

1 Research Projects

This section contains a brief description of the R&D projects in progress at ISR(Lisbon), IST and Universidade of Algarve during 1999, with the participation of the Signal and Image Processing Group members. The subsections define the main areas of intervention where the projects are being developed. The projects resulting from contracts celebrated with ISR and managed by this private research institution are identified by (*) on the title; all the remaining projects refer to contracts celebrated and managed by IST and University of Algarve.

1.1 ROBOTICS

Project name: AUTONOMOUS ROBOTIC METHODOLOGIES FOR MULTIDISCIPLINAR APPLICATIONS (*)

Project Leader: Prof. João Sentieiro (ISR)

Project description: The objectives of this project are to study, develop and test methodologies for both sensing perception and guidance of autonomous vehicles operating in dynamic, structured and partially structured environments known up to some uncertainty level. This project considers all the different functional modules necessary to define the locomotion dynamics of an autonomous robot: positioning, obstacle detection and recognition, control, path planning, communications and mission management.

Research Areas: Systems Theory, Control Theory, Computer Vision, Signal Processing, Artificial Intelligence, Estimation and Detection Theory, Pattern Recognition

Laboratories: Artificial Intelligence and Manufacturing Systems, Intelligent Control, Mobile Robotics, Underwater Robotics, Signal Processing, Computer and Robot Vision.

External Partners: ISR Porto (P), ISR Coimbra (P), Faculdade de Medicina da Univ. de Coimbra (P), INDEP (P), IGM (P).

Initiated: 1995

Expected conclusion: March 2000

Classification: PRAXIS XXI 3/3.1/TPR/23/94



Project name: *NARVAL* - NAVIGATION OF AUTONOMOUS ROBOTS VIA ACTIVE ENVIRONMENTAL PERCEPTION

Project leader within ISR: Prof. José Santos -Victor, Prof. Isabel Lourtie (IST/ISR)

Project description: The goal of this project is to develop *non-intruding* and *reliable* navigation systems giving the robot the ability to select natural landmarks, and to navigate with respect to them, extending in this way the autonomy range of autonomous robots operating in *unknown and unstructured environments*. *Reliability* is achieved by continuously controlling the uncertainty associated with knowledge of the environment and of the robot's position and orientation. In the context of the project, *non-intrusiveness* means that the robot must be able to operate without special purpose landmarks being added to its environment. Non-intrusive operation in *unstructured environments* precludes navigation with respect to a set of handcrafted "landmarks," and requires the robot's ability to infer its position from learned natural landmarks of the environment using its perception system. Instead of passive reconstruction of the working space, perception is faced as a process of selectively extracting from the world the information needed to accomplish a given task, trading generality for specificity and gaining in simplicity and robustness. It is no longer a separate off-line module, but an integral part of the closed loop control system. This coupling will be explicitly addressed at the control level by assessing the compatibility of the current state of the robot's knowledge of its environment, its mission and safety requirements. Availability of such systems has a considerable impact in many economic, social and industrial

activities such as control of marine pollution, surveillance of restricted areas, surveillance of equipment, agriculture, underwater cartography and marine biology studies, to mention but a few.

Research Areas: Computer Vision, Signal Processing, Navigation

Laboratories: Vislab - Computer Vision Lab, Signal Processing (coordinator)

External Partners: I3S (Laboratoire d'Informatique, Signaux e Systèmes de Sophia Antipolis – CNRS- Université de

Nice Sophia Antipolis) (FR), Thomson Sintra ASM (FR), DIST - University of Genova (I).

Initiated: 1998

Expected conclusion: 2001

Classification: Esprit LTR Project – 30185

1.2 Underwater AND OCEAN Robotics

Project name: DEVELOPMENT OF VEHICLES AND ADVANCED SYSTEMS FOR THE EXECUTION OF UNDERWATER INSPECTION TASKS - *INFANTE*.

Project Leader: Prof. João Sentieiro (IST/ISR), Prof. António Pascoal (IST/ISR), Prof. Victor Barroso (IST/ISR)

Project description: The objectives of this project are the design and the construction of an autonomous underwater vehicle (AUV), and the development and integration of advanced systems for navigation, guidance and control, acoustic communications and mission management. These systems will be tested in the lab. Once they are installed in the vehicle, they will be also tested in pool and sea trials.

Research Areas: Control Theory, Computer Vision, Signal Processing, Underwater Acoustics.

Laboratories: Underwater Robotics, Signal Processing, Computer and Robot Vision.

External Partners: CINTAL-Univ. do Algarve (P), RINAVE (P), Instituto Hidrográfico (P)

Initiated: 1997

Expected conclusion: December 2000

Classification: PRAXIS XXI 3/3.1/TPAR/2042/95



Project name: ASIMOV - Advanced System Integration for Managing the Coordinated Operation of Robotic Ocean Vehicles

Project Leader (Coordinator): Prof. António Pascoal (IST/ISR)

Project Description: Three major stumbling blocks have so far prevented demonstrating the potential applications of Autonomous Underwater Vehicle (AUVs) to demanding industrial and scientific missions. Namely, i) the lack of reliable navigation systems, ii) the impossibility of transmitting data at high rates between the AUV and a support ship at slant range, and iii) the unavailability of advanced mission control systems that can endow end-users with the ability to plan, program, and run scientific / industrial missions at sea, while having access to ocean data in almost real-time so as to re-direct the AUV mission if required.

As a contribution toward solving some of the abovementioned problems, this project puts forward the key concept of an Autonomous Surface Vehicle (ASV) that will operate in close cooperation with an AUV, as a mobile relay for fast communications. In the scenarios considered, the ASV will be equipped with a differential GPS receiver, an ultra short baseline unit (USBL), a radio link, and a high data rate communication link with the AUV that will be optimized for the vertical channel. Thus, by properly maneuvering the ASV to always remain in the vicinity of a vertical line with the AUV, a fast communication link can be established to transmit navigational data from the DGPS and USBL to the AUV, and ocean data from the AUV to the ASV, and

subsequently to an end-user located on board a support ship or on shore. Fast and reliable communications, as well as precise navigation, will thus be achieved by resorting to well established technologies.

The main thrust of the project is the enhancement and integration of proven technological systems to achieve coordinated operation of an AUV and ASV, while ensuring the integrity of the two platforms. To give the work greater focus, the final goal of the research and development effort is to perform a mission at sea - near the Azores islands - down to depths of 100 m, to determine the extent of shallow water hydrothermalism and to determine the patterns of community diversity at the vents in the area. In the envisioned scenario, the AUV will be asked to maneuver close to the seabed and to detect the occurrence of bubble emissions from discharging vents. The detection of those phenomena will in turn trigger the acquisition and transmission - to a support unit - of time/space stamped sonar and video images through the vertical acoustic channel, via the ASV.

Obstacle avoidance and bubble detection will rely heavily on the development of a space-stabilized sonar head with vertical and horizontal transducer elements, and the associated signal processing algorithms. Programming, executing, and modifying on-line the plans for joint ASV/AUV operation will be made possible by developing dedicated systems for joint mission and vehicle control, as well as appropriate Human-Machine interfaces. Special emphasis will be placed on demonstrating all the steps that are necessary to acquire, process, manage, and disseminate data on hydrothermal activity to a wide audience of scientists, over the Internet.

Research Areas: Navigation, Guidance, and Control, Acoustic Communications, Obstacle Detection and Avoidance, Sonar Systems, Mission Control of Autonomous Vehicles, Ocean Robotics.

Laboratories: Dynamical Systems and Ocean Robotics Lab (DSORL)

External partners: ORCA Instrumentation (FR), GESMA - Laboratory of the French Navy (FR), ENSIETA - School of the French Navy (FR), System Technologies (UK), University of the Azores (PT).

Initiated: January 1998

Conclusion : 2000

Classification: Contract No: MAS3-CT97-0092 (Commission of the European Communities), Programme MAST III (Marine Science and Technology) of the EC, 1998-2000).

1.3 Signal Processing for Communications

Project name: BLIND ARRAY PROCESSING IN MOBILE COMMUNICATIONS

Project Leader: Prof. Victor Barroso (IST/ISR)

Project description: This project addresses the problem of the blind separation of digital sources which are transmitting simultaneously in time using the same frequency channel and, eventually, the same code. Using an array receiver, the sources can be discriminated by their spatial signatures. The objectives of the project are to develop the optimum (in the maximum a posteriori sense) blind receiver and to assess theoretical performance bounds. The design of suboptimum receivers will be also considered.

Research Areas: Statistical Signal Processing

Laboratories: Signal Processing

External Partners: Carnegie Mellon University (USA)

Initiated: 1997

Conclusion: September 1999

Classification: NATO SA.5-2-05(CRG.971184)1202/97/JARC-501

1.4 Image Processing

Project name: INTEGRATED SYSTEM FOR ANALYSIS AND CHARACTERIZATION OF THE SEAFLOOR — *ISACS*

Project Leader within ISR: Prof. Hans du Buf (University of Algarve)

Project description: The objective of the ISACS project is to prove the feasibility of the analysis and characterization of the seafloor by exploiting and integrating data gathered from commercially-available sonar equipment. This has applications in geotechnical engineering, the offshore industry, archaeological research, as well as environmental research and monitoring.

The four main areas in terms of quantitative characterization are: (1) the layering of the upper seafloor strata, including location, dipping and roughness parameters, (2) quantitative (compressional wave velocity and attenuation, density) and qualitative (sand- silt-gravel) of the different layers, (3) localization and identification of buried and partially buried objects (pipelines, cables, toxic waste etc) and (4) 3D volumetric imaging of the upper strata.

The work at SIPLAB-Faro concentrates on the 3D interpolation and segmentation of bottom-penetrating sonar data plus volumetric and surface (triangulated segmentation) rendering.

Research Areas: Image Processing, Computer Graphics

Laboratories: Vision Laboratory

External Partners: Norwegian University of Science and Technology, Norway; Fugro Consultants International, The Netherlands; SACLANT Undersea Research Centre, Italy; national defense Research Establishment, Sweden; Royal Institute of technology, Sweden; University of Genova, Italy; Kongsberg Simrad, Norway.

Initiated: 1996

Conclusion: August 1999

Classification: CEC DG XII, MAS3-CT95-0046



Project name: TMO - Tracking of Moving Objects with Trained Multi-Models

Project Leader within ISR: Prof. Jorge Salvador Marques

Project description: This project aims at developing robust tracking algorithms for dealing with complex motion and shape dynamics. Current methods achieve good tracking performance in the presence of non-cluttered background and smooth motion and deformation regimes but they typically loose track if one of these conditions fails. This project studies the use of multiple deformable models with switching/mixing algorithms as a way to enlarge the tracking capabilities. This raises several interesting questions: how to combine multiple models or switch between them? Can tracking be improved if the parameters lie on manifold contained in \mathbb{R}^n ? What methods can be used to estimate the manifold and the parameter trajectory? Other topics that will be addressed in this project are multi-model learning and robust trajectory estimation methods to reduce the influence of outliers. The proposed algorithms will be tested in selected applications.

Research Areas: Image Processing

Laboratories: Signal Processing Lab.

External Partners: IST, ISEL

Initiated: 1999

Expected conclusion: 2001

Classification: PRAXIS/P/EEI/12050/1998

Project name: Automatic Classification of Marble Tiles – CVAM

Project Leader within ISR: Prof. Jorge Salvador Marques

Project description: This project aims to develop methods for automatic classification of marble tiles. Presently, there are no standard criteria to classify marble tiles. Each tile is manually inspected and compared with other based on subjective evaluation. Furthermore, the subjective inspection rules changes depend on the factory that produces the tiles. The goal of this project is the choice of a set of visual features useful for the inspection of marble tiles and the development of classification methodologies. The results will be compared with the opinion of several experts in order to characterize the differences. The main difficulty of this problem lies on the fact that the optimal classification is not known in this problem.

Research Areas: Image Processing

Laboratories: Signal Processing Lab.

External Partners: IST, INESC, INETI

Initiated: 1999

Expected conclusion: 2001

Classification: PRAXIS/2/2.1/TPAR/2057/95

1.5 Underwater Acoustics

Project name: INTERNAL TIDE MEASUREMENTS WITH ACOUSTIC TOMOGRAPHIC EXPERIMENTS — *INTIMATE*

Project Leader within ISR: Prof. Sérgio Jesus (University of Algarve)

Project description: Today acoustics one of the main tools for ocean exploration. Inspired by a technique from biomedical engineering, ocean acoustical tomography (OAT) consists of the use of one or more acoustic sensors/sources strategically distributed in a volume of water and simultaneously emitting and receiving coded signals. The *comparison* of the emitted and received signals allows for the acoustical characterization of the environment in between the source(s) and receiver(s). The experiments that have been performed to date, mainly in deep water, showed that it is possible to estimate: (1) the temperature over the water column, (2) the physical characteristics of the seabottom and (3) the velocity and direction of currents.

Due to the large water mass involved and its periodic nature, internal tides signatures have been frequently observed during ocean tomography experiments in the Bay of Biscay. In the continental shelf, internal tides are extremely important to the study of the coastal dynamics with a very special relevance close to the shelf break and to topographic irregularities like submarine canyons. This project aims at providing the concept of using vertical arrays of sensors and acoustic sources in the band 50 - 400 Hz for tomographic estimation of the oceanographic characteristics of internal tides on the continental shelf up to 200 m of water depth. During the project, areas of interest near the portuguese coast will be selected for at sea testing including the validation of the tomographic results with ground truth measurements. The conclusions of this study are hoped to bring a better knowledge of the internal tide phenomena and its impact on the portuguese coastal dynamics. This should lead to improved prediction accuracy for coastal dynamical models and to a better management of existing resources. The results will also be important in providing more refined predictions of the impact of potential ecological accidents and climate changes.

Research Areas: Signal Processing

Laboratories: Signal Processing Lab.

External Partners: Instituto Hidrográfico (Lisbon, Portugal); Centre Militaire Oceanographique - Service Hydrographique et Oceanographique de la Marine (Brest, France)

Initiated: 1997

Expected conclusion: June 2000

Classification: PRAXIS project, contract n° 2/2.1/MAR/1698/95

2 Theses

In this subsection the Doctoral and Master theses in progress, at ISR/IST (ECE) and ISR/Algarve (ECE), are identified.

Doctoral Theses

Research Area: Signal Processing

Title: Detecção de Sinais Transientes para Aplicações em Acústica Submarina

Doctoral Student: Francisco M. Garcia

Advisor: Isabel Lourtie

Initiated: 1994

Expected conclusion: 2000

Current status: on-going

Grant:

Research Area: Image Processing

Title: Rigid Structure from Video

Doctoral Student: Pedro Aguiar

Advisors: José M. F. Moura and João Sentieiro

Initiated: 1995

Expected conclusion: 2000

Current Status: writing up the dissertation

Grant:

Research Area: Image Compression

Title: Not yet available

Doctoral Student: Jorge Barbosa

Advisor: Victor Barroso

Initiated: 1996

Expected conclusion: 2000

Current Status: on-going

Grant: PRODEP

Research area: Inverse Problems on Ocean Acoustics

Title: to be decided

Doctoral Student: Orlando Camargo Rodriguez

Advisor: Sérgio Jesus

Initiated: 1996

Expected conclusion: 2000

Current status: on going

Grant: PRODEP

Research Area: Blind Equalization
Title: Not yet available
Doctoral Student: João P. Gomes
Advisor: Victor Barroso
Initiated: 1997
Expected conclusion: 2000/2001
Current Status: on-going
Grant:

Research Area: Time-Frequency Signal Analysis
Title: Not yet available
Doctoral Student: Paulo Mónica
Advisor: Victor Barroso
Initiated: 1997
Expected conclusion: 2000/2001
Current Status: on-going
Grant:

Research Area: Array Processing
Title: Not yet available
Doctoral Student: João Xavier
Advisor: Victor Barroso
Initiated: 1997
Expected conclusion: 2000/2001
Current Status: on-going
Grant:

Research area: Image processing
Title: 3D Acoustic Data Processing Of The Seabottom - From Interpolation To Visualization
Doctoral Student: Robert E. Loke
Advisor: Hans du Buf
Initiated: 1997
Expected conclusion: 1999
Grant: MAS3 ISACS project
Current status: on going

Research Area: Parallel Computing
Title: Parallelization tools for SPMD programming
Doctoral Student: Patricio Serendero
Advisor: Hans du Buf
Initiated: 1997
Expected conclusion: 2000
Current status: On-going
Grant: PRODEP

Research Area: Computer Graphics; Parallel Computing
Title: Parallel Raytracing
Doctoral Student: Roberto Lam
Advisor: Hans du Buf
Initiated: 1997
Expected conclusion: 2000
Current status: On-going
Grant:

Research area: Computational Geometry and Optimization
Title: to be decided
Doctoral Student: Mário Carlos M. Jesus
Advisor: Sérgio Jesus and Alberto Marquez (Univ. Sevilla)
Initiated: 1997
Expected conclusion: 2000
Current status: on going
Grant: PRODEP

Research area: Video Segmentation
Title: Not yet available
Doctoral Student: Pedro M. Jorge
Advisor: Jorge S. Marques
Initiated: 1998
Expected conclusion: 2002
Grant:
Current status: on going

Research area: 3D Ultrasound
Title: Not yet available
Doctoral Student: João Sanches
Advisor: Jorge S. Marques
Initiated: 1998
Expected conclusion: 2002
Grant:
Current status: on going

Research area: Tracking of Moving Objects with Multiple Models
Title: Not yet available
Doctoral Student: Jacinto Nascimento
Advisor: Jorge S. Marques
Initiated: 1998
Expected conclusion: 2002
Grant: PRAXIS XXI
Current status: on going

Research area: Underwater Acoustic Communications
Title: to be decided
Doctoral Student: António João Silva
Advisor: Sérgio Jesus
Initiated: 1998
Expected conclusion: 2001
Current status: on going
Grant:

Research area: image processing
Title: Not yet available
Doctoral Student: Adrian Ciobanu
Advisor: Hans du Buf
Initiated: 1998
Expected conclusion: 2001
Grant: MAS3 ADIAC project
Current status: on going

Research area: image processing, visual psychophysics
Title: A new spatial brightness model
Doctoral Student: João Rodrigues
Advisor: Hans du Buf
Initiated: 1998
Expected conclusion: 2002
Current status: on going
Grant: PRODEP

Master Theses

Research Area: Image Processing
Title: A segmentação de imagem em três dimensões
Master Student: João Rodrigues
Advisor: Hans du Buf
Initiated: 1997
Expected conclusion: 1999
Current status: On-going
Grant:

Research Area: Signal Processing
Title: Not available
Master Student: Nelson Martins
Advisor: Sérgio Jesus
Initiated: 1998
Expected conclusion: 1999
Current status: On-going
Grant:

Research Area: Signal Processing
Title: Not available
Master Student: Cristiano Soares
Advisor: Sérgio Jesus
Initiated: 1998
Expected conclusion: 1999
Current status: On-going
Grant:

3 Invited Talks

Jorge S. Marques - Presented an invited talk at the Workshop on Biomechanics and Computer Vision, Minho University, July 1999.

Victor Barroso - "Blind Identification of MIMO Channels: A Closed Form Solution Based on Second Order Statistics," invited presentation, Asilomar Conference on Signals, Systems, and Computers, USA, October 1999.

Sérgio Jesus - "INTIMATE Results" at Scientific Committee of National Representatives (SCNR), NATO SACLANTCEN, La Spezia, Italy, May 1999.

Sérgio Jesus - "Localizacao de Fontes Acusticas em Aguas pouco profundas", IV Encontros de Tecnologia Acustica Submarina, Instituto de Pesquisa da Marinha, Rio de Janeiro, Brasil, Nov 1999.

4 Service Activities

This section is dedicated to service activities developed by the researchers of the Signal and Image Processing Group of ISR-Lisbon as members of the national and international scientific community.

Editorial Boards

Victor Barroso - Associate Editor of the IEEE Trans. on Signal Processing (the appointment period has finished February 1999, but several papers have yet to be handled)

Sérgio Jesus - Associate Editor of the IEEE Trans. on Signal Processing.

Programme and Technical Committees

Jorge S. Marques - Member of the Technical Committee of IV Simposio IberoAmericano de Reconhecimento de Padrões, March 1999.

Isabel Lourtie - member of the IEEE Sensor Array and Multichannel technical Committee.

Sérgio Jesus - Workshop on "Experimental Acoustic Inversion Methods for the Exploration of the Shallow Water Environment", March 1999, Carvoeiro, Portugal.

Sérgio Jesus - 5th European Conference on Underwater Acoustics, Lyon, France, July 2000.

Reviewers

Jorge S. Marques - Signal Processing Letters; Journal of Machine Vision Applications; International Symposium on Intelligent Robotic Systems; IV Simposio IberoAmericano de Reconhecimento de Padrões.

Isabel Lourtie - IEEE Trans. on Signal Processing

Isabel Lourtie - IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP).

Victor Barroso - IEEE Transactions on Signal Processing; IEEE Transactions on Circuits and Systems II.

Pedro M. Q. Aguiar -Reviewer requested by the Technical Committee of IEEE International Workshop on Multimedia Signal Processing; Second International Workshop on Energy Minimization Methods in Computer Vision and Pattern Recognition

Miloud Frikel - IEEE Transactions on Signal Processing; IEEE Transactions on Circuits and Systems II.

João Xavier - IEEE Transactions on Signal Processing; IEEE Transactions on Circuits and Systems II.

João P. Gomes - IEEE Transactions on Signal Processing

Paulo M. Oliveira - IEEE Transactions on Signal Processing

Sérgio Jesus - Journal of the Acoustical Society of America;

Sérgio Jesus - IEEE Journal of Oceanic Engineering.

Other Activities

Isabel Lourtie - Member of the portuguese evaluation committee of the Honeyweel Futurist Competition, June 1999.

Victor Barroso - Coordinator of the project proposal "Interrelated Problems of Array Signal Processing and Channel Estimation in Nonstationary Environments," involving the Institute of Applied Physics, Russia Academy of Science, the University of Nizhny Novgorod (both from Russia), the Kharkov Technical University of Radio Electronics (Ukraine), the I3S-CNRS Lab. of the University of Nice (France), and ISR/IST (Portugal).

5 Academic Activities

Here we list the participation of ISR-Lisbon (ECE) researchers in committees for Master and Doctoral Thesis, and other academic related activities.

Victor Barroso - Participation in 4 M. Sc. Committees, IST.

Jorge S. Marques - Member of the Coordinating Commission of the M.Sc. programme in Electrical and Computer Engineering, IST.

Jorge S. Marques - Member of the Equivalence Commission of IST.

Jorge S. Marques - Member of 2 Ph.D. committee and 3 M.Sc. Committees.

Isabel Lourtie - Coordinator of the Systems and Control Sectin of the Department on Electrical and Computer Engineering of IST.

6 Publications In 1999

Books - Author (1)

[1] Jorge S. Marques. "Pattern Recognition. Statistical and Neural Approaches," (in Portuguese), IST Press, 1999.

Books – Chapters (5)

[2] O.C.Rodriguez, S.M.Jesus, Y. Stephan, X. Demoulin, M. Porter and E. Coelho, "Dynamics of Acoustic Propagation Through a Soliton Wave Packet: Observations from the INTIMATE'96 Experiment", on *Experimental Acoustics Inversion Methods for Exploration of the Shallow Water Environment*, Ed. Caiti, Hermand, Jesus and Porter, KLUWER, 1999.

- [3] Y. Stephan, X. Demoulin, T. Folegot, S. M. Jesus, M. B. Porter and E. Coelho, "Acoustical Effects of Internal Tides on Shallow Water Propagation: An overview of the INTIMATE'96 Experiment," on *Experimental Acoustics Inversion Methods for Exploration of the Shallow Water Environmen*, Ed. Caiti, Hermand, Jesus and Porter, KLUWER, 1999.
- [4] M. B. Porter, S. M. Jesus, Y. Stephan, X. Demoulin and E. Coelho, "Tidal Effects on Source Inversion, " on *Experimental Acoustics Inversion Methods for Exploration of the Shallow Water Environmen*, Ed. Caiti, Hermand, Jesus and Porter, KLUWER, 1999.
- [5] J.H. van Deemter, and J.M.H. du Buf, "Line and edge detection by curvature-adaptive neural networks," chapter to appear in: *Neural networks as models for neuronal phenomena*, J.E. Vos and H.A.K. Mastebroek (eds), Addison-Wesley Longmans (1999).
- [6] J.M.H. du Buf, "Introduction to modeling brightness perception," chapter to appear in: *Vision models and applications to image and video processing*, C. van den Branden (ed), Elsevier (1999).

International Journals (2)

- [7] J. Xavier, V. Barroso. "Blind Source Separation, ISI Cancellation and Carrier Phase Recovery in SDMA Systems for Mobile Communications," *Wireless Personal Communications Journal*, special issue on Wireless Broadband Communications, June 1999.
- [8] Paulo M. Oliveira, Victor Barroso. "Instantaneous Frequency of Multicomponent Signals," *IEEE Signal Processing Letters*, April 1999.

International Conferences with peer review (w.p.r.) (31)

- [9] João Xavier, Victor Barroso. "A Channel Order Independent Method for Blind Equalization of SIMO/MIMO Systems," *Proc. IEEE International Conference on Acoustics, Speech and Signal Processing, ICASSP'99, USA, March 1999.*
- [10] João Gomes, Victor Barroso. "Performance Analysis of a Recursive Fractional Super-Exponential Algorithm," *Proc. IEEE International Conference on Acoustics, Speech and Signal Processing, ICASSP'99, USA, March 1999.*
- [11] Paulo M. Oliveira, Victor Barroso. "Sequential Extraction of Components of Multicomponent PPS Signals," *Proc. IEEE International Conference on Acoustics, Speech and Signal Processing, ICASSP'99, USA, March 1999.*
- [12] João Xavier, Victor Barroso. "Correlative Coding Approach for Blind Identification of MIMO Systems," *Proc. 2nd IEEE Signal Processing Workshop on Signal Processing Advances in Wireless Communications, SPAWC'99, USA, May 1999.*
- [13] Miloud Frikel, Victor Barroso, and João Xavier. "Blind Recursive Estimation of SIMO Channels," *Proc. 2nd IEEE Signal Processing Workshop on Signal Processing Advances in Wireless Communications, SPAWC'99, USA, May 1999.*
- [14] João Gomes, Victor Barroso. "A Matched Field Processing Approach to Underwater Acoustic Communications," *IEEE International Conference on Oceanic Engineering, OCEANS'99, USA, September 1999.*

- [15] João Xavier, Victor Barroso. "Polyhedral Concepts for Deterministic Blind Separation of Binary Sources," 33rd Asilomar Conference on Signals, Systems, and Computers, USA, October 1999.
- [16] Victor Barroso, João Xavier, "Blind Identification of MIMO Channels: A Closed Form Solution Based on Second Order Statistics," Invited paper, Proc. Asilomar Conference on Signals, Systems, and Computers, Asilomar, Pacific Grove, California, USA, Outubro 1999.
- [17] João Xavier, Victor Barroso. "Polyhedral Methods for Blind Deterministic Separation of Binary Co – Channel Signals," IEEE GLOBECOM'99, Brazil, December 1999.
- [18] Jacinto Nascimento, Arnaldo J. Abrantes, and Jorge S. Marques. "An Algorithm for Centroid Based Tracking of Moving Objects," Proc. IEEE Int. Conf. Acoustics, Speech and Signal Processing, ICASSP99, USA, March 1999.
- [19] Jorge S. Marques, João M. Lemos. "Tracking of Moving Objects with Multiple Models Using Gaussian Mixtures," Proc. IEEE Int. Conf. Acoustics, Speech and Signal Processing, ICASSP99, USA, March 1999.
- [20] Pedro M. Q. Aguiar, José M. F. Moura. "Factorization as a Rank 1 Problem", IEEE International Conference on Computer Vision and Pattern Recognition, USA, June 1999.
- [21] Pedro M. Q. Aguiar, José M. F. Moura. "Maximum Likelihood Inference of 3D Structure from Image Sequences", Second International Workshop on Energy Minimization Methods in Computer Vision and Pattern Recognition, EMMCVPR99, Springer Lecture Notes in Computer Science, UK, July 1999.
- [22] Pedro M. Q. Aguiar, José M. F. Moura. "Fast 3D Modelling from Video," IEEE International Workshop on Multimedia Signal Processing, Copenhagen, Denmark, September 1999
- [23] Pedro M. Q. Aguiar, José M. F. Moura. "A Fast Algorithm for Rigid Structure from Image Sequences," IEEE International Conference on Image Processing, Japan, October 1999.
- [24] Jorge S. Marques, João M. Lemos, and Arnaldo J. Abrantes. "Estimation of Random Trajectories on Manifolds: Application to Object Tracking," IEEE Int. Conf. Image Processing, ICIP99, Japan, October 1999.
- [25] Jorge S. Marques, João M. Lemos. "Shape Tracking Based on Switching Dynamical Models," IEEE Int. Conf. Image Processing, ICIP99, Japan, October 1999.
- [26] João M. Lemos, Luis Rato, and Jorge S. Marques. "Switching Reconfigurable Control Based on Hidden Markov Models," European Control Conference, 1999.
- [27] O.C.Rodriguez, S.M.Jesus, Y. Stephan, X. Demoulin, M. Porter and E. Coelho, "Non-linear soliton interaction with acoustic signals: focusing effects", Proc. Int. Conf. of Theoretical and Comp. Acoustics (ICTCA'99), Trieste, May 1999.
- [28] M. B. Porter, S. M.Jesus, Y. Stephan, X. Demoulin, and E. Coelho, "Using the echo pattern to range a sound source," Proc. Int. Conf. On Physics, Signal and Image Processing (PSIP'99), Paris, 1999.
- [29] S. M.Jesus, "Localização de fontes acústicas em águas pouco profundas," Proc. Of IV Encontros de Tecnologia e Acústica Submarina (IV ETAS), Rio de Janeiro, 1999 (invited).
- [30] C.Souares, A. Waldhorst e S.M.Jesus, "Matched Field Processing: Environmental Focusing and Source Tracking with Application to the North Elba Data Set", Proc. of IEEE Oceans'99, Seattle, USA, September 1999.

- [31] R.E. Loke, and J.M.H. du Buf, (1999) "Fast interpolation, segmentation and visualization of 3D sonar seabottom data by using tree structures". Accepted for presentation at the MTS/IEEE OCEANS'99 Conf., Seattle, Wa (USA), Sept. 13-16.
- [32] T.R. Reed, , R.E. Loke, and J.M.H. du Buf, (1999) "The analysis of underwater acoustic data via 3D segmentation". Accepted for presentation at the 33rd Asilomar Conf.\ on Signals, Systems, and Computers, Pacific Grove, Ca (USA), Oct. 24-27.
- [33] J.M.H. du Buf, et al. (1999) "Diatom identification: a double challenge called ADIAC. Accepted for presentation at the ICIAP'99 Conf., Venice, Italy, Sept. 27-29.
- [34] J.M.H. du Buf, et al. (1999) "AMOVIP: advanced modeling of visual information Processing". Accepted for presentation at the ICIAP'99 Conf., Venice, Italy, Sept. 27-29.
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