INSTITUTE FOR SYSTEMS AND ROBOTICS

Annual Report – 2011

Lisbon Pole

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1. INTRODUCTION

The Institute for Systems and Robotics (Lisbon) is organized in five (5) Laboratories or Research Groups: Intelligent Robot and Systems, Computer and Robot Vision, Signal and Image Processing, Evolutionary Systems and Biomedical Engineering, and Dynamical Systems and Ocean Robotics. For each one those Labs/Groups, this report includes the list with the members of the research team, projects, objectives, main achievements, and the group productivity, which includes a list of activities that contributes for internationalization.

2. RESEARCH GROUPS

2.1. INTELLIGENT ROBOT AND SYSTEMS GROUP

A) RESEARCH TEAM

Maria Isabel Ribeiro, *Full Professor*
Pedro Lima, *Associate Professor*
Carlos Bispo, *Assistant Professor*
João Sequeira, *Assistant Professor*
Luís Custódio, *Assistant Professor*
Rodrigo Ventura, *Assistant Professor*

Danesh Tarapore, *Post-Doc Researcher*
Jesús Capitán, *Post-Doc Researcher*
Porfírio Silva, *Post-Doc Researcher*

Aamir Ahmad, *Ph.D. Student*
Abdolkarim Pahliani, *Ph.D. Student*
Bruno Lacerda, *Ph.D. Student*
Bruno Nery, *Ph.D. Student*
David Belo, *Ph.D. Student*
João Messias, *Ph.D. Student*
José Pereira, *Ph.D. Student*
Nelson Gonçalves, *Ph.D. Student*
Pedro Fazenda, *Ph.D. Student*
Tiago Veiga, *Ph.D. Student*

Américo Ambrózio, *M.Sc. Student*
Bruno Tibério, *M.Sc. Student*
Carlos Neves, *M.Sc. Student*
Daniel Salgueiro, *M.Sc. Student*
Diogo Duarte, *M.Sc. Student*
Duarte Dias, *M.Sc. Student*
Fábio Grego, *M.Sc. Student*
Filipe Jesus, *M.Sc. Student*
Francisco Freitas, *M.Sc. Student*
Henrique Silva, *M.Sc. Student*
João Reis, *M.Sc. Student*
João Marques, *M.Sc. Student*

João Reis, *M.Sc. Student*
Joao Figueiredo, *M.Sc. Student*
João Mendes, *M.Sc. Student*
João Sousa, *M.Sc. Student*
João Carvalho, *M.Sc. Student*
José Sousa, *M.Sc. Student*
Marco Prata, *M.Sc. Student*
Maria Féria, *M.Sc. Student*
Miguel Vaz, *M.Sc. Student*
Miguel Serafim, *M.Sc. Student*
Pedro Agostinho, *M.Sc. Student*
Pedro Vieira, *M.Sc. Student*
Davide Periquito, *Bachelor*
Keiya Okada, *Bachelor*

B) PROJECTS

- **MAIS-S** - Multiagent Intelligent Surveillance System, FCT - CMU-PT/SIA/0023/2009, Sept.2010-August 2013.

- Perception-Driven Coordinated Multi-Robot Motion Control, FCT - PTDC/EEA-CRO/100692/2008, Jan. 2010 - Dec.2012.

- **BioInstBots** - From Bio-Inspired to Institutional-Inspired Collective Robotics, FCT - PTDC/EEA-CRO/104658/2008, Feb. 2010 – Jan. 2013.

- **AuReRo** - Human-robot interaction with field robots using augmented reality and interactive mapping, FCT - PTDC/EIACCO/113257/2009, Apr. 2011 - Mar. 2014.

- ITER CPRHS/CTS – Optimisation of Trajectories for the Cask and Plug Remote Handling System in the Tokamak Building and Hotel Cell –F4E-GRT-276 (MS-RH), funded by Fusion for Energy (F4E), April/2011-Oct/2011 [together with Instituto de Plasmas e Fusão Nuclear(IPFN)/IST].

C) OBJECTIVES

The driving theme of the Intelligent Robots and Systems Group is wide in scope. Its members approach complex systems from a holistic standpoint, rather than focusing on some of the subsystems. The topic of cooperation (among agents and/or robots, among robots and humans) arises naturally from this viewpoint. The historic background of the lab senior researchers has lead us to use Artificial Intelligence concepts (e.g., sequential decision making, learning, task planning, cognitive systems) driven by formal approaches that stem from Systems and Control Theory and from Operations Research (e.g., mathematical modeling, analysis and synthesis, optimization, path planning, navigation, localization, discrete-event systems, estimation theory, simulation, queuing theory, Markov systems). Our research is often driven by practical applications, as we strongly believe it is very important to apply our methodologies to practical domains, since challenging real-life problems provide richer sources of inspiration. Therefore, we have been exploring the application of our research to networked robot systems, remote handling systems, kinematically

complex robots, field robots, soccer robots, humanoid robots, scheduling of queuing networks, and management of health systems, to name but a few.

Our distinctive feature is that we bring together people with a common background on systems theory, but different approaches to modeling, analysis and synthesis of intelligent systems, mainly coming from:
• artificial intelligence, with a focus on decentralized and distributed methods, and with specific interest in 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., navigation of autonomous systems, sensor and robot networks, institutional management systems, biological systems, and specific interest on modeling, analysis and synthesis methods.

D) MAIN ACHIEVEMENTS

In 2011, the group main achievements were:

- In the project ITER CPRHS/CTS, complete studies on motion planning methodologies for the mobile vehicles CPRHS and CTS operating in the Tokamak and Hot Cell buildings of ITER (The International Thermonuclear Experimental reactor) were conducted, in particular those that explore the full flexibility of the rhombic kinematics of the vehicles and allow for each wheel to follow a different path. More than 500 trajectories were generated for all ports in Tokamak Building and Hot cell Building. Update of the Trajectory and Evaluator Software tool (TES) aiming at providing, in CATIA format, the volume occupied by the CPRHS vehicle when following a 2D path was carried out.

- We developed a detailed stochastic simulator of T helper (Th) cells, in collaboration with biologists at the Gulbenkian Institute of Science. Discrete events at multiple time scales were simulated within each cell. The simulator was further improved with a novel implementation of the Gillespie Stochastic Simulation Algorithm, to scale the system to very large number of Th cells. In addition, classical immunology experiments were replicated to calibrate the parameters of the simulator.

- We devised a bio-inspired algorithm that simulates the interactions between different effector and regulator Th cells using a limited number of robots, for the detection of novel features. The dynamics of the interactions between the cells would allow our collective robotics system to discriminate between features without the need for any hard-coding of the feature vector.

- We published a paper in RSS2011, where we extend our work on supervision of robot tasks represented as Petri nets by introducing a methodology to build a Petri net realization of a supervisor that, given a Petri net model of a (multi)- robot system and an LTL specification, forces the system to fulfil the specification. The methodology encompasses composing the Petri net model with the Buchi automaton representing the LTL formula and trimming the result using a known method to reduce the size of the supervisor.

- We have been developing theory as well as solution methods for multiagent planning under uncertainty, advancing the state of the art significantly. We developed the currently fastest optimal planner for general Dec-POMDPs (IJCAI 2011).

- We have been working on developing methods for multiagent planning under uncertainty for multi-robot systems. Such real-world systems violate several assumptions typically made in the field. For instance, synchronization issues between agents are not considered or when communication is available it is assumed to be flawless and instantaneous. We published a paper in NIPS 2011 where we assume Factored Dec-POMDPs and we allow inter-robot communication, which turns the problem into a centralized Multiagent POMDP (MPOMDP). The keypoint is that when sparse dependencies between the agents' decisions exist, often the belief over its local state factors is sufficient for an agent to unequivocally identify the optimal action, and communication can be avoided.

- We published in ECMR2011 an algorithm that handles Cooperative Perception problems under a common Bayesian framework, based on particle filters, for moving targets and observer sensors. The paper was selected as one of the ECMR2011 best papers, and invited for submission to a Special Issue of the Elsevier JRAS.

- We published in ECAL2011 a formalism for institutions in the Institutional Robotics model using the abstract representation of Executable Petri Nets. We assessed the ability of our formalism to replicate results obtained with other approaches to the modelling of swarm robotics systems. We also assessed if institutional controllers can be used in modelling and analysing the distributed robotic system they control by providing the necessary structure to build macroscopic models of that system. The paper was selected as one of ECAL2011 best papers and invited for submission to the ALife journal.

- The research project MAIS+S, funded by the CMU-Portugal program, has been very positively evaluated by an international panel of reviewers. Within the project, we have defined some reference scenarios and started networking several cameras in the 8th floor of ISR/IST, together with 3 quad-core servers, that will be used for image processing and planning under uncertainty, the project main research activities.

- In joint work with researchers from Universidad Carlos III de Madrid, we published a journal paper (Elsevier JRAS) where we introduced the application of the Voronoi Fast Marching (VFM) method to path planning of mobile robot formations. The navigation function can be classified as a type of potential field, but it has no local minima, it is complete (it finds the solution path if it exists) and it has a complexity of order n(O(n)), where n is the number of cells in the environment map.

E) GROUP PRODUCTIVITY

1. Organization of Conferences

- M. Spaan - IJCAI'11 Workshop on Decision Making in Partially Observable, Uncertain Worlds: Exploring Insights from Multiple Communities.
- P. Lima - co-chair of Competitions in IROS 2012, Vilamoura, Algarve, 7-12 October 2012.

2. Industry contract research

- F4E-GRT-276 (MS-RH) – ITER CPRHS/CTS: Optimisation of Trajectories for the Cask and Plug remote Handling System in the Tokamak Building and Hotel. Leader: ISR/IST, Other Partners: ASTRIUM (F).
- QREN project with Portuguese SME UAVision - QuadMission: Desenvolvimento de um Sistema Automático e Inteligente para Aeronave Não Tripulada - Plataforma QuadCopter U4.

3. Internationalization

Pedro Lima

- Member of the Board of Trustees of the RoboCup Federation.
- Member of the editorial board of the Elsevier Journal of Robotics and Autonomous Systems.
- Member of the editorial board of the IN-TECH International Journal of Advanced Robotic Systems.

2.2. COMPUTER AND ROBOT VISION LAB

A) RESEARCH TEAM

José Santos Victor, *Full Professor*
Alexandre Bernardino, *Assistant Professor*
José Gaspar, *Assistant Professor*

Plinio Lopez, *Post-Doc Researcher*
Ricardo Ferreira, *Post-Doc Researcher*

Bruno Damas, *Ph.D. Student*
Dario Figueira, *Ph.D. Student*
Giovanni Saponaro, *Ph.D. Student*
Hugo Silva, *Ph.D. Student*
Jonas Ruesch, *Ph.D. Student*
Karl Hornstein, *Ph.D. Student*
Matteo Taiana, *Ph.D. Student*
Nuno Moutinho, *Ph.D. Student*
Ricardo Beira, *Ph.D. Student*
Ravin Souza, *Visiting Ph.D. Student*
Sébastien Gay, *Visiting Ph.D. Student*

David Antunes, *M.Sc. Student*
Filipe Veiga, *M.Sc. Student*
Jitesh Pramodray, *M.Sc. Student*
Lester Garcia Cobos, *M.Sc. Student*
Marco Henriques, *M.Sc. Student*
Pedro Vicente, *M.Sc. Student*
Ricardo Santos, *M.Sc. Student*
Rui Figueiredo, *M.Sc. Student*

Ricardo Galego, *Research Engineer*
Duarte Aragão, *Research Engineer*
João Pimentel, *Research Engineer*
Nuno Conraria, *Engineer*
Ricardo Nunes, *Technician*

Daniela Pamplona, *External Collaborator*
Etienne Grossmann, *External Collaborator*
Giampiero Salvi, *External Collaborator*
Luís Vargas, *External Collaborator*

Luis Montesano, *External Collaborator*
Manuel Lopes, *External Collaborator*
Martim Brandão, *External Collaborator*
Nicola Greggio, *External Collaborator*
Nuno Gracias, *External Collaborator*
Pedro Osório, *External Collaborator*
Ruben Martinez Cantin, *External Collaborator*

B) PROJECTS

- **DICO(RE)2S** - Discount Coupon Recommendation and Redemption System, EU-FP7, Jul. 2011 - Jun. 2013.

- **First-MM** - Flexible Skill Acquisition and Intuitive Robot Tasking for Mobile Manipulation in the Real World, ICT- 248528, Feb 2010 – Jul 2013.

- **HANDLE** - Developmental pathway towards autonomy and dexterity in robot in-hand manipulation, ICT –231640– HANDLE, Feb 2009 - Jan 2013.

- **ROBOSOM** - Robotic Sense of Movement, ICT- 248366-ROBOSOM, Dec 2009 - Nov 2012.

- **DCCAL** - Discrete Cameras Calibration using Properties of Natural Scenes, FCT - PTDC/EEA-CRO/105413/2008, Jan 2010–Dec 2012.

C) OBJECTIVES

One of the key objectives of the VisLab is to conduct research in computer and robot vision aiming at (i) the development of new methodologies and tools for computer and robot vision and the (ii) demonstration of such methodologies in challenging applications.

We take a multidisciplinary perspective encompassing areas ranging from engineering to neuroscience or linguistics. On one hand we look at biological systems to understand how vision has developed to become a powerful sensing modality. On the other hand we use our computational and embodied models based on biological plausible principles to better understand biological systems or human cognition.

Our research is organized in two main lines:
- Vision Based Control and Navigation;
- 3D Reconstruction, Motion Analysis and Surveillance.

a) Vision Based Control and Navigation
We address the problem of understanding how to use visual information to control an artificial system (robot) in order to perform a given task. This research is very often inspired on biological systems and aims at designing more flexible and robust artificial vision systems and to improve the understanding of biology. Thanks to massive developments in computing power we can now employ powerful learning techniques in the context of vision and robotic problems. The following topics are currently addressed:
- Learning and cognition for (humanoid) robots;
- Design of visual geometries and camera networks;

- Vision based control, active vision and navigation;
- Feature learning and object recognition.

b) 3D Reconstruction, Motion Analysis and surveillance

Vision allows us to retrieve information about the scene structure (geometry) or camera motion from video sequences. Amongst other topics, we are currently investigating the following problems:

a. Video surveillance systems able to learn and understand patterns of human activity;
b. Calibration of camera networks and nonconventional camera systems;
c. Model based tracking and object recognition;
d. Gesture analysis and recognition.

D) MAIN ACHIEVEMENTS

The work at VisLab aims to develop new methodologies for computer and robot vision as well as to address several applications with societal impact. The approach followed is strongly multidisciplinary with close links to biology, neuroscience or psychology. The group is regularly involved in large-scale, ambitious projects with international partners (e.g. EU).

Some of the main achievements are listed below:

Humanoid robotic platforms

The iCub humanoid platform available at the lab has been upgraded to include force/torque sensors, touch sensors and a second generation head. The setup is once again fully functional and serving as a testbed for research in the broad areas of cognitive systems. The research conducted with the iCub involves both methodologies and software for perception, learning and control of the platform. During 2011, we have continued the development of the mobile humanoid platform (Vizzy) and started using this platform for research on gesture recognition.

Cognitive systems and vision

We have pursued efforts to develop methods for sensorimotor learning and coordination with complex humanoid platforms. A substantial amount of research has now to do with manipulation. One research direction is that of modelling the manipulation skills of humans and transfer those skills to humanoid robots. Another line of research is to detect grasping points and grasping strategies from object models, hoping to generalize such capabilities across different objects.

Human activity analysis

We have continued the development of computer vision methods able to provide an interpretation of the observed scenes. Some of this work was developed in the previous EU Project URUS and, more recently, in the MAIS-S project integrated in the CMU-Portugal partnership.

Camera design and camera networks

We developed methods for the calibration of novel camera geometries and networks of cameras from extended observation of video streams. This work is the core of a new national project (DCCAL)

Participation in EU Projects

In addition to key contributions to our EU Projects (FIRST-MM, HANDLE, ROBOSOM), we have started two new EU Projects (DICORE2S and POETICON++) on the topics of visual shape analysis and on the understanding of the role of language as the support for cognition in humanoid robots.

International Partnerships
We have also actively participated in the IST-EPFL Joint PhD Initiative with students involved in the joint doctoral studies between IST and EPFL as well as in the CMU-PT dual doctoral program.

E) GROUP PRODUCTIVITY

1. Patents/Prototypes

- iCub humanoid platform: this humanoid platform was developed within the RobotCub project and, with 54degrees of freedom, it is the most sophisticated humanoid platform worldwide.
- Baltazar Humanoid Torso: composed of a high-speed 4 degrees of freedom binocular head, an articulated arm and hand, for research in learning by imitation. This robot was developed at VisLab since 2001 and was one of the most versatile humanoid robots in Portugal.
- Vizzy –humanoid platform mounted on a Segway mobile base. The software integration has been continued during 2011 and allows already for a number of experiments to be conducted with this platform.
- One robotic head designed for the iCub, each with 6 degrees of freedom, an inertial sensor, audio and ability to perform facial expressions.
- TRC LabMate mobile platform, equipped different sorts of cameras, including panoramic ones if curved mirrors.
- One Pioneer mobile platform equipped with a Katana manipulator used for experiments in navigation, SLAM or mobile manipulation.
- Two Nomad Superscout mobile platforms, equipped with vision and an on-board computer.
- One Tobii system for gaze tracking.
- One data glove and magnetic tracker.
- The ISobotNet is a testbed for Networked Robot Systems developed by VisLab together with ISLab and MRLab, composed of an indoor area of around 160 m2 with 10 webcams placed at the ceiling such that some of the fields of view do not overlap. Besides the camera sensors, four Pioneer AT and one ATRV-Jr robots are available. Each of the robots is equipped with sonars, onboard cameras, laser range finder and is Wi-Fi connected to the network.

2. Organization of Conferences

VisLab members were involved in the Program Committee of the following conferences:

- Robotics Science and Systems, RSS.
- International Conference on Computer Vision Systems, ICVS.
- International Conference on Image Analysis and Recognition, ICIAR.
- IEEE International Conference on Robotics and Automation, ICRA.
- IEEE Computer Society Conference on Computer Vision and Pattern Recognition, CVPR.
- IEEE Intlernational Conference on Intelligent Robots and Systems, IROS.

3. Industry contract research

- One EU project started in 2011, includes a large Robotics Company (KUKA).
- Collaborative project with the company Ydreams.

4. Internationalization

The group has more than 50% of international members and currently comprising 8 different nationalities. Most core activities are carried out in the context of large international projects.

EU Projects and Partnerships
EU Projects:
+ FIRST-MM

+ ROBOSOM
+ HANDLE

FCT-CMU/ MAIS-S

Partnerships

- IST-EPFL Joint Doctoral Initiative
- CMU-Portugal Joint Doctoral Initiative

National Projects with International Partners

- FCT DCCAL - IDIAP.

Participation in Theses Committees Abroad

Supervision of International Students

- Giovanni Saponaro, Universitat di Roma La Sapienza.
- Matteo Tajana, M.Sc Politecnico di Milano.
- Jonas Ruesch, University of Zurich.
- Jonas Hornstein, University of Gottemburg.
- Urbain Prieur, UPMC, Paris, France. Joint PhD IST-UPMC.
- Luka Lukic, joint PhD with EPFL (supervisors: José Santos-victor, Aude billard).
- Ravin de Souza, joint PhD with EPFL (supervisors: José Santos-victor, Aude billard).
- Stephan Gay, joint PhD with EPFL (supervisors: José Santos-victor, Auke Ijspeert).
- Adam Owczarek (Supervisor A. Bernardino).

Invited Talks/Seminars

- José Santos-Victor - Reverse Engineering the Brain with Humanoid Robots, PhD Program in Neuroscience, Medical School University of Lisbon.
- Alexandre Bernardino - Vibot Master Seminar, Girona, 2-3rd May 2011, "Real-Time Vision: From Biology to Computer Algorithms".

Reviewers International Journals

- Autonomous Robots
- IEEE Transactions:
  - Autonomous Mental Development
  - Biomed Engineering
  - Circuits and Systems for Video Technology
  - Image Processing
  - Neural Systems & Rehabilitation Engineering
  - PAMI
  - Robotics
  - System Man and Cybernetics
- International Journal of Humanoid Robotics
- International Journal of Robotics Research
- Journal of Robotics and Autonomous Systems
- Journal of Intelligent and Robotic Systems
- Journal of Real-Time Image Processing

5. Government/Organization contract research

- José Santos-Victor;
  - IST Board Member, Vice-President for International Affairs.
  - General Secretary of the CLUSTER network (www.cluster.org).
  - IST Director for the IST-EPFL Joint Doctoral Program.

- Alexandre Bernardino
  - IST Department of Electrical and Computer Engineering, Member of the Board.

2.3. SIGNAL AND IMAGE PROCESSING GROUP

A) RESEARCH TEAM

Victor Barroso, *Full Professor (IST)*
Sérgio Jesus, *Full Professor (UAlg)*
Isabel Lourtie, *Associate Professor (IST)*
João Paulo Costeira, *Associate Professor (IST)*
Johannes du Buf, *Associate Professor (UAlg)*
Jorge Salvador Marques, *Associate Professor (IST)*
João Pedro Gomes, *Assistant Professor (IST)*
João Sanches, *Assistant Professor (IST)*
João Xavier, *Assistant Professor (IST)*
Margarida Silveira, *Assistant Professor (IST)*
Orlando Rodriguez, *Assistant Professor (UAlg)*
Pedro Aguiar, *Assistant Professor (IST)*
Pedro Ferreira, *Assistant Professor (IST)*
António Silva, *Adjoint Professor (UAlg)*
João Rodrigues, *Adjoint Professor (UAlg)*
Paulo Felisberto, *Adjoint Professor (UAlg)*
Marko Stosic, *Doctoral Researcher (IST)*
Paul Laskowski, *Doctoral Researcher (IST)*
Vasco Pedro, *Doctoral Researcher (IST)*

Jacinto Nascimento, *Post-Doc Researcher (IST)*
Kasim Terzic, *Post-Doc Researcher (UAlg)*
Manya Afonso, *Post-Doc Researcher (IST)*
Nuno Silva, *Post-Doc Researcher (IST)*

Ana Catarina Barata, *Research Assistant*
Carlos Cabral, *Research Assistant*
Carlos Santiago, *Research Assistant*
Celestino Martins, *Research Assistant (UAlg)*
Friedrich Zabel, *Research Assistant (UAlg)*
Helder Miranda, *Research Assistant*
Joseph Schneiderwind, *Research Assistant*
Manuel Marques, *Researcher*

Alexandre Domingues, *Ph.D. Student*
Ana Bela Santos, *Ph.D. Student (UAlg)*
Augusto Santos, *Ph.D. Student (IST-CMU)*
Brandon Mauch, *Ph.D. Student (IST-CMU)*
Caitlin Forschner, *Ph.D. Student (IST-CMU)*
Cláudia Soares, *Ph.D. Student*
Colleen Horin, *Ph.D. Student (IST-CMU)*
David Afonso, *Ph.D. Student*

David Bravo, *Ph.D. Student (UAlg)*
Dragana Bajovic, *Ph.D. Student (IST-CMU)*
Dusan Jakovetic, *Ph.D. Student (IST-CMU)*
Ehsan Zamanizadeh, *Ph.D. Student (IST)*
Fábio Santos, *Ph.D. Student (UAlg)*
Ivonne Peña, *Ph.D. Student (IST-CMU)*
Jaime Martins, *Ph.D. Student (UAlg)*
Javier Pînilla-Dutoit, *Ph.D. Student (UAlg)*
João José, *Ph.D. Student (UAlg)*
João Mota, *Ph.D. Student (IST-CMU)*
José Jerónimo Rodrigues, *Ph.D. Student (IST-CMU)*
Mário Saleiro, *Ph.D. Student (UAlg)*
Miguel Farrajota, *Ph.D. Student (UAlg)*
Miguel Matos, *Ph.D. Student (IST-CMU)*
Moinul Zaber, *Ph.D. Student (IST-CMU)*
Nelson Martins, *Ph.D. Student (UAlg)*
Patrick Agyapong, *Ph.D. Student (IST-CMU)*
Paulo Santos, *Ph.D. Student, Adjoint Professor (UAlg)*
Pedro Guerreiro, *Ph.D. Student*
Pinar Oguz Ekim, *Ph.D. Student*
Qiwei Han, *Ph.D. Student (IST-CMU)*
Rathapon *Saruthirathanaworakun, Ph.D. Student (IST-CMU)*
Ricardo Cabral, *Ph.D. Student*
Roberto Lam, *Ph.D. Student, Adjoint Professor (UAlg*)
Rodrigo Belo, *Ph.D. Student (IST-CMU)*
Ricardo Ribeiro, *Ph.D. Student*
Rui Guerreiro, *Ph.D. Student*
Ryan Turner, *Ph.D. Student (IST-CMU)*
Sabina Zejnilovic, *Ph.D. Student (IST-CMU)*
Susana Brandão, *Ph.D. Student (IST-CMU)*
Tânia Oliveira, *Ph.D. Student*

Ana Milene Vieira, *M.Sc. Student (UAlg)*
Carlos Carreiras, *M.Sc. Student*
David Lazera, *M.Sc. Student*
Emanuel Vieira, (UAlg)
Fábio Gameiro, *M.Sc. Student*
Filipa Mesquita, *M.Sc. Student*
Filipe Funenga, *M.Sc. Student*
João Leal, *M.Sc. Student*
Manuel Moreno, *M.Sc. Student (UAlg)*
Michel Cânovas, *M.Sc. Student*
Pedro Ferrão, *M.Sc. Student*
Ricardo Maximiano, *M.Sc. Student*
Salman Siddiqui, *M.Sc. Student (UAlg)*
Sérgio Agostinho, *M.Sc. Student*

Cristiano Soares, *Collaborator*
Marko Beko, *Collaborator*
Ricardo Sousa, *Collaborator*

B) PROJECTS

- **NEURALDYNAMICS** - FP7-ICT-2009-6 PN: 270247
- **UAN** - FP7, ICT/Security Nº 225669
- **OAEx** - FP7-PIRSES-GA-2008-230855
- **SMARTVISION** - PTDC/EIA/73633/2006
- **WEAM** - PTDC/ENR/70452/2006
- **ADDI** - PTDC/SAU-BEB/103471/2008
- **ARGUS** - PTDC/EEA-CRO/098550/2008
- **Detection of Brain Microstates in Fibromyalgia** - PTDC/SAU-BEB/104948/2008
- **URBISNET** - PTDC/EEA-CRO/104243/2008
- **SENSOCEAN** - PTDC/EEA-ELC/104561/2008
- **ANIMAR** - PTDC/CTE-SPA/110909/2009
- **BLAVIGATOR** - RIPD/ADA/109690/2009
- **ADIAR** - Doença de Alzheimer: Análise de Imagens e Reconhecimento - PTDC/SAU-ENB/114606/2009
- **COGNAT** - PTDC/MAR/112446/2009
- **PHITOM** - PTDC/EEA-TEL/71263/2006
- **NIPS** - CMU-PT/SIA/0026/2009

C) OBJECTIVES

Fundamentals
Bilinear data models are ubiquitous in engineering applications, e.g., photometric stereo in computer vision, blind source separation in wireless communications, bilinear matrix inequalities in robust control, hyperspectral image unmixing with nonnegative matrix factorizations, etc. The recently introduced BALM (Bilinear modeling via Augmented Lagrange Multipliers) is an algorithm paradigm which seamlessly handles data fitting problems for bilinear models with constraint manifolds by reducing them to successive least-squares and manifold projections. Extensive numerical simulations have shown its excellent performance in a variety of bilinear problems, but a theoretical study of its capabilities is still lacking. The goal is to do a theoretical study of the BALM convergence properties.

Sensor networks
Many applications involving networks of agents consist in solving distributed convex optimization problems through local message exchanges, e.g., distributed estimation in wireless sensor networks, cooperative spectrum sensing in cognitive radio networks, etc. The main goal is to design fast decentralized optimization algorithms resilient to the random wireless channels connecting the agents. In these and other sensing problems spatial information plays a fundamental role, e.g., the data collected by individual nodes in the network has to be georeferenced to make it truly useful, or the positions of nodes or targets may even be the actual quantities of interest to be derived from measurements. The unavailability of GPS at network nodes due to economic or technical constraints (e.g., operation in indoor environments, or with very limited energy budget) motivates a line of research whose goal is to obtain estimates for the positions/parameters of nodes and point-like or diffusive sources from unreliable measurements of variables such as range, received signal strength, concentrations of chemicals, etc.

Image and Video Analysis
In what respects to Image and Video Analysis Several, our group addresses several fundamental problems, guided by key applications. In general, our objectives concern the development of

fundamental tools for inferring high level content from image sequences, with applications that range from image recognition to medical image analysis. Examples are the representation and estimation of non-rigid (i.e., deformable) 3D shape of objects from video sequences; the development of representations suitable for image recognition tasks such as image database indexing, information retrieval and object recognition; the recognition of human activity in surveillance applications; the detection of skin lesions in dermoscopic images; and the automatic segmentation of the left ventricle of the heart in ultrasound images.

Biomedical Engineering
Our research activity addresses biomedical engineering along two main lines: i) Basic research in Neurosciences and physiology modeling and ii) Computer added diagnosis (CAD) applications and algorithms. In the first class, the ongoing works on perfusion and functional magnetic resonance imaging (MRI) and physiological modeling of the Autonomic nervous System will continue and incremented. In the second line (CAD), the characterization of the atherosclerotic disease of the carotid (CADC) for help in the decision making of endarterectomy, Automatic Chronic Liver Disease Diagnosis and characterization, Sleep disorders monitoring and diagnosis, Alzheimer's Disease and Mild Cognitive Impairment Diagnosis (ADIAR) and Brain Decoding are the main ongoing projects docking our main research activity and the main support to our scientific production.

Underwater Acoustics
Taking advantage of the spatial diversity of multi-sensor arrays and the inherent physical media variability, the emphasis of this group is to provide enhanced methods for underwater acoustic channel distortion mitigation. Areas of application include: mobile and fixed node underwater acoustic networks, target detection in port protection activities and remote environmental monitoring.

D) MAIN ACHIEVEMENTS

Fundamentals
We made a detailed theoretical study of the convergence properties of the algorithm BALM (Bilinear modeling via Augmented Lagrange Multipliers). BALM is a general-purpose optimization framework which solves data fitting problems for bilinear models with manifold constraints. Our theoretical analysis proved that BALM enjoys the typical local convergence properties of standard block coordinate descent (BCD) methods in spite of the presence of the manifold constraints. This required extending the proofs of BCD methods to the manifold setting. As a result of independent interest, we have also proved that many constraint sets in computer vision factorizations problems are actually differentiable manifolds, hence amenable to the BALM framework. One IJCV and one IEEE-PAMI papers were published.

Sensor Networks
We designed a novel distributed optimization algorithm for solving convex optimization problems in networks of agents. The algorithm is implementable by the popular gossip protocol and converges even with random asymmetric link failures between agents. Four IEEE-TSP journal papers and two ICASSP conference papers were published tied to this research, conducted within the CMU-Portugal program. We developed centralized algorithms, based on semidefinite relaxations of likelihood functions for Gaussian or Laplacian noise, for target or node localization using range measurements. These exhibit very good accuracy and the convex nature of the associated optimization problems dispenses with prior information on the target or node positions. The algorithms for Laplacian noise are particularly useful for accommodating outlier measurements that occur in practical ranging systems. One IEEE-TSP journal paper and an OCEANS conference paper were published.

Image and Video Analysis
We showed how to uniquely define the orientation of an arbitrary 2D shape in terms of what we call its Principal Moments. We further show that a small subset of these moments suffices to describe the underlying 2D shape, which is particularly relevant when dealing with large databases. One IEEE-TIP journal paper was published.
We designed a feature extractor methodology that is able to handle several types of matching problems for which the system has not been trained, and proposed an efficient representation/normalization procedure for arbitrary 2D shapes and images. Using matrix completion techniques we introduced a new object recognition. One ICIP and a NIPS conference papers were published. We developed a model for the description of human trajectories and activities based on multiple parametric motion fields. The model is able to represent a wide variety of motion regimes due to its ability to switch among different motion fields. One ICIP paper was published.

Biomedical Engineering
In the scope of the project CADC a reliable and validated score, called Enhanced Activity Index (EAI), was designed and implemented. A PhD thesis was concluded, several book chapters were published and a patent submission process was initiated at the USA for commercialization purposes. Also, in the scope of the work with Ultrasound data a book on advanced techniques on Ultrasonography was edited. In the scope of our collaboration with the Institute of Molecular Medicine in reconstruction from Laser Scanning Fluorescent Confocal Microscopy images a PhD thesis was also concluded and several publications were produced.

Underwater Acoustic
In underwater communication networking, a common understanding was reached on the perturbations of time variable channel impulse responses between moving nodes of a network deployed on a shallow water area, leading to a series of mitigation measures implemented with a time-reversal based equalizer. The algorithms were implemented and tested at sea during an experiment in Norway and to date the only known experiment with a functioning full IP – layered underwater network incorporating fixed and moving nodes. The development of environmental inversion algorithms pointed towards the usage of ambient acoustic noise sources for environmental monitoring by estimating the channel Green's function between two underwater sensors arbitrarily located, which is novel for determining water column properties along time and space.

A tomographic framework was developed for localizing a source based on the observed pattern of wavefronts impinging upon a receiver array, using a combination of semidefinite relaxation and inverse problem methods. This enables useful positioning and navigation data to be extracted with no overhead from high-frequency transmissions used in underwater acoustic communication systems.

E) GROUP PRODUCTIVITY

1. Patents/propotypes
Patents:
“Modelo, processo e dispositivo para a avaliação da mobilidade/acessibilidade em áreas urbanas”, António Cunha, João Varajão, Maria Cunha, João Rodrigues, Paula Teles. Patente Provisória Acto nº 20111000059017 - processo nº 01 105837 (2011/07/27).

Prototypes:
SmartVision: active vision aid for the blind.

2. Organization of Conferences

Local Organizing Committee, V Symposium Ibero American in Computer Graphics (SIACG 2011), University of the Algarve, Faro, Portugal, 2-3 July, 2011.

3. Internationalization

The new EU project NeuralDynamics (start 1/4/11, duration 4 years, 3 Meuro) allows to establish an active collaboration with Ruhr-University in Bochum (Germany), Hogskolan I Skovde (Sweden) and Scuola Univ. Prof. della Svizzeria Italiana (Switzerland).

2.4. EVOLUTIONARY SYSTEMS AND BIOMEDICAL ENGINEERING LAB

A) RESEARCH TEAM

Agostinho Rosa, *Associate Professor*
Patrícia Figueiredo, *Assistant Professor*
Carlos Fernandes, *Post-Doc Researcher*

Alexandre Calapez, *Ph.D. Student*
Daria Migotina, *Ph.D. Student*
Hongfei Gong, *Ph.D. Student*
Inês Sousa, *Ph.D. Student*
João Jorge, *Ph.D. Student*
Marco Leite, *Ph.D. Student*
Marta Sousa, *Ph.D. Student*
Nelson Pereira, *Ph.D. Student*
Nuno Fachada, *Ph.D. Student*
Nuno Leite, *Ph.D. Student*
Rogério Largo, *Ph.D. Student*
Teresa Murta, *Ph.D. Student*

Ana Portêlo, *M.Sc. Student*
Bruno Martins, *M.Sc. Student*
Carlos Cabral, *M.Sc. Student*
Carlos Isidoro, *M.Sc. Student*
João Semedo, *M.Sc. Student*
Marco Miranda, *M.Sc. Student*
Pedro Osório, *M.Sc. Student*

Cristian Munteanu, *Collaborator*
Ernesto Soares, *Collaborator*
Fernando Melicio, *Collaborator*
João Caldeira, *Collaborator*
João Rodrigues, *Collaborator*
Vitor Lopes, *Collaborator*
Vitorino Ramos, *Collaborator*

B) PROJECTS

- **Fluct.Wind** - PTDC/SEN-ENR/114178/2009
- **NEUROIMAGIOLOGIA** - Neuroimaging investigation of learning mechanisms in the human brain: new methodological approaches – PTDC/SAU-BEB-65977/2006, Jan 2008 – Jun 2011.
- **DYNIMAG:** Dynamic Neuroimaging in Epilepsy - PTDC/SAU-ENB/112294/2009, Jan 2011 – Dec 2013.

C) OBJECTIVES

The long term objective of LaSEEB group is to develop model-based real-time detection and classification of brain states using the multichannel Electroencephalogram (EEG) signal, where models and classifiers are optimized by bio-inspired algorithms. The final goal is not only to provide a better understanding of the brain functions but also providing affordable efficient training, prevention and therapy techniques.

Modelling and Classification of brain States during awake and sleep for Neurocognitive training using Self-Organized Swarm Intelligence techniques.

Research in neuroimaging was conducted with two main objectives: 1) development of quantitative functional magnetic resonance imaging (fMRI) techniques, resorting to both Blood Oxygen Level Dependent (BOLD) and Arterial Spin Labeling (ASL) contrasts; and 2) dynamic imaging in epilepsy, resorting to the simultaneous acquisition of the electroencephalogram (EEG) with fMRI.

D) MAIN ACHIEVEMENTS

The main achievements during 2010 are the first steps toward the new proposal of Linguistic Modelling through Rhythm Segmentation of the Electroencephalographic (EEG) signals of Human Sleep and on further development, implementation and application of Neurofeedback (NF) based Brain Training and Neurophysiologic Therapy. The potential application of the advances have been demonstrated namely on the definition of Peripheral Vision (PV) Indexes for Team Sports or Driving/Steering Machines and currently on the development of PV enhancement through NF. The topic of biologically inspired new algorithms and paradigms for search and optimization has been extended. Current focus is on Evolutionary Algorithms for Dynamic Environments and Artificial Life Modelling and Simulations of Bio-systems and its application to Exams Timetabling. Advantages of using multiprocessor or multicell architectures have been investigated as workhorse for Agent Based Modelling and Simulations Systems.

Along the quantitative fMRI research line, Bayesian optimization of perfusion measurements obtained using ASL was achieved (Santos et al., 2011; Sousa et al., 2011). A study comparing BOLD and ASL measurements of functional activation during a motor task was conducted (Pimentel et al., 2011; Vilela et al., 2011). A successful improvement to existing brain decoding techniques for fMRI data was also achieved (Cabral et al., 2011).

In the dynamic imaging in epilepsy project, dynamic systems methodologies for estimating effective connectivity were applied to a case study (Murta et al., 2011), and novel methodologies are being developed resorting to multiple-model approaches (Rosa et al., 2011). Models of the transfer function between EEG and fMRI signals were also explored for improved multimodal integration (Leite et al., 2011).

E) GROUP PRODUCTIVITY

1. Organization of Conferences

ACM SAC 2011 – Computational Intelligence Image Analysis track, Taichung, Taipei.
INSTICC – IJCCI - International Conference on Evolutionary Computation 2011 – Program Chair, Paris, France.

2. Internationalization

ION-UCL group in the Dynamic Neuorimaging in Epilepsy project
Patricia Figueiredo hosted Prof. Louis Lemieux, from Institute of Neurology (ION) University College London (UCL), UK, September – December 2011.

IST-EPFL Joint Doctoral Initiative
Patrícia Figueiredo is co-supervisor of PhD candidate João Jorge, with Prof. Rolf Gruetter at EPFL, Switzerland, since September 2011.

2.6. DYNAMICAL SYSTEMS AND OCEAN ROBOTICS LAB

A) RESEARCH TEAM

Antonio Pascoal, *Associate Professor*
Carlos Silvestre, *Associate Professor*
Paulo Oliveira, *Associate Professor*
António Pedro Aguiar, *Assistant Professor*
Alessandro Saccon, *Post-Doc Researcher*
Marco Martins Morgado, *Post-Doc Researcher*
Paulo André Nobre Rosa, *Post-Doc Researcher*
Pedro Tiago Martins Batista, *Post-Doc Researcher*
Rita Cunha, *Post-Doc Researcher*

Andre Oliveira, *Ph.D. Student*
Andrea Alessandretti, *Ph.D. Student*
Andreas Häusler, *Ph.D. Student*
Bruno Guerreiro, *Ph.D. Student*
Bruno Gomes, *Ph.D. Student*
Daniel Silvestre, *Ph.D. Student*
Daniel Viegas, *Ph.D. Student*
David Cabecinhas, *Ph.D. Student*
Francisco Machado, *Ph.D. Student*
João Almeida, *Ph.D. Student*
Jorge Soares, *Ph.D. Student*
Mohammadreza Bayat, *Ph.D. Student*
Pedro Serra, *Ph.D. Student*
Pedro Casau, *Ph.D. Student*
Pramod Maurya, *Ph.D. Student*
Sérgio Brás, *Ph.D. Student*
Sérgio Pequito, *Ph.D. Student*
Tiago Gaspar, *Ph.D. Student*
Vahid Hassani, *Ph.D. Student*

Bruno Cardeira, *Technician*
João Botelho, *Research Assistant*
Jorge Ribeiro, *Research Assistant*
Luis Sebastiao, *Research Assistant*
Manuel Cecílio Rufino, *Research Assistant*

Filipa Almeida, *Administrative*
Loic Bamdé, *Administrative*

B) PROJECTS

- **AIRTICI** – AdI - 2009-2012 QREN
- **SCARVE** – FCT - PTDC/EEA-CRO/102857/2008
- **AMMAIA** – FCT - PTDC/HISARQ/103227/2008
- **MAST/AM** – FCT - PTDC/EEA-CRO/111197/2009
- **CONAV** – FCT - PTDC/EEA-CRO/113820/2009
- **HIVCONTROL** - FCT - PTDC/EEA-CRO/100128/2008
- **ATLAS** – FCT - PTDC/EEA-ELC/111095/2009
- **TRIDENT** - 2010-2013 FP7248497 ICT-2009.2.1
- **CO3AUVs** - 2009-2012 FP720073 ICT2007.2.1

C) OBJECTIVES

The key objectives of the R&D work carried out at the DSORL are twofold: i) to study a number of challenging theoretical problems in the areas of advanced robotic vehicle systems design, navigation, and control, and ii) to exploit the theoretical methodologies developed to yield faster, cheaper, and far more efficient systems and tools for ocean exploration and exploitation and critical infrastructure inspection, than those available today. The tools include surface and underwater robots, as well as aerial vehicles working as communication relays or re-directing the operations of marine vehicles upon detection of relevant episodic events. These goals have motivated the definition of a research and development program addressing theoretical and practical engineering topics, as well as issues that are at the crossroads of marine science and technology and are the main focus of some of the cooperative research and development work set forth under Research Lines D and E of the LARSyS. Two main lines of action underpin the work carried out at the DSORL:
1. Contributing to furthering the knowledge in the general area of dynamical system theory.
2. Developing new analysis and design tools in the areas of motion planning, navigation, guidance, and control (NGC) and applying them to the development of advanced systems to enable the operation of multiple networked autonomous marine and aerial vehicles, including humans in the loop.

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. Multiple Model Adpative Estimation (MMAE) and Robust Multiple Model Adaptive Control (RMMAC): Development of new methodologies for the design of estimators and robust adaptive controllers for plants with structured and unstructured uncertainty.
C. Design of Navigation and Positioning Systems for autonomous underwater platforms and groups of marine vehicles interacting with human divers. Study of advanced solutions focusing on the: i) development of high performance, moderate cost heading and attitude reference units; ii) study and

practical evaluation of optimal sensor placement algorithms and acoustics-based systems for simultaneous underwater vehicle tracking; iii) development of geophysical-based navigation algorithms for single and cooperative multiple vehicles using terrain and geomagnetic data.
D. Motion Control of single and multiple vehicles under stringent communication constraints, including those imposed by the harsh conditions observed in the ocean: temporary communication losses, acoustic multiple path effects, "ray bending", and fading. Problems addressed: i) Cooperative control and navigation of groups of autonomous vehicles; ii) Close-range multiple vehicle formation control using acoustic and optical-based range/bearing measurements, iii) Networked control over faulty communication links, iv) Terrain Contour Tracking, v) Visual servoing control.
E. Development of advanced methods for Cooperative Multiple Vehicle Motion Planning in the presence of stationary and moving obstacles, subjected to energy and temporal constraints, as well as navigation-related constraints.
F. Inspired by single and multiple vehicle control scenarios, develop advanced compensators that can be used in networked environments by: i) resorting to the framework of hybrid systems to model several networked control systems that are periodic or event based, and ii) using the machinery of Volterra equations, piecewise deterministic processes, dynamic programming, and Lyapunov based tools to address and solve the resulting problems.

Practical Objectives:
A. Design and development of Autonomous Underwater Vehicles (AUVs), Autonomous Surface Crafts (ASCs), and Unmanned Air Vehicles (UAVs); with on-board integration of scientific sensor suites and data acquisition / logging systems.
B. Development of distributed hardware and software architectures for cooperative navigation and motion control of multiple vehicles, as well as mission control of heterogeneous platforms.
C. Tests and scientific missions at sea (with the autonomous vehicles and support systems developed) in cooperation with the scientific partners in Research Lines D and E of the LARSyS and other international institutions.
D. Dissemination actions for young students and the public at large with the objective of bringing visibility to the challenging areas of advanced marine and aerial robotic systems and their multifaceted applications in challenging scientific, surveillance, and security mission scenarios.

D) MAIN ACHIEVEMENTS

Theoretical Achievements
1. Development of novel Multiple-Model Adaptive Control (MMAC) and Multiple Model Adaptive Estimation (MMAE) architectures for plants subjected to structured and unstructured uncertainty and sensor noise. Selected algorithms were successfully tested during experiments of Dynamic Positioning of a scale model of a surface ship at the Norwegian University of Science and Technology (NTNU).
2. Study of new algorithms for control and state estimation on SE(3). Development of a method to solve constrained cooperative motion planning problems for multiple vehicles (undergoing translational and rotational motions) by using a Lie group projection-operator approach.
3. Development of a projection-operator approach (in Euclidean space) for multiple vehicle cooperative motion planning with temporal or energy cost criteria, with due account for full vehicle dynamics, temporal or spatial deconfliction, and communication and navigation-related constraints.
4. Development and field testing of robust decentralized strategies for cooperative path-following control and time-coordination of unmanned air vehicles (UAVs) over dynamic communications networks (work done in cooperation with the Naval Postgraduate School. Monterey, CA and the Univ. Illinois, Urbana, USA).

5. Study of nonlinear filter algorithms for combined Terrain-Aided / Single-Beacon based navigation in the presence of unknown marine currents; assessment of their performance in field tests using an autonomous marine vehicle equipped with an acoustic ranging device and a bottom-looking echosounder.
6. Further development of nonlinear filtering structures for USBL tightly coupled inertial navigation and development of nonlinear GPS/IMU based observers for rigid body attitude and position estimation.
7. Further developments on rotorcraft and aircraft image based controllers for extended flight envelope coverage. The proposed solution consists of a nonlinear state feedback controller for thrust and torque actuations that uses directly the image features in the control loop.
8. Further development of new methods to prove almost input-to-state stability (ISS) and almost global stability of nonlinear "rotational motion" systems by exploiting the combined use of Lyapunov Functions and Density Functions.
9. Further development of algorithms for Nonlinear Attitude Estimation Systems Using Active Vision and Inertial Measurements, as applied to the problem of estimating the attitude of a rigid body equipped with a triad of rate gyros and a pan and tilt camera.
10. Further results on Networked and Event Based Control Systems. New developments were obtained for a class of systems that is especially suited to model networked control systems utilizing CSMA-type protocols, with stochastic intervals between transmissions and packet drops.
11. Optimal acoustic sensor placement: study of the performance that can be achieved with networked acoustic sensors to track multiple underwater targets by resorting to tools from estimation theory and multiple-objective optimization (Pareto optimal solutions).

Practical Achievements
1. Further redesign, development, and test of an autonomous quadrotor for the inspection of critical infrastructures. The aerial vehicle, developed under the AIRTICI project, is equipped with video cameras and lasers that, together with advanced control and navigation algorithms, will enable the robot to operate close to walls or under bridges without GPS.
2. Further development and testing of an integrated Ultra Short Baseline (USBL) and Inertial Navigation System (INS) to be used as a low cost cooperative navigation system for underwater robotic vehicles. Tests were conducted both in Sesimbra and in Spain, in the scope of the EU-TRIDENT project.
3. Design, development, and full demonstration of the capabilities at sea of a small fleet of three autonomous surface vehicles named MEDUSA and related systems for cooperative mission programming and mission execution. The vehicles are equipped with equipped with acoustic devices for underwater target tracking and cooperative, complementary terrain-based / single beacon navigation.
4. Development and demonstration of an integrated system for assisted diving operations, illustrating joint robot/human missions (final demo in the scope of the EU-CO3AUVs project): a diver was guided along a path underwater by relying solely on information issued by a small fleet of MEDUSA vehicles in charge of tracking him. The information was transmitted via the acoustic channel and, after being processed, displayed as heading commands on an array of LEDs placed on the diver´s mask.

E) GROUP PRODUCTIVITY

1. Patents/propotypes

- DELFIM and DELFIM_X Autonomous Surface Vehicles (ASCs) – designed and built by ISR/IST to carry out experimental research in the area of ocean robotics and to perform scientific missions at sea. These vehicles have 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.

- MEDUSA Autonomous Semisubmersibles – a fleet of 3 marine robots and associated software/hardware systems for cooperative mission programming and execution, designed and built by ISR/IST. The vehicles are equipped with acoustic devices to carry out experiments of underwater target tracking and cooperative navigation. The underwater segment communicates via an acoustic network that can be expanded to include 6 modems.
- Autonomous Quadrotor - designed and built by ISR/IST. A quadrotor helicopter with payload capability of about 1 kg. Developed in the scope of the AIRTICI project for aerial vehicle hardware and software architectures test and evaluation. The prototype will be used in bridge inspection tasks.
- 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.
- CARAVELA 2000 Autonomous Research Vessel – designed and built by IMAR/DOP/UAzores, 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).
- INFANTE Autonomous Underwater Vehicle (AUV) – designed and built by ISR/IST and the company RINAVE 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.

2. Organization of Conferences

- Chairman of Session: Linear Systems IV, 50th IEEE Conference on Decision and Control and European Control Conference (CDC-ECC 2011), Orlando, Florida, USA, December 2011.
- Chairman of Session: Hybrid Systems II, 50th IEEE Conference on Decision and Control and European Control Conference (CDC-ECC 2011), Orlando, Florida, USA, December 2011.
- Chairman of Session: Output Feedback and Observers III, 50th IEEE Conference on Decision and Control and European Control Conference (CDC-ECC 2011), Orlando, Florida, USA, December 2011.
- Chairman of Session: Aircraft GNC, 17th IFAC World Congress, Milano, Italy, September 2011.
- Chairman of Session: Underwater Vehicles, American Control Conference (ACC 2011), San Francisco, California, USA, June 2011.
- Organizers, Special Session entitled Marine vehicle motion planning, navigation, and control, 17th IFAC World Congress, Milano, Italy, September 2011.
- Chairman of Session: Marine vehicle motion planning, navigation, and control, 17th IFAC World Congress, Milano, Italy, September 2011.
- Co-chairman of Session: Multiple model adaptive control, 17th IFAC World Congress, Milano, Italy, September 2011.
- Co-organizers (A. Aguiar, J. Hespanha, I. Kaminer, A. Pascoal), 1 day Pre-Conference Workshop on Multiple Vehicle Motion Planning, Navigation, and Control - Theory and Practice, 17th IFAC World Congress, Milano, Italy, September 2011.
- Organizers, 5 day course on Cooperative Navigation and Control of Multiple Robotic Vehicles, EECI-HYCON2 Graduate School on Control, www.eeci-institute.eu/GSC2011, Feb. 21-25, 2011, European Embedded Control Institute, SUPELEC, Paris, France. This intensive course covered a number of issues pertaining to cooperative navigation control of multiple

marine vehicles. Special emphasis was placed on a number of systems being developed in the scope of the CO3AUVs project. In the course of the lectures, the scope and state of progress of the project were explained to an audience of doctoral students with excellent academic credentials.

3. Internationalization

- Naval Postgraduate School, Monterey, CA (USA) – a long standing collaborative research program on AUV and UAV Navigation, Guidance, and Control (NGC).
- Center for Control, Dynamical Systems, and Computation (CCDC) at the University of California, Santa Barbara, CA (USA) – joint work on control, estimation theory, and networked control systems.
- National Institute of Oceanography (NIO), Goa (India) – an intensive AUV research and development program initiated in 1999.
- Department of Engineering Cybernetics, Norwegian University of Science and Technology (NTNU), Trondheim (Norway) - joint work on cooperative path following control.
- Georgia Institute of Technology (USA). Joint initiatives on development of decision systems based on Set Valued Observers.
- Laboratoire I3S – CNRS, Sophia-Antipolis, NICE France. Joint initiatives on Vision Based Control for Unmanned Air Vehicles.
- ECE, Carnegie Mellon University, Pittsburgh (USA). Joint initiatives on Analysis and Design of Complex Hybrid Dynamical Control Systems.
- University of Lund, Sweden. Joint initiatives on the development of stability analysis techniques or nonlinear observers on manifolds.

Participation in International Technical Committees

- Member, IEEE Control System Society Technical Committee on Aerospace Control (TCAC).
- Member, IFAC Technical Committee on Aerospace.
- Chair, IFAC Technical Committee on Marine Systems.
- Member, IFAC Technical Committee on Intelligent Autonomous Vehicles.
- Vice-President, EUROCEAN (http://www.eurocean.org/), the European Center for Information on Marine Science and Technology.

Talks by invitation

- Online Inertial map and trajectory estimation, French Group in Robotics Research, GDR-Robotique, ENSAM Paris, November, 2011.
- Aerial and Marine Vehicles for Critical Infrastructures Inspection, Faculty of Science and Technology University of Macau, April, 2011.
- Cooperative Navigation and Motion Control of Multiple Autonomous Marine Vehicles, 3rd International Interdisciplinary Field Training of Marine Robotics and Applications, Murter, Croatia, Sept. 19-24, 2011.
- Cooperative Navigation and Control of Multiple Marine Robots: Theory and Practice, 15th International Conference on Advanced Robotics ICAR 2011, Tallinn, June, 2011.
- Nonlinear motion control of marine robotic vehicles (Part I) and Cooperative control of multiple robotic vehicles (Part II), (Co3-AUVs) 2nd Summer School, Bremen, Jul. 2011.

3. PUBLICATIONS

A) PH.D. THESES (6)

[1] **José Seabra**, "Medical Ultrasound B-Mode Modeling, De-speckling and Tissue Characterization. Assessing the Atherosclerotic Disease", Ph.D. Thesis, Instituto Superior Técnico, Universidade Técnica de Lisboa, 2011.

[2] **Manuel Marques**, "The Role of Rigidity in Structure from Motion: Unique Solutions in 3D Reconstruction and Object Matching", Ph.D. Thesis, Instituto Superior Técnico, Universidade Técnica de Lisboa, 2011.

[3] **Duarte Antunes**, "Stochastic, Dynamic, and Periodic Networked Control Systems", Ph.D. Thesis, Instituto Superior Técnico, Universidade Técnica de Lisboa, 2011.

[4] **Marco Morgado**, "Advanced Ultra-Short Baseline Inertial Navigation Systems", Ph.D. Thesis, Instituto Superior Técnico, Universidade Técnica de Lisboa, 2011.

[5] **Isabel Rodrigues**, "Cell nucleus reconstruction and analysis of laser scanning fluorescence confocal microscopy (LSFCM) images", Ph.D. Thesis, Instituto Superior Técnico, Universidade Técnica de Lisboa, 2011.

[6] **Paulo Rosa**, "Robust Adaptive Control Theory", Ph.D. Thesis, Instituto Superior Técnico, Universidade Técnica de Lisboa, 2011.

B) BOOKS (Author) (1)

[1] **P. Silva**, *Das Sociedades Humanas às Sociedades Artificiais*, Âncora Editora, Lisboa, 2011.

C) BOOKS (Editor) (1)

[1] **Computational Intelligence**, K. Madani, A. D. Correia, Agostinho Rosa, J. Filipe (Eds.), Springer, Series: Studies in Computational Intelligence, Vol. 343, 1st Edition, 2011.

D) CHAPTERS IN BOOKS (8)

[1] **C. Isidoro, N. Fachada, F. Barata, A. Rosa**, An Agent Based Model of Dengue Disease Transmission by Aedes aegypti Populations, *LNCS, Artificial Life*, Part II, pp. 339-346, Springer , 2011.

[2] **C. Fernandes, C. F. Lima, J. L. Gimenez, A. Rosa, J. J. Merelo**, An Ant-based Rule for UMDA's update Strategy, *LNCS, Artificial Life*, Part I, pp. 339-346 Springer, 2011.

[3] **A. Rosa, J. P. Rodrigues**, Dream therapy: correlation of dream contents with encephalographic and cardiovascular activations, *States of Consciousness: Experimental Insights into Meditation,*

Waking, Sleep and Dreams, Dean Cvetkovic and Irena Cosic (Eds), Springer, The Frontiers Collection, ISBN 9-78-3-642-18046-0, pp. 109-132, 2011.

[4] **C. Fernandes, J. L. Laredo, A. Mora, A. Rosa, J. J. Merelo**, The Sandpile Mutation Operator for Genetic Algorithms, *LNCS, Learning and Intelligent Optimization*, Vol. 6683, pp. 552-556, 2011.

[5] **A. M. Mora, C. Fernandes, J. J. Merelo**, KANTS: A Self-Organized Ant System for Pattern Clustering and Classification, in *Ant Colonies: Behavior in Insects and Computer Applications*, Ant Colonies: Behavior in Insects and Computer Applications, Nova Publishers, 2011.

[6] J**. P. Rodrigues, A. Rosa**, EEG Biofeedback: Viability and Future Directions, *Human Computer System Interaction: Background and Application 2*, Hippe, Zdzislaw S; Kullowski, Julusz L; Mroczak, Theresa (Eds.), Computational Intelligence and Complexity series, Springer , 2011.

[7] **C. Fernandes, J. L. Laredo, A. Mora, A. Rosa, J. J. Merelo**, A Study on the Mutation Rates of a Genetic Algorithm Interacting with a Sandpile, *LNCS, Applications of Evolutionary Computation*, Vol. 6624, pp. 32-42, 2011.

[8] J**. L. Laredo, J. J. Merelo, C. Fernandes, A. Mora, M. G. Arenas, P. Castillo, P. G. Sanchez**, Analysing the Performance of Different Population Structures for an Agent-based Evolutionary Algorithm, *LNCS, Computer Science*, Vol. 6683, pp. 582-585, 2011

E) INTERNATIONAL JOURNALS (45)

[1] **F. Valente, A. Vale, D. Fonte, M. I. Ribeiro**, "Optimized trajectories of the transfer cask system in ITER", *Fusion Engineering and Design*, Elsevier, Vol. 86, pp. 1967-1970, 2011, http://dx.doi.org/10.1016/j.fusengdes.2010.12.027, 2011.

[2] **N. Greggio, A. Bernardino, C. Laschi, J. Santos-Victor, P. Dario**, "Real-Time 3D Stereo Tracking and Localizing of Spherical Objects With The iCub Robotic Platform", *Journal of Intelligent Robotic Systems*, Vol. 63, No. 3-4, pp. 417-446, 2011.

[3] **N. Greggio, A. Bernardino, C. Laschi, J. Santos-Victor, P. Dario**, "Fast Estimation of Gaussian Mixture Models for Image Segmentation", *Machine Vision and Applications*, DOI 10.1007/s00138-011-0320-5, March, 2011.

[4] **P. Ekim, J. Gomes, J. Xavier, P. Oliveira**, "Robust Localization of Nodes and Time-Recursive Tracking in Sensor Networks Using Noisy Range Measurements", *IEEE Transactions on Signal Processing*, Vol. 59, No. 8, pp. 3930-3942, August, 2011.

[5] **M. Morgado, P. Batista, P. Oliveira, C. Silvestre**, "Position USBL/DVL Sensor-Based Navigation Filter in the Presence of Unknown Ocean Currents", *Automatica*, Vol. 47, No. 12, December, pp. 2604–2614, 2011.

[6] **P. Batista, C. Silvestre, P. Oliveira**, "Partial Attitude and Rate Gyro Bias Estimation: Observability Analysis, Filter Design, and Performance Evaluation", International Journal of Control, Vol. 84, No. 5, 2011.

[7] **J. Vasconcelos, A.Rantzer, C. Silvestre, P. Oliveira**, "Combination of Lyapunov and Density Functions for Stability of Rotational Motion", *IEEE Transactions on Automatic Control*, Vol. 56, No. 11, pp. 2599-2607, November, 2011.

[8] **J. Vasconcelos, C. Silvestre, P. Oliveira**, "INS/GPS Aided by Frequency Contents of Vector Observations with Application to Autonomous Surface Crafts", *IEEE Journal of Oceanic Engineering*, Vol. 36, No. 2, April, 2011.

[9] **P. Batista, C. Silvestre, P. Oliveira**, "Vector-based Attitude Filter for Space Navigation", *Journal of Intelligent & Robotic Systems*, Vol. 64, No. 2, pp. 221-243, 2011.

[10] **P. Rosa, J. Shamma, C. Silvestre, M. Athans**, "Stability Overlay for Adaptive Control Laws", Automatica, Vol.47, No 5, pp. 1007-1014, May, 2011.

[11] **D. Jakovetic, J. Xavier, J. M. F. Moura**, "Cooperative convex optimization in networked systems: augmented Lagrangian algorithms with directed gossip communication", *IEEE Transactions on Signal Processing*, vol. 59, no.8, pp. 3889-3902, August, 2011.

[12] **D. Bajovic, D. Jakovetic, J. Xavier, B. Sinopoli, J. M. F. Moura**, "Distributed detection via Gaussian running consensus: large deviations asymptotic analysis", *IEEE Transactions on Signal Processing*, Vol. 59, No. 9, pp. 4381-4396, September, 2011.

[13] **P. Oguz-Ekim, J. P. Gomes, J. Xavier, P. Oliveira**, "Robust Localization of Nodes and Time-Recursive Tracking in Sensor Networks Using Noisy Range Measurements", *IEEE Transactions on Signal Processing*, Vol. 59 , Issue: 8, DOI:10.1109/TSP.2011.2153848 , pp. 3930 - 3942 , 2011.

[14] **J. Sequeira, A. Tsourdos, S. Lazarus**, "Robust covariance estimation for data fusion from multiple sensors", *IEEE Trans Instrumentation and Measurement*, Vol. 60 (12), Dec. 2011, pp. 3833-3844, 2011.

[15] **C. Cabral, M. Silveira, P. Figueiredo**, "Decoding visual brain states from fMRI using an ensemble of classifiers", *Pattern Recognition*, 44: 2983–2993, 2011.

[16] **N. Santos, J. Sanches, I. Sousa, P. Figueiredo**, "Bayesian Optimization of Sampling and Estimation in PASL-MRI Perfusion Imaging", *IEEE Transactions on Biomedical Engineering*, 58(11): 3165-3174, 2011.

[17] **M. Pimentel, P. Vilela, I. Sousa, P. Figueiredo**, "Localization of the hand motor area by ASL and BOLD Fmri", *Human Brain Mapping* (Epub ahead of print), 2011.

[18] **B. Nery, R. Ventura**, "A dynamical systems approach to online event segmentation in cognitive robotics", *Paladyn. Journal of Behavioral Robotics*, 2(1):18–24, March, 2011.

[19] **C. Fernandes, J. J. Merelo, A. Rosa**, "A comparative study on the performance of dissortative mating and immigrants' strategies for evolutionary dynamic optimization", Special Issue on Interpretable Fuzzy Systems, *Information Sciences*, Vol. 181, No. 20, pp. 4428-4459, 2011.

[20] **V. A. Ziparo, L. Iocchi, P. Lima, D. Nardi, P. F. Palamara**, "Petri Net Plans: A Framework for Collaboration and Coordination in Multi-Robot Systems", *Journal of Autonomous Agents and Multi-Agent Systems*, Vol. 23, No. 3, pp. 344-383, 2011.

[21] **M. I. Ribeiro, C. Damiani, A. Tesini, S. Kakudate, M. Siuko, C. Neri**, "The Remote Handling Systems in ITER", *Fusion Engineering and Design*, Elsevier, Vol. 86, pps. 471-477, 2011, doi:10.1016/j.fusengdes.2011.01.138, 2011.

[22] **J. Vasconcelos, B. Cardeira, C. Silvestre, P. Oliveira, P. Batista**, "Discrete-Time Complementary Filters for Attitude and Position Estimation: Design, Analysis and Experimental Validation", *IEEE Transactions on Control Systems Technology*, Vol. 19, No. 1, pp. 181-198, January, 2011.

[23] **P. Batista, C. Silvestre, P. Oliveira**, "On the observability of linear motion quantities in navigation systems", *Systems & Control Letters*, Vol. 60, No. 2, pp. 101-110, February, 2011.

[24] **P. A. Afonso, C. Bispo**, "Railway Traffic Management: Meet and Pass Problem", *Journal of System and Management Sciences*, Vol. 1, No. 6, December, 2011.

[25] **P. Vilela, M. Pimentel, I. Sousa, P. Figueiredo**, "Quantification of Perfusion Changes during a Motor Task Using Arterial Spin Labeling", *The Neuroradiology Journal,* 1: 51-57, 2011.

[26] **I. Sousa, N. Santos, J. Sanches, P. Vilela, P. Figueiredo**, "Challenges for Non-Invasive Brain Perfusion Quantification Using Arterial Spin Labeling", *The Neuroradiology Journal*, 1: 44-50, 2011.

[27] **S. Garrido, L. Moreno, P. Lima**, "Robot Formations Motion Planning using Fast Marching", *Journal of Robotics and Autonomous Systems*, Elsevier, 2011.

[28] **P. Batista, C. Silvestre, P. Oliveira**, "Single Range Aided Navigation and Source Localization: observability and filter design", *Systems and Control Letters*, Vol. 60, No. 8, pp. 665-673, 2011.

[29] **S. Brás, R. Cunha, J. Vasconcelos, C. Silvestre, P. Oliveira**, "A Nonlinear Attitude Observer Based on Active Vision and Inertial Measurements", *IEEE Transactions on Robotics*, Vol. 27, No. 4, pp. 664-677, August, 2011.

[30] **P. Batista, C. Silvestre, P. Oliveira**, "Accelerometer Calibration and Dynamic Bias and Gravity Estimation: Analysis, Design, and Experimental Evaluation", *IEEE Transactions on Control Systems Technology*, Vol. 19, No. 5, pp. 1128-1137, 2011.

[31] **R. Cunha, C. Silvestre, J. Hespanha, A. P. Aguiar**, "Vision-based control for rigid body stabilization", *Automatica*, Vol. 47, No. 5, pp. 1020-1027, May, 2011.

[32] **J. Vasconcelos, G. Elkaim, C. Silvestre, P. Oliveira, B. Cardeira**, "A Geometric Approach to Strapdown Magnetometer Calibration in Sensor Frame", IEEE Transactions on Aerospace and Electronics Systems, Vol. 47, No. 2, pp. 1293-1306, April, 2011.

[33] **T. Gaspar, P. Oliveira**, "Single Pan and Tilt Camera Indoor Positioning and Tracking System", *European Journal of Control*, Vol. 17, No. 4, August, 2011.

[34] **C. Pereira, J. Teixeira, P. Figueiredo, J. Xavier, S. L. Castro, M. Castelo-Branco**, "Music and Emotions in the Brain: Familiarity Matters", *PLoS One*, 6(11):e27241. Epub Nov 16, 2011.

[35] **R. Lemos, P. Figueiredo, I. Santana, M. R. Simões, M. Castelo-Branco**, "Temporal integration of 3D coherent motion cues defining simple objects of unknown orientation is impaired in

amnestic Mild Cognitive Impairment and Alzheimer's Disease", *Journal of Alzheimer's Disease* (Epub ahead of print), 2011.

[36] **J. José, M. Farrajota, J. Rodrigues, H. Du Buf**, "The SmartVision local navigation aid for blind and visually impaired persons", *JDCTA: International Journal of Digital Content Technology and its Applications*, Vol. 5, No. 5, pp. 362 - 375. doi: 10.4156/jdcta.vol 5.issue 5.40, 2011.

[37] **I. Rodrigues, J. Sanches**, "Convex Total Variation Denoising of Poisson Fluorescence Confocal Images with Anisotropic Filtering, *IEEE Transactions on Image Processing*, Vol. 20, No.1, 2011.

[38] **J. Seabra, F. Ciompi, O. Pujol, J. Mauri, P. Radeva, J. Sanches**, "Rayleigh Mixture Model for Plaque Characterization in Intravascular Ultrasound", *IEEE Transactions on Biomedical Engineering*, vol.58, no.5, pp.1314-1324, 2011.

[39] **M. Stošić, M. Marques, J. P. Costeira**, "Convex solution of a permutation problem", *Linear Algebra and its Applications,* Vol. 434, No. 1, pp. 361-369, 2011.

[40] **D. Bajovic, B. Sinopoli, J. Xavier**, "Sensor selection for event detection in wireless sensor networks", *IEEE Transactions on Signal Processing*, vol. 59, no. 10, pp. 4938-4953, 2011.

[41] **L. Bandeira, J. S. Marques, J. Saraiva, P. Pina**, "Automated Detection of Martian Dune Fields", *IEEE Geoscience and Remote Sensing Letters*, Vol. 8, no. 4, pp. 626-630, 2011.

[42] **H. Du Buf, J. Barroso, J. Rodrigues, H. Paredes, M. Farrajota, H. Fernandes, J. José, V. Teixeira, M. Saleiro**, "The SmartVision navigation prototype for blind users", *JDCTA: International Journal of Digital Content Technology and its Applications*, Vol. 5, No. 5, pp. 351 - 361. doi: 10.4156/jdcta.vol5.issue 5.39, 2011.

[43] **J. F. P. Crespo, P. Aguiar**, "Revisiting Complex Moments for 2D Shape Representation and Image Normalization", *IEEE Transactions on Image Processing*, vol. 20, no. 10, 2011.

[44] **N. Santos, J. Sanches, I. Sousa, P. Figueiredo**, "Optimal Sampling and Estimation in PASL Perfusion Imaging", *IEEE Transactions on Biomedical Engineering*, vol.58, no.11, pp.3165-3174, 2011.

[45] **F. Zabel, C. Martins, A. Silva**, "Design of a UAN node capable of high-data rate transmission", *Sea Technology*, Vol.52, No.3, pp.32-36, 2011.

E) INTERNATIONAL CONFERENCES (139)

[1] **B. Lacerda, P. Lima**, "Designing Petri Net Supervisors for Multi-Agent Systems from LTL Specifications" (Extended Abstract), *Proc. of AAMAS 2011 - 10th International Conference on Autonomous Agents and Multiagent Systems*, Taipei, Taiwan, 2011.

[2] **J. Capitán, M. Spaan, L. Merino, A. Ollero**, "Decentralized Multi-Robot Cooperation with Auctioned POMDPs", *Proc. MSDM 2011 - Workshop on Multi-agent Sequential Decision Making in Uncertain Domains*, part of AAMAS 2011 - 10th International Conference on Autonomous Agents and Multiagent Systems, Taipei, Taiwan, 2011.

[3] **M. Spaan, F. Oliehoek, C. Amato**, "Scaling Up Optimal Heuristic Search in Dec-POMDPs via Incremental Expansion", *Proc. MSDM 2011 - Workshop on Multi-agent Sequential Decision Making in Uncertain Domains*, part of AAMAS 2011 - 10th International Conference on Autonomous Agents and Multiagent Systems, Taipei, Taiwan, 2011.

[4] **D. Viegas, P. Batista, P. Oliveira, C. Silvestre**, "Computationally efficient GES cascade observer for attitude estimation", *Proc. of ACC 2011 - American Control Conference*, San Francisco, USA, 2011.

[5] **J. Almeida, C. Silvestre, A. Pascoal**, "Self-triggered output feedback control of linear plants", *Proc. of ACC 2011 - American Control Conference*, San Francisco, USA, 2011.

[6] **D. Viegas, P. Batista, P. Oliveira, C. Silvestre**, "Linear Motion Observers for ASC/AUV Tandems based on Single Range Readings", *Proc. of ACC 2011 - American Control Conference*, San Francisco, USA, 2011.

[7] **D. Antunes, J. Hespanha, C. Silvestre**, "Stochastic networked control systems with dynamic protocols", *Proc. of ACC 2011 - American Control Conference*, San Francisco, USA, 2011.

[8] **P. Batista, C. Silvestre, P. Oliveira**, "Computationally Efficient GES Cascade Observer for Attitude Estimation", *Proc. of ACC 2011 - American Control Conference*, San Francisco, USA, 2011.

[9] **A. Martins, N. Smith, E. Xing, P. Aguiar, M. Figueiredo**, "Online Learning of Structured Predictors with Multiple Kernels", *Proc. of AISTATS 2011 - International Conference on Artificial Intelligence and Statistics*, Ft. Lauderdale, FL, USA, 2011.

[10] **D. Bajovic, D. Jakovetic, J. Moura, J. Xavier, B. Sinopoli**, "Large deviations analysis of consensus+innovations detection in random networks", *Proc. of ALLERTON 2011 - 49th Annual Allerton Conference on Communication, Control, and Computing*, University of Illinois, Urbana-Champaign, USA, 2011.

[11] **S. Pequito, A. Aguiar, B. Sinopoli, D. A. Gomes**, "Unsupervised Learning of Finite Mixture Models using Mean Field Games", *Proc. of ALLERTON 2011 - 49th Annual Allerton Conference on Communication, Control, and Computing*, University of Illinois, Urbana-Champaign, USA, 2011.

[12] **S. Zejnilović, J. P. Gomes, B. Sinopoli**, "Collaborative sequential-based detection in wireless sensor networks", *45th Asilomar Conference on Signals, Systems, and Computers*, Pacific Grove, California, USA, 2011.

[13] **M. Farrajota, J. Rodrigues, H. Du Buf**, "Optical flow by multi-scale annotated keypoints: A biological approach", *Proc. of BIOSIGNALS 2011 - International Conference on Bio-inspired Systems and Signal Processing*, Rome, Italy, 2011.

[14] **A. F. Ares, A. M. Mora, P. A. Castillo, J. J. Merelo, P. G. Sanchez, C. Fernandes**, "Optimizing the Parameters of a Real-time Strategy Bot using Real-valued Evolutionary Algorithms", *Proc. of CEC 2011 - IEEE Congress on Evolutionary Computation*, New Orleans, USA, 2011.

[15] **C. Fernandes, C. Isidoro, F. Barata, J. J. Merelo, A. Rosa**, "From Pherographia to Color Pherographia — Color Sketching with Artificial Ants", *Proc. of CEC 2011 - IEEE Congress on Evolutionary Computation*, New Orleans, USA, 2011.

[16] **C. Neves, R. Ventura, J. Sequeira**, "Adaptive Walking Gait for Locomotion on Terrain with Non-uniform Slope", *Proc. of CLAWAR 2011 - International Conference on Climbing and Walking Robots and the Support Technologies for Mobile Machines*, Paris, France, 2011.

[17] **R. Cabral, J. P. Costeira, F. De la Torre, A. Bernardino, G. Carneiro**, "Time and order estimation of paintings based on visual features and expert priors", *Proc. of the Conference on Computer Vision and Analysis of Images of Art II*, part of the IS&T/SPIE Electronic Imaging 2011, San Francisco, USA, 2011.

[18] **N. Pinho da Silva, M. Marques, G. Carneiro, J. P. Costeira**, "Explaining scene composition using kinematic chains of humans: application to Portuguese tiles history", *Proc. of the Conference on Computer Vision and Analysis of Images of Art II*, part of the IS&T/SPIE Electronic Imaging 2011, San Francisco, USA, 2011.

[19] **G. Carneiro, J. P. Costeira**, "The Automatic Annotation and Retrieval of Digital Images of Prints and Tile Panels using Network Link Analysis Algorithms", *Proc. of the Conference on Computer Vision and Analysis of Images of Art II*, part of the IS&T/SPIE Electronic Imaging 2011, San Francisco, USA, 2011.

[20] **I. Tom, D. Zhang, W. Nan, M. Yen, V. Mang, A. Rosa**, "Cardiovascular characterization of Snorers", *Proc. of Computing in Cardiology*, Hangzhou, China, 2011.

[21] **A. Saccon, A. Aguiar, J. Hauser**, "Lie Group Projection Operator Approach: Optimal Control on TSO(3)", *Proc. of CDC - ECC 2011 - 50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, USA, 2011.

[22] **A. Adhami-Mirhosseini, A. Aguiar, M. J. Yazdanpanah**, "Seabed Tracking of an Autonomous Underwater Vehicle with Nonlinear Output Regulation", *Proc. of CDC - ECC 2011 - 50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, USA, 2011.

[23] **D. Antunes, D. Silvestre, C. Silvestre**, "Average Consensus and Gossip Algorithms in Networks with Stochastic Asymmetric Communications", *Proc. of CDC - ECC 2011 - 50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, USA, 2011.

[24] **P. Rosa, C. Silvestre, M. Athans**, "Model Falsification Using SVOs for a Class of Discrete-Time Dynamic Systems: A Coprime Factorization Approach", *Proc. of CDC - ECC 2011 - 50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, USA, 2011.

[25] **P. Rosa, C. Silvestre**, "On the Distinguishability of Discrete Linear Time-Invariant Dynamic Systems", *Proc. of CDC - ECC 2011 - 50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, USA, 2011.

[26] **P. Casau, D. Cabecinhas, C. Silvestre**, "Autonomous Transition Flight for a Vertical Take-Off and Landing Aircraft", *Proc. of CDC - ECC 2011 - 50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, USA, 2011.

[27] **P. Batista, C. Silvestre, P. Oliveira**, "Globally Asymptotically Stable Filters for Source Localization and Navigation aided by Direction Measurements", *Proc. of CDC - ECC 2011 - 50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, USA, 2011.

[28] **S. Brás, P. Rosa, C. Silvestre, P. Oliveira**, "Optimal Attitude Estimation Using Set-Valued Observers", *Proc. of CDC - ECC 2011 - 50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, USA, 2011.

[29] **A. Alessandretti, A. Aguiar, J. P. Hespanha, P. Valigi**, "A Minimum Energy Solution to Monocular Simultaneous Localization and Mapping", *Proc. of CDC - ECC 2011 - 50th IEEE Conference on Decision and Control and European Control Conference*, Orlando, USA, 2011.

[30] **J. N. Pereira, P. Silva, P. Lima, A. Martinoli**, "Formalizing Institutions as Executable Petri Nets for Distributed Robotic Systems", *Proc. of ECAL 2011 - European Conference on Artificial Life*, Paris, France, 2011.

[31] **A. Ahmad, P. Lima**, "Multi-Robot Cooperative Object Tracking Based on Particle Filters", *Proc. of ECMR 2011 - European Conference on Mobile Robots*, Orebro, Sweden, 2011.

[32] **C. Barata, J. S. Marques, J. Rozeira**, "Detecting the Pigment Network in Dermoscopy Images: a Directional Approach", *Proc. of EMBC 2011 - 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, Boston, USA, 2011.

[33] **R. Ribeiro, R. Marinho, J. Velosa, F. Ramalho, J. Sanches, J. Suri**, "The Usefulness of Ultrasound in the Classification of Chronic Liver Disease", *Proc. of EMBC 2011 - 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, Boston, USA, 2011.

[34] **U. Acharya, O. Faust, S. Sree, A. Alvin, G. Krishnamurthi, J. Seabra, J. Sanches, J. Suri**, "Atheromatic™: Symptomatic vs. Asymptomatic Classification Of Carotid Ultrasound Plaque using a combination of HOS, DWT & Texture", *Proc. of EMBC 2011 - 33rd Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, Boston, USA, 2011.

[35] **A. Martins, N. Smith, P. Aguiar, M. Figueiredo**, "Structured Sparsity in Structured Prediction", *Proc. of EMNLP 2011 - SIGDAT Conference on Empirical Methods in Natural Language Processing*, Edinburgh, UK, 2011.

[36] **A. Martins, N. Smith, P. Aguiar, M. Figueiredo**, "Dual Decomposition with Many Overlapping Components", *Proc. of EMNLP 2011 - SIGDAT Conference on Empirical Methods in Natural Language Processing*, Edinburgh, UK, 2011.

[37] **D. Antunes, D. M. Matos, J. Gaspar**, "Improving Domotic Services Combining a Dialog System and a Resident Tracking System", *Proc. of Eurocon 2011 - IEEE International Conference on Computer As A Tool*, Lisbon, Portugal, 2011.

[38] **J. P. Gomes, C. Berger, A. Silva**, "Demodulation of Underwater OFDM Transmissions by Time Reversal and Basis Pursuit Methods" (invited), *Proc. of EW 2011 - 17th European Wireless Conference*, Vienna, Austria, 2011.

[39] **R. Sharma, M. Spaan**, "Fuzzy Reinforcement Learning Control for Decentralized Partially Observable Markov Decision Processes", *Proc. of FUZZ-IEEE 2011- IEEE International Conference on Fuzzy Systems*, Taipei, Taiwan, 2011.

[40] **D. Migotina, C. Isidoro, A. Rosa**, "Brain Art: Abstract Visualization of Sleeping Brain", *Proc. of GA 2011 - 14th Generative Art Conference*, Rome, Italy, 2011.

[41] **V. Cichella, E. Xargay, V. Dobrokhodov, I. Kaminer, A. Pascoal, N. Hovakimyan**, "Geometric 3D Path-Following Control for a Fixed Wing UAV on SO(3)", *Proc. of GNC 2011 - AIAA Guidance, Navigation, and Control Conference*, Portland, Oregon, USA, 2011.

[42] **M. Leite, A. Leal, P. Figueiredo**, "A voxelwise study of the HRF during epileptic seizures", *Proc. of HBM 2011 - 17th Annual Meeting of the Organization for Human Brain Mapping*, Québec City, Canada, 2011.

[43] **M. Leite, A. Leal, P. Figueiredo**, "Using EEG metrics to predict BOLD fMRI data in epilepsy", *Proc. of HBM 2011 - 17th Annual Meeting of the Organization for Human Brain Mapping*, Québec City, Canada, 2011.

[44] **T. Murta, A. Leal, P. Figueiredo**, "Dynamic Causal Modelling of EEG-fMRI data of epileptic seizures", *Proc. of HBM 2011 - 17th Annual Meeting of the Organization for Human Brain Mapping*, Québec City, Canada, 2011.

[45] **J. P. Jorge, P. Figueiredo, W. van der Zwagg, M. Narsude, J. P. Marques**, "Correlated noise correction in 2D and 3D fMRI at 7 Tesla", *Proc. of HBM 2011 - 17th Annual Meeting of the Organization for Human Brain Mapping*, Québec City, Canada, 2011.

[46] **J. Rodrigues, A. Andrade, H. Fernandes, P. Figueiredo**, "Effect of TR on a spectral effective connectivity fMRI study", *Proc. of HBM 2011 - 17th Annual Meeting of the Organization for Human Brain Mapping*, Québec City, Canada, 2011.

[47] **P. Rosa, C. Silvestre, P. Figueiredo**, "HRF Model Selection in fMRI using Multiple-Model Kalman Filters", *Proc. of HBM 2011 - 17th Annual Meeting of the Organization for Human Brain Mapping*, Québec City, Canada, 2011.

[48] **J. S. Marques, J. Lemos, M. Figueiredo, J. Nascimento, M. Barão**, "Trajectory Analysis Using Switched Motion Fields: a Parametric Approach", *Proc. of IbPRIA 2011 - 5th Iberian Conference on Pattern Recognition and Image Analysis*, Las Palmas de Gran Canaria, Spain, 2011.

[49] **R. Ribeiro, J. Sanches**, "Diffuse liver disease classification from ultrasound surface characterization, clinical and laboratorial data", *Proc. of IbPRIA 2011 - 5th Iberian Conference on Pattern Recognition and Image Analysis*, Las Palmas de Gran Canaria, Spain, 2011.

[50] **D. Afonso, P. Figueiredo, J. Sanches**, "Automatic Hyper-Parameter estimation in fMRI", *Proc. of IbPRIA 2011 - 5th Iberian Conference on Pattern Recognition and Image Analysis*, Las Palmas de Gran Canaria, Spain, 2011.

[51] **J. Seabra, J. Sanches, L. Pedro, J. Fernandes**, "Ultrasound Plaque Enhanced Activity Index for Predicting Neurological Symptoms", *Proc. of IbPRIA 2011 - Iberian Conference on Pattern Recognition and Image Analysis*, Las Palmas, Gran Canaria, 2011.

[52] **P. Moreno, P. Ribeiro, J. Santos-Victor**, "Feature Set Search Space for FuzzyBoost Learning", *Proc. of IbPRIA 2011 - Iberian Conference on Pattern Recognition and Image Analysis*, Las Palmas, Gran Canaria, 2011.

[53] **D. Fonte, A. Vale, M. I. Ribeiro**, "Path Optimization for Rhombic-Like Vehicles: An Approach Based on Rigid Body Dynamics", *Proc. of ICAR 2011 - 15th IEEE International Conference on Advanced Robotics*, Tallinn, Estonia, 2011.

[54] **H. Reboredo, V. Prabhu, M. Rodrigues, J. Xavier**, "Filter design with secrecy constraints: the MIMO Gaussian wiretap channel with zero-forcing receive filters", *Proc. of ICASSP 2011 - IEEE International Conference on Acoustics, Speech and Signal Processing*, Prague, Czech Republic, 2011.

[55] **J. Mota, J. Xavier, P. Aguiar, M. Pueschel**, "Basis pursuit in sensor networks", *Proc. of ICASSP 2011 - IEEE International Conference on Acoustics, Speech and Signal Processing*, Prague, Czech Republic, 2011.

[56] **D. Bajovic, D. Jakovetic, J. Xavier, B. Sinopoli, J. Moura**, "Asymptotic performance of distributed detection over random networks", *Proc. of ICASSP 2011 - IEEE International Conference on Acoustics, Speech and Signal Processing*, Prague, Czech Republic, 2011.

[57] **J. Ruesch, Ricardo Ferreira, Alexandre Bernardino**, "A Measure of Good Motor Actions for Active Visual Perception", *Proc. of ICDL-EPIROB 2011 - IEEE Conference on Development and Learning and Epigenetic Robotics*, Frankfurt, Germany, 2011.

[58] **D. Figueira, A. Bernardino**, "Re-Identification of Visual Targets in Camera Networks: A Comparison of Techniques", *Proc. of ICIAR 2011 - International Conference on Image Analysis and Recognition*, Burnaby, BC, Canada, 2011.

[59] **P. Moreno, P. Ribeiro, J. Santos-Victor**, "Feature Selection for tracker-less human activity recognition", *Proc. of ICIAR 2011 - International Conference on Image Analysis and Recognition*, Burnaby, BC, Canada, 2011.

[60] **N. Greggio, A. Bernardino, C. Laschi, P. Dario, J. Santos-Victor**, "Real-Time Ellipse Fitting, 3D Spherical Object Localization and Tracking for the iCub Simulator", *Proc. of ICINCO 2011 - 8th International Conference on Informatics in Control, Automation and Robotics*, Noordwijkerhout, The Netherlands, 2011.

[61] **N. Greggio, J. Gaspar, A. Bernardino, J. Santos-Victor**, "Monocular vs Binocular 3D Real-Time Ball Tracking From 2d Ellipses", *Proc. of ICINCO 2011 - 8th International Conference on Informatics in Control, Automation and Robotics*, Noordwijkerhout, The Netherlands, 2011.

[62] **R. Guerreiro, P. Aguiar**, "Incremental Local Hough Transform for Line Segment Extraction", *Proc. of ICIP 2011 - IEEE International Conference on Image Processing*, Brussels, Belgium, 2011.

[63] **J. S. Marques, M. Figueiredo**, "Image Super-segmentation: Segmentation with Multiple Labels from Shuffled Observations", *Proc. of ICIP 2011 - IEEE International Conference on Image Processing*, Brussels, Belgium, 2011.

[64] **J. Nascimento, J. S. Marques, J. Lemos**, "Flexible trajectory modeling using a mixture of parametric motion fields for video surveillance", *Proc. of ICIP 2011 - IEEE International Conference on Image Processing*, Brussels, Belgium, 2011.

[65] **J. Nascimento, J. S. Marques, M. Figueiredo**, "Discriminative Model Selection Using a Modified Bayesian Criterion: Application to Trajectory Modeling", *Proc. of ICIP 2011 - IEEE International Conference on Image Processing*, Brussels, Belgium, 2011.

[66] **R. Cabral, J. P. Costeira, F. De la Torre, A. Bernardino**, "Fast Incremental Method for Matrix Completion: An Application to Trajectory Correction", *Proc. of ICIP 2011 - IEEE International Conference on Image Processing*, Brussels, Belgium, 2011.

[67] **T. Gaspar, P. Oliveira, C. Silvestre**, "UAV-based Marine Mammals Positioning and Tracking System", *Proc. of ICMA 2011 - IEEE International Conference on Mechatronics and Automation*, Beijing, China, 2011.

[68] **M. Morgado, P. Oliveira, C. Silvestre**, "A Closed-loop Design Methodology for Underwater Transducers Pulse-shaping", *Proc. of ICMA 2011 - IEEE International Conference on Mechatronics and Automation*, Beijing, China, 2011.

[69] **A. Martins, M. Figueiredo, P. Aguiar, N. Smith, E. Xing**, "An Augmented Lagrangian Approach to Constrained MAP Inference", *Proc. of ICML 2011 - International Conference on Machine Learning, Bellevue*, Washington, USA, 2011.

[70] **T. Gaspar, P. Oliveira**, "Monocular Depth from Focus Estimation with Complementary Filters", *Proc. of ICRA 2011 - IEEE International Conference on Robotics and Automation*, Shanghai, China, 2011.

[71] **B. Guerreiro, C. Silvestre, P. Oliveira**, "Automatic LADAR Calibration Methods using Geometric Optimization", *Proc. of ICRA 2011 - IEEE International Conference on Robotics and Automation*, Shanghai, China, 2011.

[72] **D. Salinas, A. Pascoal, J. Aranda**, "Optimal Sensor Placement for Underwater Localization with Uncertainty in the Target Position", *Proc. of ICRA 2011 - IEEE International Conference on Robotics and Automation*, Shanghai, China, 2011.

[73] **M. Barão, J. S. Marques**, "Offline Bayesian Identification of Jump Markov Nonlinear Systems", *Proc. of 18th IFAC World Congress*, Milan, Italy, 2011.

[74] **P. Rosa, C. Silvestre, M. Athans**, "Model Falsification of LPV Systems Using Set-Valued Observers", *Proc. of 18th IFAC World Congress*, Milan, Italy, 2011.

[75] **A. Saccon, J. Hauser, A. Aguiar**, "Optimal Control on Lie Groups: Implementations Details of the Projection Operator Approach", *Proc. of 18th IFAC World Congress*, Milan, Italy, 2011.

[76] **O. Namaki-Shoushtari, A. Aguiar, A. K. Sedigh**, "A Switched Based Control Strategy for Target Tracking of Autonomous Robotic Vehicles using Range-only Measurements", *Proc. of 18th IFAC World Congress*, Milan, Italy, 2011.

[77] **D. Salinas, A. Pascoal, J. Aranda**, "Optimal Sensor Placement for Multiple Underwater Target Localization with Acoustic Range Measurements", *Proc. of 18th IFAC World Congress*, Milan, Italy, 2011.

[78] **P. Casau, D. Cabecinhas, C. Silvestre**, "Transition Control for a Fixed-Wing Vertical Take-Off and Landing Aircraft", *Proc. of 18th IFAC World Congress*, Milan, Italy, 2011.

[79] **J. Almeida, C. Silvestre, A. Pascoal**, "Self-Triggered Observer Based Control of Linear Plants", *Proc. of 18th IFAC World Congress*, Milan, Italy, 2011.

[80] **D. Viegas, P. Batista, P. Oliveira, C. Silvestre**, "Decentralized Linear Motion Estimators for AUV Formations with Fixed Topologies", *Proc. of 18th IFAC World Congress*, Milan, Italy, 2011.

[81] **V. Hassani, J. Hespanha, M. Athans, A. Pascoal**, "Stability Analysis of Robust Multiple Model Adaptive Control", *Proc. of 18th IFAC World Congress*, Milan, Italy, 2011.

[82] **P. Batista, C. Silvestre, P. Oliveira**, "GES Attitude Observers - Part II: Single Vector Observations", *Proc. of 18th IFAC World Congress*, Milan, Italy, 2011.

[83] **P. Batista, C. Silvestre, P. Oliveira**, "GES Attitude Observers - Part I: Multiple General Vector Observations", *Proc. of 18th IFAC World Congress*, Milan, Italy, 2011.

[84] **J. Messias, P. Oliveira, P. Lima**, "Online Model Identification for Set-Valued State Estimators with Discrete-Time Measurements", *Proc. of 18th IFAC World Congress*, Milano, Italy, 2011.

[85] **M. Morgado, C. Silvestre, P. Oliveira, P. Batista**, "Position and Velocity USBL/IMU Sensor-based Navigation Filter", *Proc. of 18th IFAC World Congress*, Milan, Italy, 2011.

[86] **D. Viegas, P. Batista, P. Oliveira, C. Silvestre**, "Decentralized Linear Motion Estimators for AUV Formations", *Proc. of 18th IFAC World Congress*, Milan, Italy, 2011.

[87] **S. Brás, C. Silvestre, P. Oliveira, J. Vasconcelos, R. Cunha**, "An Experimentally Evaluated Attitude Observer Based on Range and Inertial Measurements", *Proc. of 18th IFAC World Congress*, Milan, Italy, 2011.

[88] **T. Gaspar, P. Oliveira**, "Depth Estimation in Active Monocular Vision Systems for Indoor 3D Tracking", *Proc. of 18th IFAC World Congress*, Milan, Italy, 2011.

[89] **M. Spaan, F. Oliehoek, C. Amato**, "Scaling Up Optimal Heuristic Search in Dec-POMDPs via Incremental Expansion", *Proc. of IJCAI 2011 - 22nd International Joint Conference on Artificial Intelligence*, Barcelona, Spain, 2011.

[90] **B. Lacerda, P. Lima**, "LTL-Based Decentralized Supervisory Control of Multi-Robot Tasks Modelled as Petri Nets", *Proc. of IROS 2011 - IEEE/RSJ International Conference on Intelligent Robots and Systems*, San Francisco, CA, USA, 2011.

[91] **N. Moutinho, N. Cauli, E. Falotico, R. Ferreira, J. Gaspar, A. Bernardino, J. Santos-Victor, P. Dario, C. Laschi**, "An Expected Perception Architecture using Visual 3D Reconstruction for a Humanoid Robot", *Proc. of IROS 2011 - IEEE/RSJ International Conference on Intelligent Robots and Systems*, San Francisco, CA, USA, 2011.

[92] **F. Arrichiello, G. Antonelli, A. Aguiar, A. Pascoal**, "Observability metric for the relative localization of AUVs based on range and depthmeasurements: theory and experiments", *Proc. of IROS 2011 - IEEE/RSJ International Conference on Intelligent Robots and Systems*, San Francisco, CA, USA, 2011.

[93] **R. Gafaniz, J. Sanches**, "Neuronal Electrical Activity, Energy Consumption and Mitochondrial ATP Restoration Dynamics: a Physiological based Model for FMRI", *Proc. of ISBI 2011 - 8th IEEE International Symposium on Biomedical Imaging*, Chicago, Illinois, USA, 2011.

[94] **A. Coito, D. Belo, T. Paiva, J. Sanches**, "Topographic EEG Brain Mapping Before, During and After Obstructive Sleep Apnea Episodes", *Proc. of ISBI 2011 - 8th IEEE International Symposium on Biomedical Imaging, Chicago*, Illinois, USA, 2011.

[95] **N. Santos, J. Sanches, P. Figueiredo**, "Spatial priors for perfusion and transit time estimation in PASL-MRI", *Proc. of ISBI 2011 - 10th IEEE International Symposium on Biomedical Imaging*, Chicago, USA, 2011.

[96] **C. Cabral, M. Silveira, P. Figueiredo**, "Decoding visual stimuli using classifier ensembles with optimized feature selection", *Proc. of ISBI 2011 - 10th IEEE International Symposium on Biomedical Imaging*, Chicago, USA, 2011.

[97] **R. Ribeiro, J. Velosa, F. Ramalho, J. Sanches**, "Chronic Liver Disease Staging Classification Based on Ultrasound, Clinical and Laboratorial Data", *Proc. of ISBI 2011 - 8th IEEE International Symposium on Biomedical Imaging*, Chicago, Illinois, USA, 2011.

[98] **L. J. Herrera, A. M. Mora, D. Migotina, A. Rosa, C. Fernandes**, "Symbolic Representation of EEG for Sleep Stage Classification", *Proc. of ISDA 2011 - 11th International Conference on Intelligent Systems Design and Applications*, Córdoba, Spain, 2011.

[99] **N. Santos, J. Sanches, I. Sousa, P. Figueiredo**, "A Total Variation spatial prior for the estimation of perfusion and transit time maps in PASL-MRI", *Proc. of ISMRM 2011 - 19th Annual Meeting of the International Society for Magnetic Resonance in Medicine*, Montreal, Canada, 2011.

[100] **J. P. Jorge, P. Figueiredo, W. van der Zwaag, M. Narsude, J. P. Marques**, "Sources of signal fluctuations in single-shot 2D EPI and segmented 3D EVI acquisitions for fMRI at 7T", *Proc. of ISMRM 2011 - 19th Annual Meeting of the International Society for Magnetic Resonance in Medicine*, Montreal, Canada, 2011.

[101] **I. Sousa, P. Vilela, P. Figueiredo**, "Dynamics of CBF and BOLD responses to a Cued Deep Breathing paradigm", *Proc. of ISMRM 2011 - 19th Annual Meeting of the International Society for Magnetic Resonance in Medicine*, Montreal, Canada, 2011.

[102] **I. Sousa, P. Vilela, P. Figueiredo**, "Dynamics of CBF and BOLD responses to a Cued Deep Breathing paradigm", *Proc. of ISMRM 2011 - 19th Annual Meeting of the International Society for Magnetic Resonance in Medicine*, Montreal, Canada, 2011.

[103] **J. S. Marques, M. Figueiredo**, "Fast Estimation of Multiple Vector Fields: Application to Video Surveillance", *Proc. of ISPA 2011 - 7th International Symposium on Image and Signal Processing and Analysis*, Dubrovnik, Croatia, 2011.

[104] **J. Martins, J. Rodrigues, H. Du Buf**, "Disparity energy model using a trained neuronal population", *Proc. of ISSPIT 2011 - IEEE International Symposium on Signal Processing and Information Technology*, Bilbao, Spain, 2011.

[105] **A. F. Ares, A. Mora, J. J. Merelo, P. G. Sanchez, C. Fernandes**, "Optimizing Strategy Parameters in a Game Bot", *Proc. of IWANN 2011 - 11th International Work-Conference on Artificial Neural Networks* (Advances on Computational Intelligence), Torremolinos-Málaga, Spain, 2011.

[106] **P. A. Afonso, C. Bispo**, "Railway Traffic Management. The Meet & Pass Problem", *Proc. of LISS 2011 - 1st International Conference on Logistics, Informatics and Service Science*, Beijing, People's Republic of China, 2011.

[107] **C. Bispo**, "Single Server Scheduling Problem. Optimal policy for convex costs depends on arrival rates", *Proc. of MISTA 2011 - 5th Multidisciplinary International Scheduling Conference*, Phoenix, USA, 2011.

[108] **M. Brandão, A. Bernardino, J. Santos-Victor**, "Image Driven Generation of Pose Hypotheses for 3D Model-Based Tracking", *Proc. of MVA 2011 - 12th IAPR Conference on Machine Vision Applications*, Nara, Japan, 2011.

[109] **S. Pequito, A. Aguiar, B. Sinopoli, D. A. Gomes**, "Nonlinear Estimation using Mean Field Games", *Proc. of NetGCooP 2011 – International Conference on Network Games, Control and Optimization*, Paris, France, 2011.

[110] **R. S. Cabral, J. P. Costeira, A. Bernardino**, "Matrix Completion for Multi-label Image Classification", *Proc. of NIPS 2011 - 25th Annual Conference on Neural Information Processing Systems*, Granada, Spain, 2011.

[111] **J. Messias, M. Spaan, P. Lima**, "Efficient Offline Communication Policies for Factored Multiagent POMDPs", *Proc. of NIPS 2011 - 25th Annual Conference on Neural Information Processing Systems*, Granada, Spain, 2011.

[112] **E. Zamanizadeh, J. P. Gomes, J. M. Bioucas-Dias**, "Source Localization from Time-Differences of Arrival using High-Frequency Communication Signals", *Proc. of MTS/IEEE OCEANS 2011 Conference*, Santander, Spain, 2011.

[113] **A. Birk, G. Antonelli, A. Caiti, G. Casalino, G. Indiveri, A. Pascoal, A. Caffaz**, "The CO3AUVs (COoperativeCOgnitiveCOntrol for Autonomous Underwater Vehicles) Project: overview and current progresses", *Proc. of MTS/IEEE OCEANS 2011 Conference*, Santander, Spain, 2011.

[114] **A. Caiti, P. Felisberto, S. Jesus, T. Husoy, I. Karasalo, R. Massimelli, T. Reinen, A. Silva**, "UAN - Underwater Acoustic Network", *Proc. of MTS/IEEE OCEANS 2011 Conference*, Santander, Spain, 2011.

[115] **C. Berger, J. P. Gomes, J. Moura**, "Sea-trial results for cyclic-prefix OFDM with long symbol duration", *Proc. of MTS/IEEE OCEANS 2011 Conference*, Santander, Spain, 2011.

[116] **C. Berger, J. P. Gomes, J. Moura**, "Study of pilot designs for cyclic-prefix OFDM on time-varying and sparse underwater acoustic channels", *Proc. of MTS/IEEE OCEANS 2011 Conference*, Santander, Spain, 2011.

[117] **A. Silva, S. Jesus, J. P. Gomes**, "Probe timing optimization for time-reversal underwater communications", *Proc. of MTS/IEEE OCEANS 2011 Conference*, Santander, Spain, 2011.

[118] **P. Santos, P. Felisberto, O. Rodriguez, J. João, S. Jesus**, "Geometric and Seabed parameter estimation using a Vector Sensor Array – Experimental results from Makai experiment 2005", *Proc. of MTS/IEEE OCEANS 2011 Conference*, Santander, Spain, 2011.

[119] **C. Soares, P. Felisberto, S. Jesus**, "Acoustic Observatories for Ocean Tomography: geometries and multi-array Matched-Field Tomography", *Proc. of MTS/IEEE OCEANS 2011 Conference*, Santander, Spain, 2011.

[120] **U. Vilaipornsawai, A. Silva, S. Jesus**, "Underwater communications for moving source using geometry-adapted time reversal and DFE: UAN10 data", *Proc. of MTS/IEEE OCEANS 2011 Conference*, Santander, Spain, 2011.

[121] **E. Zamanizadeh, J. P. Gomes, J. Bioucas-Dias**, "Source localization from time-differences of arrival using high-frequency communication signals", *Proc. of MTS/IEEE OCEANS 2011 Conference*, Santander, Spain, 2011.

[122] **P. Oliveira, C. Silvestre, M. Morgado, K. Erzini, A. Afonso, F. Hazin, B. Block**, "Preliminary Results of Project MAST/AM: Advanced Tracking and Telemetry Methodologies to Study Marine Animals", *Proc. of MTS/IEEE OCEANS 2011 Conference*, Santander, Spain, 2011.

[123] **S. Ijaz, A. Silva, O. Rodriguez, S. Jesus**, "Doppler domain decomposition of the underwater acoustic channel arriving paths for the CALCOM'10 experiment", *Proc. of MTS/IEEE OCEANS 2011 Conference*, Santander, Spain, 2011.

[124] **L. Perera, C. Guedes Soares, P. Oliveira**, "Dynamic Parameter Estimation of a Nonlinear Vessel Steering Model of Ocean Navigation", *Proc. of OMAE 2011 - 30th International Conference on Ocean, Offshore and Arctic Engineering*, Roterdan, The Netherlands, 2011.

[125] **L. Perera, C. Guedes Soares, P. Oliveira**, "Collaborated and Constrained Neural-EKF Algorithm for the Vessel Traffic Monitoring and Information System", *Proc. of OMAE 2011 - 30th International Conference on Ocean, Offshore and Arctic Engineering*, Roterdan, The Netherlands, 2011.

[126] **D. M. Antunes, D. Figueira, D. M. Matos, A. Bernardino, J. Gaspar,** "Multiple Hypothesis Tracking in Camera Networks", *OMNIVIS - 11th Workshop on Omnidirectional Vision, Camera Networks and Non-classical Cameras*, held in conjunction with ICCV 2011, Barcelona, Spain, 2011.

[127] **M. Bicego, A. Ulas, P. Schuffler, U. Castellani, V. Murino, A. Martins, P. Aguiar, M. Figueiredo**, "Renal Cancer Cell Classification using Generative Embeddings and Information Theoretic Kernels", *Proc. of PRIB 2011 - IAPR International Conference on Pattern Recognition in Bioinforma*tics, Delft, The Netherlands, 2011.

[128] **B. Coltin, Manuela Veloso, R. Ventura**, "Dynamic User Task Scheduling for Mobile Robots", The *AAAI 11th Workshop on Automated Action Planning for Autonomous Mobile Robots*, San Francisco, California, USA, 2011.

[129] **L. Merino, J. Capitán, A. Ollero**, "Person Tracking in Urban Scenarios by Robots Cooperating with Ubiquitous Sensors", *Proc. of ROBOT 2011 Workshop de Robótica: Robótica Experimental*, Sevilla, Spain, 2011.

[130] **A. Vale, M. I. Ribeiro**, "Mobile Robot Navigation for Remote Handling operations in ITER", *Proc. of ROBOT 2011 Workshop de Robótica: Robótica Experimental*, Sevilla, Spain, 2011.

[131] **A. R. Mendes, M. Spaan, P. Lima**, "Planning under Uncertainty for Search and Rescue", *Proc. of ROBOTICA 2011 - 11th International Conference On Mobile Robots And Competitions*, Lisbon, Portugal, 2011.

[132] **B. Lacerda, P. Lima, J. Gorostiza, M. A. Salichs**, "Petri Net Based Supervisory Control of a Social Robot with LTL Specifications", *Proc. of ROBOTICA 2011 - 11th International Conference on Mobile Robots and Competitions*, Lisboa, Portugal, 2011.

[133] **N. Greggio, A. Bernardino, J. Santos-Victor**, "Robotic Color Image Segmentation by Means of Finite Mixture Models", *Proc. of ROBOTICA 2011 - 11th International Conference on Mobile Robots and Competitions*, Lisbon, Portugal, 2011.

[134] **B. Lacerda, P. Lima**, "Designing Petri Net Supervisors from LTL Specifications", *Proc. of the 2011 Robotics: Science and Systems Conference*, Los Angeles, CA, USA, 2011.

[135] **R. Galego, A. Bernardino, J. Gaspar**, "Vignetting Correction for Pan-Tilt Surveillance Cameras", *Proc. of VISAPP - International Conference on Computer Vision Theory and Applications*, Algarve, Portugal, 2011.

[136] **J. Rodrigues, H. Du Buf**, "A cortical framework for scene categorization", *Proc. of VISAPP - International Conference on Computer Vision Theory and Applications*, Algarve, Portugal, 2011.

[137] **T. Gaspar, P. Oliveira**, "New Dynamic Estimation of Depth from Focus in Active Vision - Data acquisition, LPV design, analysis and test", *Proc. of VISAPP - International Conference on Computer Vision Theory and Applications*, Algarve, Portugal, 2011.

[138] **H. Reboredo, M. Rodrigues, M. Ara, J. Xavier,** "Filter design with secrecy constraints: the degraded MIMO Gaussian wiretap channel", *Proc. of VTC 2011 Spring - IEEE 73rd Vehicular Technology Conference*, Budapest, Hungary, 2011.

[139] **A. Silva, S. Jesus**, "A post-detection maximum ratio combiner: experimental assessment on high diversity underwater channels" (invited), *Proc. of WoSSPA - 7th International Workshop on Systems, Signal Processing and their Applications*, Tipaza, Algeria, 2011.

G) IN NATIONAL CONFERENCES (17)

[1] **R. Ribeiro, J. Sanches, J. Velosa, F. Ramalho, R. Marinho**, "Relacão das características físicas da ecografia hepatobiliar com a reserva hepática", *APEF 2011 – 14ª Reunião Anual da Associação Portuguesa para o Estudo do Fígado*, Porto, Portugal, 2011.

[2] **B. Lacerda, P. Lima**, "Petri Nets as an Analysis Tool for Data Flow in Wireless Sensor Networks", *Proc. of CNRS 2011 - 1st Portuguese Conference on Wireless Sensor Networks*, Coimbra, Portugal, 2011.

[3] **I. Sousa, A. Portelo, P. Vilela, P. Figueiredo**, "Avaliação não-invasiva por ressonância magnética das variações do metabolismo cerebral de O2", *Proc. of VII Congresso da Sociedade Portuguesa de Neurorradiologia*, Amadora, Portugal, 2011.

[4] **A. Portelo, I. Sousa, P. Vilela, P. Figueiredo**, "Avaliação não-invasiva da vaso-reactividade cerebral por BOLD fMRI", *Proc. of VII Congresso da Sociedade Portuguesa de Neurorradiologia*, Amadora, Portugal, 2011.

[5] **R. Ribeiro, R. Marinho, J. Sanches**, "Objective measures from Ultrasound Images of Cirrhotic Livers for Prediction of MELD Score", *Proc. of RecPad 2011 - 17th Portuguese Conference on Pattern Recognition*, Porto, Portugal, 2011.

[6] **J. Leal, M. Oliveira, J. Sanches**, "Analysis of cut-off criteria in ROC curve for endarterectomy decision making", *Proc. of RecPad 2011 - 17th Portuguese Conference on Pattern Recognition*, Porto, Portugal, 2011.

[7] **R. Maximiano, J. Sanches**, "Pharmacokinetic Parameter Estimation in DCE-MRI", *Proc. of RecPad 2011 - 17th Portuguese Conference on Pattern Recognition*, Porto, Portugal, 2011.

[8] **D. Leite, A. Bernardino, José Gaspar**, "Auto-Calibration of Pan-Tilt-Zoom Cameras: Estimating Intrinsic and Radial Distortion Parameters", *Proc. of RecPad 2011 - 17th Portuguese Conference on Pattern Recognition*, Porto Portugal, 2011.

[9] **R. Galego, R. Ferreira, A. Bernardino, J. Gaspar**, "Enforcing Consistency of Image Gains in Panoramic Mosaics", *Proc. of RecPad 2011 - 17th Portuguese Conference on Pattern Recognition*, Porto Portugal, 2011.

[10] **D. Afonso, J. Sanches**, "Probe Velocity Tracking in Free-hand US without Spatial Locator", *Proc. of RecPad 2011 - 17th Portuguese Conference on Pattern Recognition*, Porto, Portugal, 2011.

[11] **M. Canôvas, A. Domingues, J. Sanches**, "Real Time HRV with smartphone", *Proc. of RecPad 2011 - 17th Portuguese Conference on Pattern Recognition*, Porto, Portugal, 2011.

[12] **C. Carreiras, L. Almeida, J. Sanches**, "ERD/ERS Event Detection from Phase Desynchronization Measurements in BCI", *Proc. of RecPad 2011 - 17th Portuguese Conference on Pattern Recognition*, Porto, Portugal, 2011.

[13] **A. Domingues, T. Paiva, J. Sanches**, "Sleep and Wakefulness activities: are they intrinsically different?", *Proc. of RecPad 2011 - 17th Portuguese Conference on Pattern Recognition*, Porto, Portugal, 2011.

[14] **M. Farrajota, J. Martins, J. Rodrigues, H. Du Buf**, "Disparity energy model with keypoint disparity validation", *Proc. of RecPad 2011 - 17th Portuguese Conference on Pattern Recognition*, Porto, Portugal, 2011.

[15] **D. Dias, R. Ventura**, "Absolute localization for low capability robots in structured environments", *Proc. RecPad 2011 - 17th Portuguese Conference on Pattern Recognition*, Porto, Portugal, 2011.

[16] **D. Belo, J. Sanches, R. Ventura**, "Detection of relevant events in a biocontrol framework with BCI", *Proc. of RecPad 2011 - 17th Portuguese Conference on Pattern Recognition*, Porto, Portugal, 2011.

[17] **R. Ribeiro, João Sanches, J. Velosa, F. Ramalho, R. T. Marinho**, "Correlação do MELD com as características físicas da ecografia hepatobiliar na cirrose hepática", *Semana Digestiva 2011*, Cascais, Portugal, 2011.

H) TECHNICAL REPORTS (1)

[1] **G. Carneiro, J. Nascimento, A. Freitas**, The Detection and Segmentation of the Left Ventricle of the Heart from Ultrasound Data using Deep Learning Architectures and Efficient Search Methods, Technical Report, Institute for Systems and Robotics, Instituto Superior Técnico, 2011.