (e.g., Natural Resources, Environmental Studies, The Carbon Cycle and CO₂ Sequestration, Forensic Geology, Geoarchaeology) includes an Inductively Coupled Plasma Mass Spectrometer and a Laser Ablation system. Laboratory technicians must be hired, for new and existing laboratory facilities, with a minimum of two. The current unavailability of such facilities in Portugal will create new opportunities for national and international collaboration and will greatly improve our attract ability to young researchers.