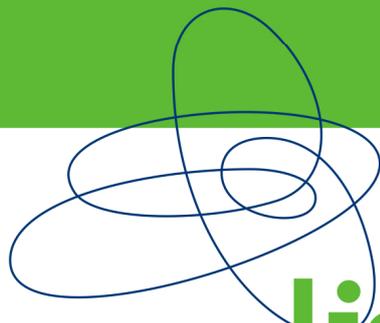


2005 Annual Report



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1 INTRODUCTION

INESC-ID was created in 2000, as a result of the reorganization of the R&D activities of INESC, in Lisbon. The year of 2005 marks simultaneously the fifth anniversary of the institution, and the first year of activity as associated laboratory.

After undergoing a significant restructuring in its first years of activity, the institution was able to reach a compromise between the conflicting objectives of high impact long term research and more immediate, but equally important, technology transfer projects. We believe that these two types of activities are crucial and necessary for an institution like INESC-ID that aims at creating value for the country by developing new technologies.

INESC-ID now stands as the most dynamic research institute in Portugal in the areas of electronics, information systems and telecommunications. In close cooperation with its partners, Instituto Superior Técnico and INESC, our institute has emerged as an institution of reference, intensely involved in a number of high visibility projects that define the state of the art in these areas, both in national and international terms.

This report summarizes the main technical activities developed in 2005. Although this year was marked by a significant slowdown of the Portuguese economy, INESC-ID was able to increase its activity and to develop a significant number of projects in cooperation with Portuguese companies and institutions.

This report aims at presenting, in a structured way, a brief description of the institution and an overview of the most important results of the activities developed, together with the key management initiatives. A listing of the most significant research projects undertaken in 2005 is included in order to provide a picture, necessarily incomplete, of the main competences of the INESC-ID.

A more detailed list of activities, organized by line of action is also provided, complemented by a complete list of projects, publications and dissertations, included as annexes to the main document.

2 GENERAL INFORMATION

2.1 Institucional Information

INESC-ID, “Instituto de Engenharia de Sistemas e Computadores: Investigação e Desenvolvimento in Lisbon” is a Private not for-profit institution, certified as of public interest as of 27/09/2003.

INESC-ID is owned by Instituto Superior Técnico (51%) and INESC-Instituto de Engenharia de Sistemas e Computadores (49%).

INESC-ID operates in two locations, near (or inside) the two campus of IST, namely at:

Campus I: Alameda
Rua Alves Redol, 9
1000-029 Lisboa
Telef.: +351 213100300
Fax: +351 213145843

Campus II: TagusPark
Avenida Professor Cavaco Silva
2780-990 Porto Salvo
Telef: +351 214233508
Fax: + 351 214233290

2.2 General Description of INESC-ID

INESC-ID is a research institute that integrates a body of highly qualified researchers, of which more than 70 hold a PhD degree as well as post-graduate students. The majority of the PhD researchers are University professors, mostly from Instituto Superior Técnico. This body of researchers, unique at national level in its scientific area, enables INESC-ID to act, in an effective way, in the different phases of the R&D process. The intense activity developed by INESC-ID since its creation in 2000 resulted, up to now, in more than 1000 scientific papers published in specialized journals and international conferences, dozens of industrial prototypes and computer systems based on state-of-art technologies, as well as a number of patents and awards.

2.3 Main Institutional Objectives

INESC-ID aims to produce added value to people and society in the field of Information and Communication Technologies (ICT). The mission of INESC-ID is to ***develop tomorrow's technologies by excelling in research, today.***

The main objectives of INESC-ID are:

- Integrate competences from researchers in electrical engineering and computer science to advance the state of the art in computers, telecommunications, and information systems;
- Support the first stages of the value generation chain: basic research, applied research and advanced education;
- In cooperation with other institutions, perform technology transfer, support the creation of technology based startups, and provide technical support.

Tangible results of the activity of the institution are

- Methodologies, tools, patents, and prototypes to be transferred to the academic, scientific or industrial sectors, and
- Advanced professional education and training. A privileged channel of results dissemination is through international publications, patents, prototypes, and participation in scientific events.

In order to fulfill its mission, INESC-ID values internationalization, networking, partnership and visibility.

R&D activities cover a broad (although focused) range of research areas and application markets (such as wireless communication, electronic equipment, health care, medical imaging, industrial automation, e-learning, enterprise information systems). Interdisciplinary heterogeneous systems engineering and synergies among R&D teams are especially encouraged.

In a limited way, INESC-ID also acts as service provider, to stimulate cooperation with industry, to focus research on practical issues, and to make the economic tissue aware of its capabilities. Close ties with professionals qualified by INESC-ID are encouraged, not only for lifelong education support, but also for networking activities.

2.4 INESC-ID as an Associated Laboratory

INESC-ID was able in 2004 to successfully carry out the negotiations that led to the recognition, by the Portuguese government, of INESC-ID as an Associated Laboratory (<http://www.labs-associados.org/>). The first five year contract (2005-2009) has been signed with the activities, starting January, 1, 2005.

2.5 Funding Agencies

The scientific activities of INESC-ID were financed by a number of funding agencies, amongst which deserve special mention FCT - Fundação para a Ciência e Tecnologia, ADI - Agência de Inovação, and the European Commission.

2.6 Human Resources

With INESC-ID focusing its activity on the rapid growth areas of information technology, communications and electronics, it is to be expected an increase in the number of human resources with higher degrees within the next few years, given the presence of numerous researchers that are carrying out their post-graduate work at INESC-ID. *Table 1* summarizes the qualifications of INESC-ID researchers.

Table 1 - Human Resources

Academic Degree	Number
Agregation	17
PhD Degree	56
MSc Degree	44
BSc Degree (licenciatura)	109
Undergraduate Students	103
Total	329

Besides the increase inherent to the internal training of new researchers with high education degrees, most of them university professors, the planned activities require the recruitment of new researchers, with complementary competences in the main thematic areas.

The increase of technical and scientific activity, associated with the status of Associated Laboratory, leads to the need of strengthening technical support and administrative services.

2.7 Management Structure

INESC-ID is structured according to the organization chart shown in *Figure 1*, with the different bodies and internal services arranged in accordance with their function. Current management of the organization is ensured by the Board of Directors, assisted by the Project Support Office (GAP), the Human Resources Office (GARH), and the administrative support units.

Besides the Administrative Support, INESC-ID is also supported in other areas, by services sub-contracted to the INESC holding or to INOV, which are: Financial Control Department (DFA), Budget Control Department (DAF), Legal Support, Infrastructures Department (DGI), and Computer Network Support.

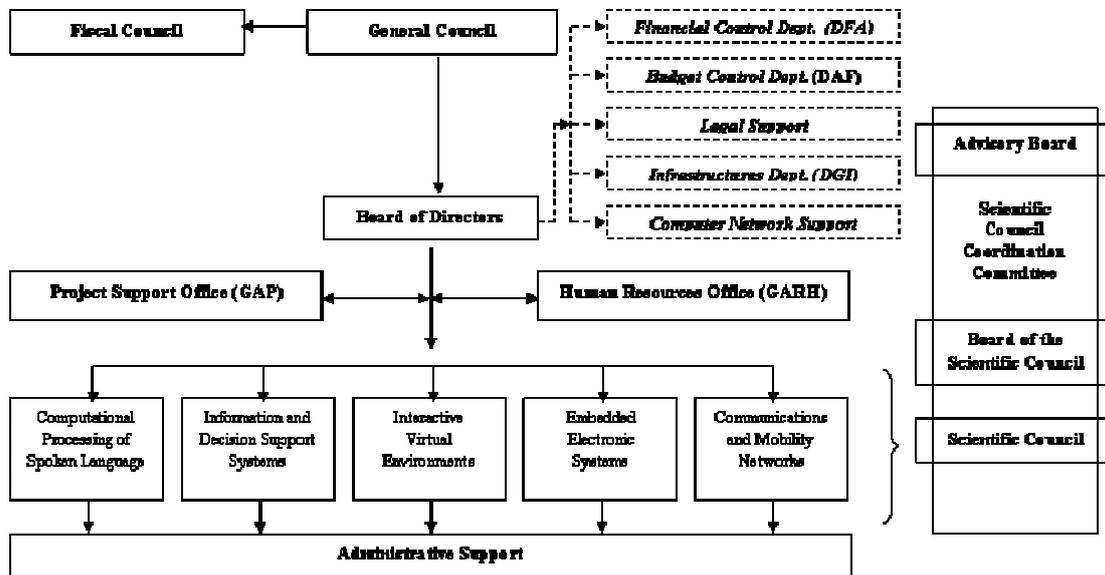


Fig. 1 - INESC-ID Organization Chart

2.7.1 Board of Directors

The Board of Directors is composed of three members proposed by the Scientific Council and appointed by the General Council. It is in charge of the general management of the Institution. In 2005 the Board was composed by Prof. Arlindo Oliveira, Prof. Luís Caldas de Oliveira, and Prof. Leonel Sousa.

2.7.2 General Council

The General Council is composed of three representatives of IST (Instituto Superior Técnico), two of INESC, and by the chairman of the Scientific Council of INESC-ID. The General Council approves the annual technical and financial reports, as well as the plan and the budget. It appoints the board of directors under proposal by the Scientific Council. In 2005 the General Council was composed by Prof. Carlos Matos Ferreira, Prof. Afonso Barbosa, Prof. António Cruz Serra, Prof. José Tribolet, Prof. João Paulo Figueiredo, and Prof. Augusto Casaca.

2.7.3 Fiscal Council

The Fiscal Council is composed of three members appointed by the General Council. It examines and certifies the accounts of the Institution. In 2005 the Fiscal Council was composed by Sr. Hermínio Ribeiro, Dr. João Gonzalez and Dr. Vitor Franco.

2.7.4 Scientific Council

The Scientific Council is composed by all researchers with a Ph.D. degree. It is responsible for the strategic planning and by the organization of the research groups, and evaluates the research projects, annual budget, plan and report. The Scientific Council is assisted by the Advisory Board which visits INESC-ID on a regular basis.

2.7.5 Scientific Council Coordination Committee

The Coordinating Committee is composed by one representative of each of the thematic areas, the president of the Scientific Council and the two members of the Board of the Scientific Council Coordination Committee.

2.7.6 Board of the Scientific Council

In 2005 the Board of the Scientific Council was composed by Prof. Paulo Ferreira, Prof. João Paulo Teixeira, and Prof. Augusto Casaca.

2.7.7 Advisory Board

The Advisory Board is composed by external advisors that provide advice concerning the strategy and plans of the Institution. The members of the Advisory Board are currently Prof. Franco Maloberti (Univ. Pavia, Italy), Prof. Srinivas Devadas (MIT, USA), Prof. Morris Sloman (Imperial College of London, UK), and Prof. Carlos Príncipe (Univ. Flórida, USA).

2.7.8 Human Resources Office

The Human Resources Office (GARH - Gabinete de Apoio aos Recursos Humanos) is responsible by all the management of the human resources of INESC-ID.

2.7.9 Projects Support Office

The Projects Support Office (GAP - Gabinete de Apoio aos Projectos) is responsible for the elaboration of proposals and control of execution of national projects. It also supports directly the activity of the Board of Directors.

2.7.10 Administrative Support

The Administrative Support is composed of five secretaries that provide secretarial and administrative support to the researchers of different R&D groups.

2.7.11 Financial Control Department

The Financial Control Department (DFA - Departamento Financeiro e Administrativo) is in charge of all the accounting and finance matters, related with direct management of INESC-ID.

2.7.12 Budget Control Department

The Budget Control Department (DAF- Departamento Administrativo e Financeiro) controls the budget of the projects and units of INESC-ID. It also handles regular budget control, acquisitions, and project reporting for national and European projects.

2.7.13 Legal Support

Legal Support gives advice on all the legal matters concerning INESC-ID.

2.7.14 Infrastructures Department

The Infrastructures Department (DGI - Departamento de Gestão de Infraestruturas) manages the infrastructure, repairing, and handles all questions directly related with the buildings where INESC-ID is settled, including telephone service.

2.7.15 Computer Networks Department

The Network Support Department is responsible for the maintenance of the computer network and servers.

2.8 Research Units

When INESC-ID started to operate in January 2000 it had inherited from its predecessor institution, INESC a set of about 25 R&D groups that used to report directly to the central management of the institution. It was decided to organize the groups into thematic areas that were initially five and later became six. Each area had one representative at the Coordinating Committee of the Scientific Council.

The basic research unit remained the R&D group: the thematic areas were basically a set of groups for administrative purposes. The groups were, in most cases, too small, and there was insufficient interaction between them. The desirability of having strategic planning and coordination at area level was recognized by the Scientific Council and strongly recommended by the Advisory Board. As a consequence, some thematic areas started to operate with some degree of integration, and, in one case, the corresponding groups have been merged. These areas with some integration of their groups were called “laboratories” to distinguish them from the others, called simply “areas”. In 2005 there were three Areas and three Laboratories:

Areas

- Communication Networks
- Electronic Systems and Control
- Intelligent Systems and Computation

Laboratories

- Spoken Language Systems Lab
- Cooperative Virtual Environments
- Programmable Systems Lab

The approved proposal of setting up INESC-ID as an Associated Laboratory considered an organization with five “Lines of Action”:

- Computational Processing of Spoken Language
- Information and Decision Support Systems
- Interactive Virtual Environments
- Embedded Electronic Systems
- Communications and Mobility Networks

Each line of action has a Coordinator, appointed by the Scientific Council. The functions of the Coordinator are as follows:

- To lead at a global level the activities within the domain of the corresponding line of action;
- To coordinate the activities of the various groups which contribute to the line of action;
- To promote the preparation of proposals for R&D projects;
- To coordinate the management of an incentive system aimed at the integration of recent PhDs, within the domain of each area;
- To coordinate the preparation of plans and activities reports within the scope of the area.

Each line of action integrates different research groups, which are indicated below together with their respective coordinator:

Computational Processing of Spoken Language

Due to its higher degree of integration, individual groups are not identifiable within this area.

The coordinator is Prof. Isabel Trancoso

Information and Decision Support Systems

SW Algorithms and Tools for Constraint Solving - Prof. Inês Lynce

Algorithms for Optimization and Simulation - The coordinator rotates among the senior researchers

Soft Computing - Prof. José Alberto Tomé

Distributed Systems - Prof. Paulo Ferreira

Software Engineering - Prof. António Rito da Silva

Information Systems - Prof. Alberto Silva

Data management and information retrieval - Prof. Helena Galhardas

Interactive Virtual Environments

Intelligent Agents and Synthetic Characters - Prof. Ana Paiva

Interactive Graphic Environments - Prof. João Pereira

Intelligent Multimodal Interfaces - Prof. Joaquim Jorge

Embedded Electronic Systems

Analogue and Mixed-Signal Circuits - Prof. Manuel de Medeiros Silva

Control of Dynamic Systems - Prof. João Miranda Lemos

Signal Processing Systems - Prof. Moisés Piedade

Wireless Communications - Prof. Maria Helena Sarmiento

Quality, Test, and Co-Design of HW/SW Systems - Prof. João Paulo Teixeira

Packaging, Measurement, and Test - Prof. Carlos Beltran Almeida

Electronic System Design and Automation - Prof. Horácio Neto

Software/Configware Algorithms - Prof. José Teixeira de Sousa

Communications Networks and Mobility

Network Architecture - Prof. Augusto Casaca

The characterization of these scientific areas will be discussed in the next chapters.

The following table maps the previous organization to the one that will be in place in 2006:

Table II - Mapping of Areas/Laboratories into Lines

Lines of Action/ Laboratories		Areas/Laboratories					
		Spoken Language Systems Lab	Intelligent Systems and Computation	Cooperative Virtual Environments	Electronic Systems and Control	Programmable Sytems Lab	Communication Networks
Lines of Action	Computational Processing of Spoken Language	x					
	Information and Decision Support Systems		x	x			
	Interactive Virtual Environments			x			
	Embedded Electronic Systems		x		x	x	
	Communications and Mobility Networks						x

3 REPORT OF THE 2005 INESC-ID ACTIVITY

In 2005, INESC-ID continued to improve the quality of the research and development performed. The present report gives the main indicators, lists the most significant activities developed during the year, and highlights some of the most significant projects, with the objective of illustrating the quality and variety of the research developed by the institution.

3.1 Results of the activities developed in 2005

The following set of tables summarises the activities carried out in 2005 and the results achieved.

Projects

Table II - Projects

Type of Project	Number
International Programs	17
National Programs	43
Direct Contracts	13
Other	2
Total	75

Publications

Table III - Publications

Publication Type	Number
International Journals	25
International Conferences	202
National Conferences	59
Technical Reports	48
PhD Theses	7
MSc Theses	29
Graduation Theses	118
Books	2
Edited Books	1
Book Chapters	16
National Journal Articles	7
Other Publications	6
Edition of Conference	6

Publication Type	Number
Special Issues of Journals (editor)	2
Total	528

Dissertations

Table IV - Thesis

Type	Ongoing	Completed	Total
PhD Theses	81	6	87
MSc Theses	90	27	117
Graduation Theses	118	106	224
Total	289	140	428

Cooperation and Dissemination Activities

Table V - Organization of Scientific Events

Type of Action		Number
International	Associate Editor of Journal	3
	Committee Chair	3
	Committee Member	65
	General Chair	3
	Invited Speaker	8
	Reviewer	45
	Committee Chair	2
	Committee Member	12
	General Chair	1
	Invited Speaker	1
	Reviewer	8
Total	151	

3.2 Initiatives

3.2.1 Kick-off Meeting of Senior Researchers

In October 2005, the senior researchers met at Ericeira, with the objectives of discussing issues related with strategic development.

Intellectual Property Protection, Creation of Startups, and Patent Registration were the subjects of the morning meetings, with the presence of an invited speaker, Joaquim Sérvulo Rodrigues, from BES Investments.

The afternoon was dedicated to the study of possible directions for the reorganization of the internal structure, in the context of the Associated Laboratory contract.



Fig. 2 - Kick-off meeting in Ericeira

3.2.2 Incentives to Excellence in Research

In 2005, a number of incentives for excellence in research have been approved by the management of INESC-ID. These include:

- Incentive given to the groups for publication in top level international journals;
- Incentive, as well as payment of costs, for registration of patents;
- Temporary PhD fellowships, to support candidates awaiting decision from funding agencies.

3.2.3 Internal Call for Projects

The management of INESC-ID opened an internal call for projects submitted by young researchers. The Advisory Board evaluated the proposals. Five projects have been approved (early 2006):

- SHIPs: Sat-based models and algorithms for Haplotype Inference by Pure Parsimony - Prof. Inês Lynce
- MAGIC: Unveiling Metabolic and Genetic Networks in Living Cells - Prof. Ana Teresa Freitas
- PRIVATO: Privacy Aware Trusted Computing - Prof. Carlos Ribeiro
- MOFACS: Mobile Fading Channel Simulator - Prof. Gonçalo Tavares
- CLAW: Cyclic Learning and Annotation of the Web - Prof. Helena Sofia Pinto

3.2.4 Research Staff Admission

INESC-ID is continuously seeking highly qualified candidates holding a PhD with a proven track record and ability to perform independent research in several scientific areas. This opportunity was announced in national and international journals and websites. There were a large number of applications of eligible individuals that submitted their expressions of interest. Two PhDs were hired during 2005.

3.2.5 Research Equipment Acquisition

INESC-ID opened an internal call to finance equipment acquisition with the objective of improving working conditions for researchers and promote closer integration of the lines of action.

3.2.6 Internal Reorganization

As explained above, during 2005 it was decided to reorganize INESC-ID, in accordance with the lines of action defined in the Associated Laboratory contract:

- Computational Processing of Spoken Language
- Information and Decision Support Systems
- Interactive Virtual Environments
- Embedded Electronic Systems
- Communications and Mobility Networks

3.3 Prizes and international recognition

INESC-ID researchers were awarded in 2005 to the following prizes:

- T. Dias, N. Roma, L. Sousa, Best Paper Award, "Two-Level Scalable Motion Estimation Architecture with Fractional-Pixel Accuracy and Efficient Data Re-Usage", Proc. of REC'05, Faro, Portugal, Feb.2005.
- J. Paulo Teixeira, IEEE Computer Society Golden Core Member, as one of the distinguished core of dedicated volunteers and staff whose leadership and service have made the IEEE Computer Society the world's preeminent association of computing professionals.
- J. Paulo Teixeira, Meritorious Service Award, IEEE Computer Society, "for providing leadership to the European Test Workshop / Symposium in the last decade and significant services as general Chair in 2000".
- L. Caldas de Oliveira and L. Filipe Garcia, Merit Award Maria Cândida da Cunha, "Design, Implementation and Test of a System to support Alternative and Augmentative Communication".

3.4 Visibility and external image of the Institution

Concerning the external image of the institution, there was an effort to improve the quality of existing material, including the following actions:

- The whole structure of INESC-ID Internet Site was reformulated, as well as its contents;
- The first issue of a Newsletter was published, with the purpose of increasing the visibility of the institution to the general public;
- The general image of INESC-ID was also reformulated, introducing the motto “technology from seed” in all INESC-ID material.

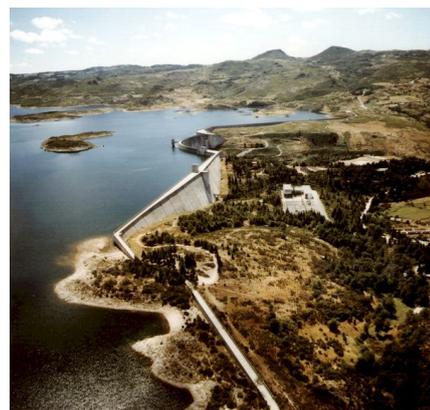
3.5 High Impact Research Projects

Of the ongoing projects during 2005, those that are believed to have higher impact are highlighted in this section.

3.5.1 GestBarragens

GestBarragensManager is an integrated Information System that manages the data required to control the safety of concrete dams. Data is manually or automatically collected by instruments (for instance, a plumbline) located in strategic points in the dam. Then, it must be stored and handled in order to produce results (e.g., displacements) that are required to support decisions concerning dam’s safety.

According to the Portuguese Dam Safety Legislation, LNEC (Laboratório Nacional de Engenharia Civil) is responsible for keeping an electronic archive of the data collected by the dam’s monitoring systems and for the exploitation of the information in order to maintain an updated knowledge about the dam’s behaviour.



The existing information system, named SIOBE (Sistema de Informação para Observação de Barragens de Betão) was written in the 70’s, using the Fortran languages, and stores data in binary and ASCII files. Through the years, new requirements have arisen, concerning the type and variety of information stored as well as the functionalities needed to handle and visualize it.

Data maintained by the old system SIOBE had to be migrated into the GestBarragens database. Besides this legacy information mainly stored in text files, a collection of excel data files containing measurements of different types had to be transformed and stored into the new database. A specific data migration application has been developed for that

purpose. This application dealt with the heterogeneity of the data formats existing in excel data files, and ensured the quality of the new data produced.

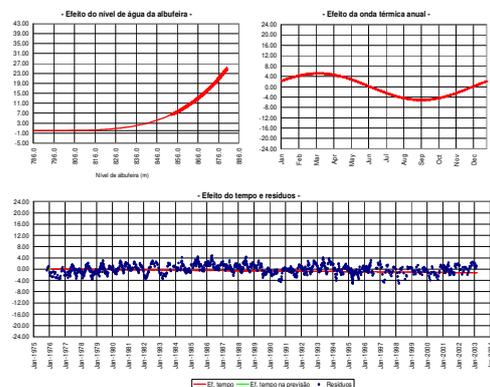
Contributions with respect to the existing system focus on the following aspects:

- **Instrumentation:** integrates new observation instruments, supports the dynamic management of new instruments, and manages metadata about instruments.
- **Types of observations:** manages geodetic information, data concerning visual inspections, and observations automatically collected by appropriate systems without human interaction.
- **Data visualization and exploitation:** data is accessed through a sophisticated set of reports designed to fulfill the types of data analyses required, and a set of graphics and diagrams able to spatially depict data.
- **Synchronization facility:** the system can be deployed in one or more places (for example, LNEC and CPPE which is the owner of many dams) and information updates are synchronized between different instances.



GestBarragens is composed by the following application modules:

- **GestBarragens-Observations:** stores, handles and exploits data concerning the dam monitoring system;
- **GestBarragens-Visual Inspections:** stores, handles and exploits data resulting from periodic inspections where anomalies in the dam are registered;
- **GestBarragens-Documental:** stores, handles and exploits data about documents that concern the dam (e.g., reports, photos, diagrams, etc);
- **GestBarragens-GIS:** integration of geo-referenced information for graphical visualization;
- **GestBarragens-Models:** integration of data concerning the mathematical and physical models developed for dams.

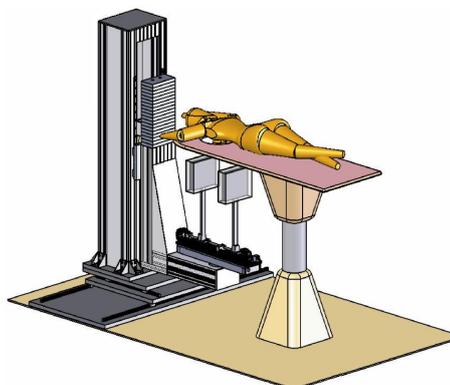


Technology used. GestBarragens has been developed in Microsoft .NET and the application is accessible through a Web browser. Data is stored and managed in Oracle 9i, reports are designed and implemented using Microsoft Reporting Services, and data is graphically and spatially visualized using the ESRI technology.

3.5.2 Pem-Positron Emission Mammography

The problem. Breast cancer early detection is recognized as a worldwide priority, since it is the most effective way to deal with this illness. Therefore, research on new diagnosis processes and systems for this type of cancer should be actively pursued.

PEM system. One of promising research lines relies on the use of Positron Emission-based Technology (PET). This is the case of the development of the Clear-PEM scanner, a high-resolution Positron Emission Mammography (PEM) system, capable of detecting tumours with diameters down to 2 mm. Based on the detection of radiation emitted by human cells when a radioactive substance is injected into the human blood stream, PET provides, by image reconstruction, the origin of the radiation source (the cancer cells).



The PEM Consortium. A consortium has been set up to undertake this mission. With the promotion and support of Tagus Park, the following Institutes have joined efforts: Laboratório de Instrumentação e Física Experimental de Partículas (LIP) (scientific leadership), INESC Inovação (INOV), INESC Investigação e Desenvolvimento (INESC-ID), Instituto de Engenharia e Gestão Industrial (INEGI), Instituto de Biofísica e Engenharia Biomédica (IBEB), Instituto Biomédico de Investigação em Luz e Imagem (IBILI) and Hospital Garcia de Orta, as partner and end-user.

The Electronic System. The Electronic system performs data acquisition and processing. It is constituted by the Front End (FE) electronics, placed on the detector heads, and the off-detector trigger (TGR) and data acquisition (DAQ) electronics. INESC-ID is responsible for the development of FE and DAQ and TGR systems. The integration of the electronic systems is under the responsibility of INOV.



Basic physics. The Clear-PEM detector system is a PET camera consisting of two parallel detector heads, each one holding 96 detector modules. Each module is composed of a 4x8 LYSO:Ce crystal array, optically coupled on each side to Avalanche Photo Diodes. In total, there are 12288 readout channels. The presence of cancer cells is determined using the information provided by these detectors each time a gamma ray originated in those cells reacts with crystals located in both crystal planes.

The electronic requirements. Theoretical studies based on statistical models and simulations have been carried out by LIP to determine functional and performance requirements that should be met by the PEM system and its electronic components.

The Front End electronics. The front-end ASIC is a complex integrated circuit with 192 channels, which have at their inputs the pulses produced by the APDs (avalanche photodiodes) attached to the crystals. The pulses are amplified and shaped by high-

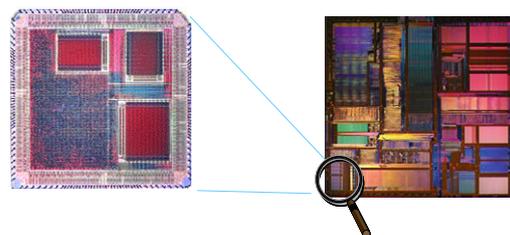
performance amplifiers and are stored in a sampled-data memory. A multiplexer selects the pulses that are above a threshold and delivers them to the two analog outputs of the ASIC. The corresponding channel identification is placed at the two digital outputs. A digital control block issues the signals to operate the almost 7000 switches contained in the ASIC.

The Data Acquisition and Processing electronics. The off detector system (DAE) is responsible for data qualification, filtering and conditioning. The DAE system is implemented in a set of boards housed in a 6U CompactPCI crate. The DAE is composed of 4 DAQ boards, each one with 2 FPGAs that implement the Data Acquisition functionality. The TGR board, housing the TGR FPGA, implements the Trigger and Data Concentration functionality. The reconfigurable logic is implemented in eight FPGAs, with 4 million gates (Xilinx™ Virtex II xc2v4000-4bf957), corresponding to the DAQ modules and one FPGA (Xilinx™ Virtex II xc2v3000-4bg728), with 3 million gates, that implements the TGR/DCC module.

3.5.3 Cadence Laboratories

As market demand drives electronics companies to pack more performance and functionality into chips manufactured at ever-smaller geometries, designers begin to hit a wall of complexity—especially as we enter the nanometer era. Today's semiconductors and electronic systems are so complex that creating them would be impossible without **electronic design automation (EDA)**. Furthermore, the economics of the marketplace are such that designs must be extensively verified for correctness and performance before fabrication, otherwise expensive redesigns are needed and opportunities may be lost. This is an overwhelming task given the complexity of the designs and the speeds of operation used nowadays.

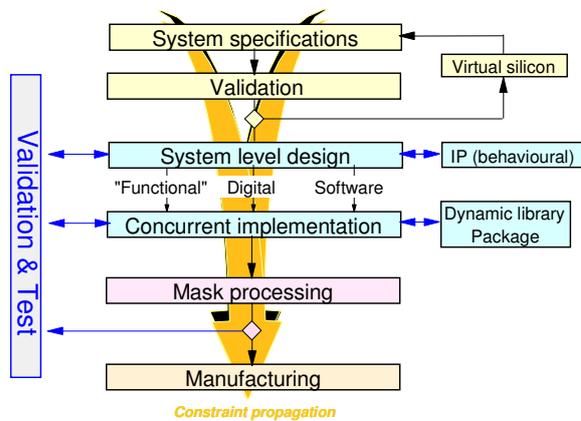
Cadence Design Systems is the world's largest EDA technologies and engineering services company. Cadence provides leading edge electronic design solutions that speed advanced IC and system designs to volume production. **Cadence Laboratories** is the industrial research facility of Cadence. Headquartered in Berkeley, California, the Laboratory's mission is to increase external visibility of Cadence as a technology leader, and help make its products successful in the marketplace. The Laboratories acts as a testbed for researching and developing interesting new ideas that can later be turned into products that will help the company's customers.



Within INESC ID, the **ALGOS - Algorithms for Optimization and Simulation** group has developed into a center of excellence for applied research in algorithms for Computer Aided Design (CAD) of Electronic Circuits and Systems., Under sponsorship from Cadence, the group's research has been directed towards real-life problems that affect some of Cadence's customers. Through this relation, new algorithms originated in the group, or developed in collaboration with other members of the Cadence Laboratories, have led to improvements in existing tools or the development of new tools that directly benefit the company's customers.

One of the main focuses of research has been in the area of Modeling and Simulation of Large-Scale Parasitics. This effort is concerned with the analysis of parasitic effects in integrated circuits, including global parasitic effects such as substrate noise prediction and power distribution network analysis, as well as reduction and simulation techniques for detection of localized signal integrity problems. Work in this area has focused on three major threads:

- developing efficient model order reduction techniques in order to automatically generate compressed representations of the interconnect structures;
- efficient algorithms for coupled circuit-interconnect simulation;
- algorithms for analyzing the effects of process variability on system behavior and performance.

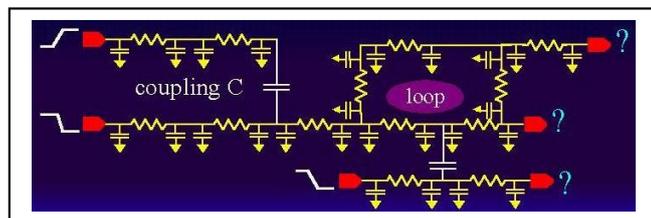


Another area of current research is related to Modeling Nonlinear Analog Systems, and to the study and development of rigorous, automated algorithms for modeling analog systems for system-wide assessment of analog effects and for increasing the level of automation in analog design tasks. In recent years we have also dedicated

considerable effort to the topic of High-frequency component modeling. Work in this area has been carried out in two main thrusts:

- accurate modeling of frequency-described passive interconnect or sub-system structures;
- optimal reduced order modeling of high-frequency systems;
- black-box algorithms for generating behavioral models of nonlinear block, in particular machine learning techniques such as those based on representations derived from support vector regression schemes.

A topic of current research is also the modeling and verification of digital systems while taking into account process variability. Work in this area has focused on the development of parameterized and statistical representations of circuit elements and algorithms for their simulation.



Other important areas of research are power estimation and optimization of combinational and sequential circuits, both at the logic and system level. Significant research effort has also been put in the development of algorithms for synthesis and optimization of digital circuits, with applications in controller optimization, intellectual property protection and technology mapping.

3.5.4 SmartSketches

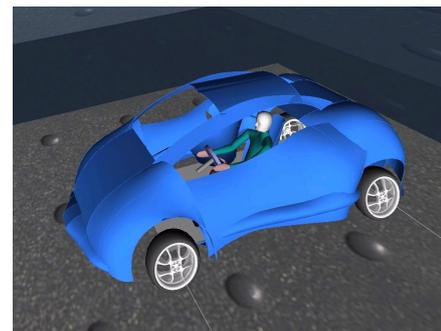
SmartSketches is a user-centred approach to introducing computer-based tools in the initial stages of product design and development. To this end we are developing innovative multimodal user interfaces combining sketches and speech to accomplish design tasks in a range of environments ranging from small tablets to large-scale displays and immersive environments.

We look to improve usability of product design systems in several important directions, through a **User-Centred Design Approach**, with involvement from Industry and Commercial partners, from the Personal Design Assistants (PDAs) to media-rich Virtual and Augmented Environments. One direction focuses on **handheld PDAs for mobile input**, combining pen and speech with retrieval of remote product and geometric data using sketches. Project Partners included key players from Industry, Research and Academia, namely Italdesign Giugiaro Spa., FIAT CentroStile, ELASIS, CENTIMFE (Mould Industry), ICEM (CAD provider), MIND, Fraunhofer Gesellschaft/IGD, Barski Design, INESC-ID, and FE/UP.



Another direction looks at **creating technical designs from sketches** using novel input techniques in 2D and 3D, exploring multiple sensorial modalities. We propose an approach to input drawings and geometric information based on imprecise sketches using multilevel pattern recognition techniques, extending our recent work and constraints, which provide a powerful control mechanism.

The research carried out combines novel interface modalities such as gaze and body tracking in immersive environments, pen-input, sketches, gestures, speech with mobile and virtual environments to replace cumbersome and unnatural input methods typical of present-day WIMP interfaces.



Sketch-Based Retrieval. The Sketch-Based Retrieval system uses a new approach to classify, index, store and retrieve technical drawings by content from large data sets. In contrast to textual organization, we propose a visual classification scheme based on spatial relationships, geometry and high-dimensional indexing structures, which are better suited to this problem, because they take advantage of designers visual memory and explore their ability to sketch as a query mechanism.

2D Sketch Editor for Mould Design. GIDES, the Gesture-based Interactive Design System, is a design program that addresses interaction through a combination of different paradigms: a sketching metaphor provides a paper-and-pencil like interaction; expectations lists, a kind of dynamic menus, expose the state of the application without interfering with the task; an incremental drawing paradigm allows precise models to be progressively

constructed using a combination of sketches and constraints. GIDES uses non-photorealistic rendering and a commercial modeling kernel to interface conventional CAD systems.

SketchAR. SketchAR is an immersive modeling application that tries to overcome the current ergonomic deficiencies of traditional CAD software, by introducing new forms of interaction. As a consequence, it provides new methods for curve and freeform surface creation, as well as additional tools to select, manipulate, delete and aid design and modeling directly in 3D



Integration-level API. We have developed a novel way of integrating CAD system components in heterogeneous environments that provides maximum flexibility, while allowing tight coupling of applications with novel devices and interaction techniques.

Input Devices for Immersive Sketching. The consortium has developed innovative input tools for 3D styling/design. Cyberstilo™, a pen-like device shown in figure, a 3 D Mouse (“CyberStone”), a personal interactive panel (PIP) and Tapefinger for use with virtual taping applications. Extensive user testing allowed us to design for optimum functionality.

3.5.5 Automatic Transcription of Multimedia Data

Goal. The main goal of the Automatic Transcription of Multimedia Data is the use of audio, speech and language processing techniques for segmentation, transcription and indexation of multimedia data.



Summary. This project represents a large framework for research and development in the area of semantic processing of multimedia information. It combines different audio, speech and language processing techniques in pipeline architecture in order to segment the multimedia data into homogeneous chunks, recognize them and classify them into topics. This process leads the way to a set of advanced applications such as selective dissemination of information, speech mining, and audio browsing.

Description. The complex pipeline process starts by an audio categorization and segmentation stage that divides the audio stream into coherent blocks, in terms of absence/presence of speech, acoustic background conditions and speaker characteristics. The blocks classified as containing speech are then fed through a large vocabulary continuous speech recognition system (*AUDIMUS.MEDIA*) that provides the corresponding transcription. This textual transcription and associated metadata derived from the segmentation stage is the input to an automatic topic indexation stage which classifies

each block according to its topic and clusters contiguous blocks with the same topic. The overall process is a pipeline combination of different processing techniques that share a common XML structure description. At the end of the process, the multimedia document is loaded into a database together with the associated XML information.

Tasks. The project is structured into the following tasks:

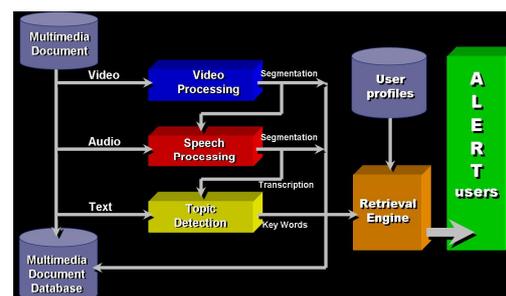
1. Multimedia Database: acquisition, definition and storage;
2. Acoustic description and segmentation of data;
3. Automatic speech recognition;
4. Automatic update of vocabulary and language modeling;
5. Analysis of spontaneous speech;
6. Rich transcription;
7. Data block segmentation based on contents;
8. Data characterization based on transcription and indexation;
9. Data summarization;
10. Application interface and services.

Application. This project is being used as a research and development platform for different applications:

- Characterization of Broadcast News programs for selective dissemination of multimedia information;
- Automatic sub-titling of Broadcast News programs;
- Classroom lecture transcription;
- Meeting transcription;
- Court session transcription;
- News distribution service for mobile devices.

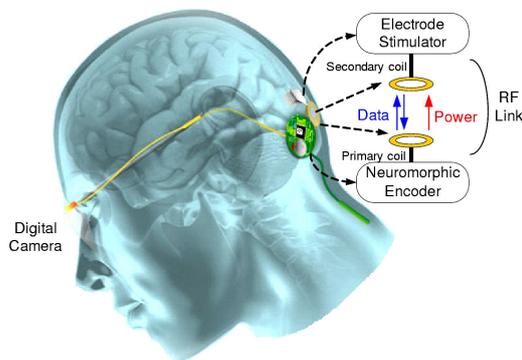
Available Demo. In order to demonstrate the results and the potentialities of this project, a demo of a selective dissemination of information system associated to the 8 o'clock news program of RTP (*Telejornal*) was made available.

Daily the news program is automatically collected directly from the cable network, loaded into a database, acoustically described and segmented, transcribed, segmented into news stories, and each story indexed in a set of topics. At the end of the process, the description data is also loaded into the database. This loading triggers a search process on the user profiles for the ones matching the same topics, and an alert message is sent to the selected users.



A service interface makes it possible for any registered user to define which thematic areas they are interested in. After the automatic processing of the daily news broadcast, users with matched topics receive an email with the news summary and an indication of the website in which they can have access through streaming to the news story about the selected topics.

3.5.6 Cortivis - Cortical Visual Neuroprosthesis for the blind



Loss of vision poses extraordinary challenges on individuals in our society, which relies heavily on sight. Currently, there is no effective treatment for a profoundly visually handicapped who suffers from degeneration or damage in the retina, optic nerve or even in the brain.

A new hope has recently emerged by showing that electrical stimulation of almost any location along the visual path can evoke the perception of visual perceptions. Even though the full restoration of vision seems to

be impossible at the moment, the discrimination of shape and location of objects could allow blind subjects to ‘navigate’ in a familiar environment and to read enlarged text, resulting in a substantial improvement in the standard of living of blind and visually impaired persons.

Several laboratories worldwide are currently involved in the development of visual implants to interact with the remaining healthy retina or optic nerve. However, the output neurons of the eye) often degenerate in many retinal blindnesses and therefore a retinal or optic nerve prosthesis would not be always helpful.

The CORTIVIS project aimed at the development of a prototype in the field of visual rehabilitation able to interface with the visual cortex. A solution of this type can restore some sense of visual perception to profoundly blind people. The development of such a prototype poses important problems concerning the interface with the visual cortex, the replication of the human visual system processing mechanism, and the transmission of information and power to devices implanted in the brain using a wireless connection (required to avoid infections in the head).



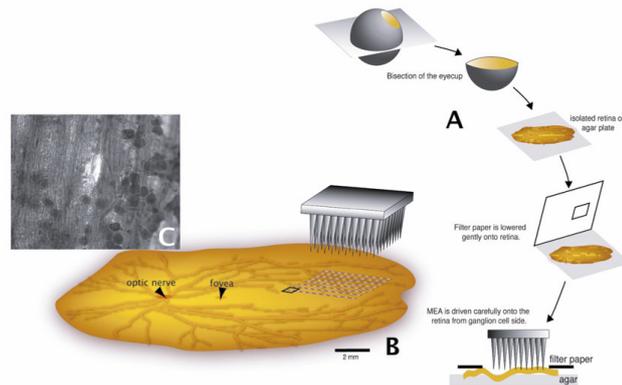
The developed visual neuroprosthesis performs intra-cortical micro-stimulation through one or more arrays of microelectrodes implanted into the primary visual cortex. The whole system is composed by:

- a **neuromorphic encoder** which encodes the visual signal captured by a miniature digital camera into a sequence of spikes (electrical pulses) capable of being interpreted by the brain;
- a **forward transmitter** which sends both data and power to the microelectrode stimulator implanted in the primary visual cortex; it uses a low-coupling transformer to establish a wireless link between the neuromorphic encoder in the outside to the microelectrode stimulator inside the patient’s brain; it achieves a maximum transfer rate of 1Mbps, transmitting 50 mW of power to the implant for a distance of up to 1cm;

- a **backward receiver** to get information from the implanted microelectrode stimulator about the status of the microelectrodes and their connectivity to the visual cortex;
- a **microelectrode stimulator** to excite the primary visual cortex cells with the spike events coded by the neuromorphic encoder.

The development of a cortical visual neuroprosthesis posed several problems in the domains of engineering, medicine and biology, thus requiring the collaboration of several European institutions devoted to research and development, namely:

University Miguel Hernandez, University of Granada and Biomedical Technologies, in Spain, University of Oldenburg, in Germany, University of Vienna, in Austria, Centre National de la Recherche Scientifique and University of Montpellier, in France, and the SiPS Group at INESC-ID, in Portugal. The SiPS group has been responsible for the design and the development of the electronic systems, which integrates the neuromorphic encoder, the transmitter and the receiver and the microelectrode simulator.



The **SiPS group** is composed by about 20 researchers; half of them got the PhD degree and teach at Technical University of Lisbon. This group has a long tradition in high level research in the areas of signal processing, electronics and high performance processing systems and currently it is also involved in the research of new and more accurate models for the neuromorphic encoder (work supported by the Portuguese Foundation for Science and Technology- FCT).

3.5.7 Papous - The Virtual Storyteller



Virtual Storyteller. Stories and storytelling are a constant presence in our lives since very early childhood. However, it is not only the story that is so compelling and engaging. The storyteller himself plays a very important role by dragging the children into the story, keeping their attention and freeing their imagination. This need for the storyteller to be expressive, to use his voice, facial expressions, and appropriate gestures and to stimulate user interaction poses major research challenges if one aims at building a synthetic storyteller. The Virtual Storyteller project aims at building a synthetic character that acts as a virtual interactive storyteller,

narrating a non-linear story, in an emotionally expressive way, which can be influenced by input received from the user.

Speech. In storytelling situations, speech is typically rich in emotional content and variability. We use a text-to-speech synthesis using the Portuguese LPC diphone-based FESTIVAL synthesizer, created at INESC-ID by the Spoken Language Systems Group (L2F), with male voice that allows rhythm and intonation variations. These perceptual effects are important in the expression of emotions.

Facial Expression. Due to its 37 pseudo-muscles, Papous is able to perform detailed facial expressions. This allows him to convey emotional information, stress an idea, perform lip-synch speech and transmit story characters' intentions, all this through the use of his face.

Gestures. The model supports key-framed and non-deterministic animation through the use of a 54-bone skeleton. While key-framed animation uses predefined animations made by specialized animators that allow complex movements, the non-deterministic animation is based on inverse kinetics and offers the possibility of dynamic generation of body movement. The gesture model used by the storyteller is based on David McNeill's theory of gestures.

Non-Linear and Interactive Model. Real human storytellers do not always tell the story the same way. They observe their "audience" and adapt the way they are telling the story to better respond to their reactions. The user supplies input to the virtual storyteller through a tangible interface allowing the character to decide how the story should be told. For instance, the user may decide he wants to listen to a more terrifying version of the story, supplying this simple wish to the virtual storyteller. The virtual storyteller is then responsible for choosing the course of the story that is most suitable for the user's input and for adapting his visible behaviour to the user's intentions.



3.5.8 FantasyA & Sentoy

Computer games usually rely on direct control. Players have full control over their avatar or over a group of characters, and decide what they should do to achieve some goals and win the game. But shouldn't the characters have their own minds and personalities? Wouldn't it be more challenging for the player if he/she could only influence the behaviour of the characters rather than have full control over their actions?

FantasyA explores a novel form of interaction in a computer game. The goal is to win a magical duel between two mages. The duel takes place in an arena and it is possible to assume the role of a mage from one of four clans: Air, Fire, Earth and Water. After

choosing a clan and naming the mage, the players enter the arena and take part in their first duel. An opponent is selected from the other clans, and the two mages fight each other, taking turns to either cast offensive spells or to defend themselves with counter-spells. However, the players cannot choose or control which spells their mages will use. Mages are autonomous and decide their own actions. The role of the players is to influence the decisions mages take through the use of emotions.



Players interact with the game using SenToy, a wireless tangible interface which allows users to express one of six emotions through gestures. The emotion expressed using SenToy changes the emotional state of the mage controlled by the player. Therefore he/she indirectly controls the actions performed by that mage in the game.

SenToy is able to recognize gestures for happiness, sadness, fear, anger, surprise and gloat emotions. These gestures were studied and have distinctive patterns of movement which are detected by a set of sensors inside SenToy: accelerometers, force sensor resistors and magnetic switches. SenToy was developed with the collaboration of the Signals Processing Systems (SiPS) Group at INESC-ID. The data collected from the sensors is continually processed and analysed and SenToy generates the appropriate emotion when one of the six patterns is recognised.

Perceiving the emotional states correctly is essential to play the game. Mages react to the player's influence by expressing their emotional state using the body through different animations. Animations change in real-time to reflect different emotional states. Moreover, mages also react to the outcome of the last action by expressing an appropriate emotion in the same way. Therefore, players should be able to perceive this feedback to correctly identify the mages' emotional states.

Understanding emotions and their relation with actions is the key to win the game. Mages use not only their emotions, but also their feelings about the opponent's emotional state to decide what action to perform next. The combination of these emotions leads to action tendencies (offensive, defensive, neutral) and then to a concrete action that will be fulfilled by the mage. Game logics and the relation between emotions and action tendencies are supported by emotion theories formulated by Lazarus, Darwin and Ekman.

FantasyA and SenToy were subject to several evaluation studies. As part of the EU-funded project SAFIRA (Supporting Affective Interactions for Real-time Applications), they were evaluated by 30 subjects in the main



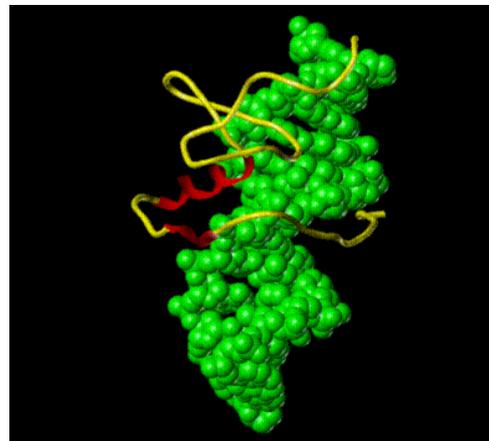
study. Results show that there is room for affective interaction in computer games. The use of a novel interaction device like SenToy was specially emphasised, which shows it can be used as an affective input device for several other applications.

3.5.9 Yeastract

The availability of the complete sequence of a number of organisms implied a significant change in biology and biotechnology in the last decade. Creating and making widely available biological databases with sequence and annotation information represents now a very significant part of the activity of the scientific community.

The ALGOS/KDBIO group of INESC-ID joined efforts with the Biological Sciences Group of CEBQ to develop YEASTRACT, a tool that supports research about the gene regulatory networks in the Yeast model organism.

The YEASTRACT (YEAsT Search for Transcriptional Regulators And Consensus Tracking; www.yeastract.com) database is a repository of more than 12500 regulatory associations between genes and transcription factors in *S. cerevisiae*. It includes the description of 269 specific DNA binding sites for 106 characterized transcription factors. This publicly available database was developed to provide assistance in three major issues: identification of documented and potential regulatory associations for an ORF/Gene; microarray data clustering based on regulatory associations; search for a DNA motif within known transcription factor binding sites and promoter regions.



4 DETAILED ACTIVITIES REPORT

The Detailed Activities Report is organized according to the lines of action of the Associated Laboratory, explained in the previous chapter.

4.1 Computational Processing of Spoken Language

Computational processing of speech is a multi-disciplinary area requiring the joint effort of competences in very distinct scientific areas. This reality leads to the creation of work teams with a broad scope of knowledge, from engineering to linguistics.

The development of this area took place prior to the creation of INESC-ID and since its start more than a dozen PhD theses have been obtained, both in Portugal and abroad. Following the creation of INESC-ID, a structure was internally formed in 2001 congregating the competences in this area, the so called "*Laboratório da Língua Falada*" (L²F), gathering researchers who could potentially provide relevant contributions to the area, not only within INESC-ID, but also from outside the Institute. The competence level was enlarged, agglutinating the different aspects of speech processing, namely recognition, synthesis and coding, together with the written language processing area. The development focus was expanded, with a shift from signal processing systems to spoken language processing systems, and from systems integrating speech only to multi-modal systems, maintaining the emphasis on the Portuguese language. The long term goal of this interdisciplinary group is to bridge the gap between natural spoken language and the underlying semantic information.

The two lines of activity which the group has considered as top priorities in the past four years, given their relevance and interdisciplinary nature, in terms of integrating several core technologies are: semantic processing of multimedia contents and spoken/multimodal dialogue systems platforms.

The first line started with our work on Broadcast News transcription, but has now expanded to encompass many different areas within computer enhanced human-to-human communication, such as the automatic transcription of meetings, classroom lectures, courtroom sessions, etc., which raise more research challenges.

Another emerging line of activity is "speech-to-speech" translation, which in itself is the area which encompasses more core technologies in the group. Our long term plan is to incorporate morphology, syntax and semantics into statistical machine translation. Despite our recent start in this area, we are already participating in joint international evaluation efforts.

It is also planned to continue this work of extending our technology to other varieties of Portuguese and our involvement in two other areas: e-learning, in particular, computer aided language learning, and e-inclusion, namely in the development of alternative and augmentative communication tools for people with special needs.

It is to emphasize also the very successful organization of the Interspeech'2005 conference, in Lisbon, both in terms of record number of submissions, record number of participants and highest rejection ratio.

Activities in 2005

The activities developed in 2005 within the framework of the Associate Laboratory and that this area maintains are the following:

- Organization of Interspeech 2005: the most important meeting in this area;
- Development and maintenance of spoken language systems demos;
- Our demos webpage currently holds demos of:
 - Transcription of Broadcast News (updated daily with the evening news of RTP);
 - Speech synthesizer for telephone numbers;
 - Virtual Butler at Home of the Future;
 - Adding a voice to Tumba, the Portuguese web search engine;
 - Corpus-based speech synthesis for any voice;
 - Transform speech emotions;
 - Voice dubbing (audio visual synchronization);
 - Automatic alignment of spoken digital books;
 - Transcription of classroom lectures;
 - Speech to text translation.
- Creation, maintenance and advertisement of resources essential to speech processing in Portuguese: *corpora*, lexical and computational tools. In this context, it is to emphasize the efforts to create a spoken lecture corpus, useful for both e-learning and e-inclusion purposes;
- Development and customization of speech technologies within the scope of augmentative and alternative communication products for handicapped individuals. In this context, it is to emphasize the Scientific Merit Award “Maria Cândida da Cunha”, awarded in 2005 to the developers of Eugenio;
- Marketing of spoken language systems in European Portuguese, both at national and international level.

Services in 2005

Services that were provided:

- Spoken language systems in Portuguese
 - Development and improvement of a complete speech synthesis/generation system, to be used both as a didactic tool for technology learning and a test bank for new technologies. Integration within this system of the results of the research performed;
 - Development of speech recognition/understanding systems, with phone and broadband quality. Integration within these systems of the results of the research performed;

- Integration of speech processing technologies with written language processing technologies and ontology based knowledge representation. This integration is particularly relevant to dialogue systems, speech-to-speech translation or translation support systems, detection of topics in spoken language (or more generically data mining in speech), etc;
- Integration of speech processing technologies in Portuguese learning systems, directed both at nationals and foreigners. In this context, it is to emphasize the active participation of this investigation group at the Seminar between the ministers of Portugal and China on how to promote the study and undergraduate teaching of languages and cultures;
- Development of spoken language systems adaptable to the linguistic differences existing amongst the various instances of spoken Portuguese. In this context, it is to emphasize the porting of the Grapheme-to-Phone system to Brazilian Portuguese, the first tests of our audio/text alignment tools and recognition systems with Brazilian speakers;
- Follow-up of progress of speech processing systems less dependent from language, such as speech coding, speaker's recognition (biometrics), etc;
- Study of the aspects related to recognition and synthesis of emotions (expressive speech processing) and its connection to human interfaces;
- Interconnection of speech technologies within the broader domain of Man-Machine interfaces, with the objective of promoting accessibility to the information society.
- Performance evaluation
 - Maintenance of an inventory of products using speech technologies in the Portuguese Language;
 - Performance of a formal evaluation of a set of products, so as to monitor the development of commercial uses for the technology and poster competition between vendors through publishing of results.
- Augmentative and alternative communication
 - Follow up of the development of augmentative and alternative communication tools involving speech technologies, and their customization to the Portuguese Language.
- Linguistic resources
 - Maintenance of an inventory of linguistic resources useful for speech processing in Portuguese. The importance of linguistic resources in speech technologies cannot be underestimated, especially when one takes into account the growing impact of data-driven type approaches;
 - Identification of the evolution of needs in terms of linguistic resources for spoken Portuguese and support the creation of these resources.
- Cooperation
 - Endorsement of synergies amongst the research groups working in spoken Portuguese processing, both at national and Portuguese official language countries level. On a national level, it is deemed as essential for the

execution of the proposed objectives the continuation of the joint work with researchers of the Phonetics and Phonology group from "Centro de Linguística da Universidade de Lisboa" (CLUL), with whom a formal cooperation agreement was established at the beginning of the decade. It is to emphasize as essential the continuation of the good working relationship with the speech groups from the Universities of Aveiro, Porto, Coimbra, and Minho. Finally, we would like to stress our strong cooperation with two new invited researchers from the Universities of Algarve and Beira Interior.

4.2 Information and Decision Support Systems

Our society is heavily dependent on information systems which support the whole structure of the economic and social framework. The impact these systems have on the everyday life of citizens is only recognized when these systems fail or are not performing correctly. In general, consequences of failures in these systems are disproportionately greater than the required investments to enable them to perform appropriately, when problems are diagnosed in an adequate and timely manner.

On the other hand, the availability in electronic format of high volumes of data, as well as the generalized use of computers to store and process information which, up to now, was stored in a variety of formats, raises endless new problems and challenges to the information society. Amongst these problems are worth mentioning the maintenance of the citizens' privacy, data security and controlled use of sophisticated analysis methods for the detection of fraud situations, abnormalities and tendencies.

INESC-ID gathers amidst its research body competences which render it as an institution unique at national and even international level in this area. In particular, it incorporates researchers who are international references in the areas of:

- Information systems architectures;
- Architectures and technologies for the Internet;
- Methods for data analysis and data mining;
- Algorithms for efficient manipulation of large volumes of data;
- Security in distributed systems (e.g. for GRIDs);
- Mechanisms for preservation of privacy ;
- Architectures and technologies for mobility.

The integration of these competences leads INESC-ID to position itself clearly as a institution of reference, on a national level, for providing support services to public and private entities which need the intervention of unbiased specialists with unquestionable competences within their areas of work.

Activities in 2005

Within this thematic area, INESC-ID's developed activities which maintain it as an excellence centre at international level:

- Development of state-of-the-art research in software technologies, distributed systems and information systems architectures;
- Development of efficient algorithms for manipulation and mining of large volumes of data stored in relational database systems;
- Development of technologies and methods for the processing, indexing and search of text and multimedia information on the Internet;
- Development of algorithms, methods and applications for manipulation of large volumes of data with a biological origin;
- Project and development of technologies for distributed information systems, with a special emphasis on the issues of persistence, object distribution, resources management, security and parallelism.

Services in 2005

In 2005 INESC-ID provided, via specific contracts, the following services:

- Analysis and definition of requirements for systems handling large volumes of information, with emphasis on:
 - Physical and logical systems architecture;
 - Hardware and software technologies to be used;
 - Data Modeling;
 - Efficacy and efficiency of the algorithms and methods to be applied to data;
 - Security and confidentiality of the information.
- Comparative analysis of third parties proposals for information systems development, with emphasis on the following components:
 - Specification of equipment, operating systems and software technologies;
 - Expected performance of the proposed solutions;
 - Adequateness of the effort estimated by the proposal to the allocated resources;
 - Robustness of the system concerning physical and logical failures.
- Analysis of new applications of information systems, with emphasis on the following domains:
 - Interactive information systems for the public;
 - Systems to support electronic democracy and direct participation of citizens;
 - Integrated information systems for educational institutions;
 - Electronic authenticity verification systems (electronic signatures, time stamp and electronic validation, etc.);
 - Information systems and methods for the analysis of biological information, (genome information databases, medical tests results, medical information repositories);
- Consulting, management and/or execution of knowledge extraction systems from databases and their application to the:
 - Optimization of information systems and management processes;

- Optimization of customer or user management systems (Customer Relationship Management - CRM), with a view to improve the quality of service provided and the efficacy of marketing campaigns;
- Detection of anomalous situations, such as frauds, errors, and intrusions in computer systems and networks.

4.3 Interactive Virtual Environments

Interactive virtual environments assume great strategic importance, given the foreseen evolution of interaction paradigms, either in supporting human-computer interaction or supporting remote computer-mediated interaction amongst people within Virtual Worlds. INESC-ID has a large number of researchers who develop their activity in a set of disciplines highly relevant to interactive virtual environments. Specifically, several groups within INESC-ID feature core competences in:

- Devising multimodal interaction models within virtual environments by using interfaces based on synergistic recognition of multiple interaction modalities;
- Architectures for cooperative virtual environments by using algorithms for gesture recognition and artificial intelligence techniques for creating realistic synthetic characters;
- Software architectures for virtual environments, with emphasis on image synthesis algorithms, intelligent agents programming and effectively using component based design and development patterns.

For the reasons mentioned above, the institution is regarded as an excellence centre in this area, with internationally recognized competences and the ability to provide a set of services of great relevance to our strategic focus areas.

Activities in 2005

We developed the following activities:

- Development of intelligent environments (design rooms) to support concurrent engineering tasks by using multimodal interaction techniques, personal design assistant devices (PDA) and instruments to support cooperative work. This has resulted in a prototype intelligent environment developed within TagusPark, organized around an array of 4x3 projectors, with a combined resolution of 4096 x 2304 pixels to support cooperative design activities;
- OSGA, a platform for distributed virtual environments. This allows connecting different applications running across a heterogeneous network to share data and control, via XML entities, using an RPC paradigm. The resulting framework is now being used in the European Project IMPROVE;
- Following the successful SmartSketches project, a number of initiatives have enabled us to explore and transfer technologies developed within that European project. The first is Eurotooling 21, an integrated project led by CENTIMFE, our partner in the Portuguese Mould Industry. Another is IMPROVE, a project centered on novel display techniques;

- Another relevant activity has been the development of multimodal interfaces for helping citizens with special needs in their everyday activities. This comes in the wake of a four-year long activity with blind and visually-impaired people for learning, guidance and improving the use of everyday devices such as mobile telephones.

Services in 2005

Within this area, INESC-ID provided a set of services of great importance:

- Development of virtual environments for training of:
 - Military, in environments simulating aerial, naval and terrestrial combat situations;
 - Police forces, in environments simulating high risk situations;
 - Emergency rescue teams, in situations caused by natural or human-made catastrophes.
- Evaluation and development of new distance learning paradigms:
 - Evaluation, development and recommendation of distance learning methodologies in virtual environments;
 - Analysis of the efficacy and efficiency of virtual environments proposals for distance learning purposes;
 - Recommendation of specific technologies for teaching children and adults with special needs, by using virtual environments and new interaction techniques.
- Analysis and study of systems architectures for cooperative work in diversified areas, with a special emphasis on:
 - Coherence maintenance mechanisms in projects developed in a distributed form;
 - Recommendation of interaction mechanisms which maximize the results of the intervenient parts, with no need for frequent physical interactions.

4.4 Embedded Electronic Systems

Information and Communications Technologies (ICT) are a fundamental part of the new information and knowledge society. The electronics industry is one of the key driving forces supporting the sustained growth of ICT potential in Europe. Besides production manufacturing areas, there is a vast set of manufacturing opportunities connected to the development of new products and associated services.

These opportunities are highly dependent on research and human resources trained in highly specialized project methodologies and tools. Among these systems, special emphasis goes to embedded electronic systems, programmable not only in terms of software, but also in hardware.

Embedded systems are nowadays basic system components in applications as diverse as access terminals and information collection points, mobile phones, consumer goods identification systems via radio frequency (RFID), smart cards and satellite navigation

systems, which have been and will continue to significantly change all sectors of human society.

The implementation of embedded systems (digital, analogue or mixed) as components or cores (embedded cores) of integrated systems (SoC, Systems on a Chip) adds value not only to large companies, but also to SMEs operating at national level, as long as specialized human resources exist in sufficient number and quality. Currently, in the SIP market (Semiconductor Intellectual Property), there are successful SMEs with a business based on the design of IP cores (Intellectual Property cores), marketing them under the form of material or virtual cores (hard or soft cores). Even large companies are already relying on outsourcing of project activities in this area. For many applications, such as safety-critical systems (avionics, TGV, automotive, life support systems such as pacemakers, etc.), development of embedded systems requires the development of systems that are fault tolerant either to physical faults or to disturbances resulting from hostile environments (vibrations, cosmic radiation, etc.) or circuit operation (e.g., hot spots).

INESC-ID has available highly qualified human resources in the supporting technologies of digital electronics, analogue electronics, microelectronics, radio frequency electronics, instrumentation and test, adaptive control, computer systems architecture and programmable electronic systems. Its researchers also master design, manufacturing, test and debug techniques, necessary for new product development and follow-up of this area of crucial industrial and social importance. The use of these technologies in the areas of telecommunications, energy systems, industrial automation, automotive and aero-spatial manufacturing and the emerging areas of electro-medicine and bio-engineering will require the collaboration of institutions with deep knowledge of the semiconductor technologies, amongst which INESC-ID is positioned as a reference institution.

INESC-ID possesses internationally recognized key competences in this scientific area and a strong drive to provide services in this area, given its prior experience in European and national projects and programs.

Activities in 2005

Within the scope of the present proposal we developed the following activities:

- Organization of DCIS 2005, an important meeting in this area;
- Research and development of algorithms, project tools and methodologies for the verification and test of electronic circuits of high integration scale;
- Research in processing architectures and development of embedded processors, both dedicated and of general use;
- Research and development of reconfigurable computing systems, for the acceleration of specific applications via execution of their heaviest functions in dynamically reconfigurable hardware;
- Research of non linear, adaptive, reconfigurable and hybrid methodologies for the development of algorithms and control applications, adequate to electronic implementation;
- Research of algorithms, techniques and architectures for electronic systems control;

- Research and development of wireless communications systems;
- Research and development of RFID technology based systems for identification and tracking of products and equipments;
- Research of new algorithms for synchronization in digital communications, active noise cancellation and powerline data transmission using OFDM;
- Development of Positron Emission Technologies (PET) systems for mammography;
- Research and development of embedded electronics systems for use in the bio-medicine area, with emphasis in the areas of (1) diagnostics using advanced imaging techniques and (2) prosthetics for the visually impaired using signal and/or image processing techniques, and also radio frequency remote non-intrusive delivery of information and power to implants;
- Research in techniques and electronic systems for physical execution in nano-technologies and/or biological physical support, such as molecular electronics, areas in which the reinforcement of the collaboration with INESC-INOV and INESC-MN is sought.

Services in 2005

Within this thematic area, the following services are available (or have been delivered):

- Consulting on design and test of reconfigurable embedded electronic systems and ASIC (Application Specific Integrated Circuits), namely those targeting wireless communications, medical diagnostics instrumentation, telemetry, advanced computing, security critical applications and education markets. In this respect, design and test technology transfer to Tecmic and INOV have been carried out;
- Consulting on the design and test of EDA (Electronic Design Automation) tools;
- Support the standardization and assessment of quality requirements of electronic systems for safety-critical applications;
- Consulting on hardware/software co-design and development of embedded electronic and control systems for specific applications, based on state-of-the-art technologies, namely in software design and software development;
- Training and re-qualification sessions for professionals, targeting the SME market in the electronics area;
- Awareness actions for industrial associations and R&D institutions, which are potential customers or suppliers of this kind of technologies.

4.5 Communications and Mobility Networks

The concept of mobility is increasingly more important in the development of products and services for the information society. In effect, it is increasingly fundamental for the information to be available from any location, at any time and using any type of terminal.

Integration of different networks (mobile, fixed, local and wide area) is not only an emerging reality but a real necessity felt by the public.

Fixed and mobile communications networks, and the mobility they provide, have a strategic importance, given the fact that they represent an important infrastructure. Within this area we gather the competences existing in the area of network architectures (fixed and mobile) which enable the integration of classic technologies, traditionally separating networks into two different domains: telecommunications and computer systems. Given the recent developments, it is clearly crucial to integrate both domains, both at network infrastructure level and at the level of services and applications.

A specially important area for the increasing mobility of citizens is related to ad-hoc networks, which, due to the fact that they do not possess high requisites in terms of planning and installation, may become extremely relevant in specific domains of society, namely military and civilian protection.

Competences in this area existing at INESC-ID cover different aspects which are key to the use of communications networks. Emphasis goes to the work developed at the levels of quality of service, network management, security and robustness of wireless networks, besides other types of challenges imposed by mobility. INESC-ID is particularly well positioned to develop research in this field, both in areas related to fixed network infrastructure, and the mobile and wireless network infrastructure. We capitalize not only in the knowledge acquired in state-of-the-art scientific research, but also in the experience gained in the practical implementation of the *virtual campus* concept, with the institute currently integrated, in a transparent way, with Instituto Superior Técnico's fixed and mobile networks, sharing its resources and infrastructures.

Research and development work performed in the networking area, both in the context of national and international projects, and the context of post-graduation theses, led to the development of competences recognized through the awarding of various prizes and the participation, as representatives of national operators, in several standardization bodies, namely ITU and ETSI, and research coordination in international projects and bodies.

Activities in 2005

The activities developed within the scope of Associate Laboratory were as follows:

- Development of state-of-the-art research in fixed, mobile and ad-hoc communications networks technologies;
- Development and maintenance of communications networks demos for specific support to applications with high quality of service requisites, such as the case of IP telephony, applications to support collaborative work and distance learning or video broadcasting on demand;
- Specification, implementation and test of the physical and logical infrastructure of mobile networks which enable the generalized access of citizens to the information in various environments, such as Universities, schools, airports and other public places;
- Specification, implementation and test of ad-hoc networks, which enable the existence of communications infrastructures in situations, or places, in which the installation of other network types is not viable;

- Development of actions that raise awareness of the various aspects of communications networks which allow support to applications with quality of service.

Services in 2005

Within this thematic area, the following services to enterprise customers and public service bodies were performed:

- Project and development of communications networks architectures with quality of service control;
- Project and development of networking integrated solutions;
- Project and development of ad-hoc network solutions and associated management;
- Project and development of optimized solutions for the support of multimedia applications, including support of applications with different quality requisites and in heterogeneous environments;
- Consulting in fixed and mobile public and enterprise network architectures;
- Analysis of requisites and evaluation of functionalities in public access wireless networks projects;
- Measurement and analysis of network traffic.

5 ANNEXES

5.1 Research Projects during 2005

Title: COST 277 - Nonlinear Speech Processing

Funding Institution: European Commission

Coordinator from INESC-ID: Carlos Eduardo Meneses Ribeiro

Short Summary:

The ultimate objective of this Action is to improve the voice services in telecommunication systems. The new technologies we will develop are to provide higher quality speech synthesis, more efficient speech coding, improved speech recognition, and improved speaker identification and verification. Our methods are to contribute significantly to the acceptance of voice interfaces for information systems such as the mobile Internet (by improved synthesis and recognition). Furthermore, our methods are to lead to improved efficiency in future generations of speech coders used in wireless networks, including packet-based wireless networks. We intend to accomplish the stated goals by developing techniques based on nonlinear processing.

Title: COST 278 - Spoken Language Interaction in Telecommunication

Funding Institution: EU

Coordinator from INESC-ID: João Paulo da Silva Neto

Short Summary:

The main objective is to increase the knowledge of potentially useful applications and methodologies in deploying spoken language interaction in telecommunication. Emphasis is on achieving knowledge of speech and dialogue processing in multi-modal communication interfaces.

Title: PAPOUS

Funding Institution: FCT

Coordinator from INESC-ID: Luís Miguel Veiga Vaz Caldas de Oliveira

Short Summary:

In this project, we aim at developing a new type of interactive technology, by building the first European Portuguese spoken synthetic character: the "ContadorDeHistorias" (the StoryTeller) using a European Portuguese text-to-speech system.

Title: DIGA - Dialog Interface for Global Access

Funding Institution: FCT

Coordinator from INESC-ID: Nuno João Neves Mamede

Short Summary:

The primary goal of this project is integration. It is intended as a vehicle for bringing together, for the first time, research contributions from all the members of the recently created Spoken Language Systems Lab (L2F - Laboratório de sistemas de Língua Falada) of INESC ID. Hence, it will integrate teams with very different expertise - speech processing, neural networks and natural language processing - who will join efforts to develop a conversational interface for accessing and retrieving online information.

Title: WFST - Weighted Finite State Transducers Applied to Spoken Language Processing

Funding Institution: FCT

Coordinator from INESC-ID: Diamantino António Caseiro

Short Summary:

This project aims at developing techniques and algorithms based on weighted finite-state transducers (WFSTs) for application on spoken language processing, with special emphasis on automatic speech recognition and text to speech synthesis. This project also covers the application of WFSTs to other areas such as machine translation.

Title: VOICEMAIL

Funding Institution: Vodafone Portugal

Coordinator from INESC-ID: João Paulo da Silva Neto

Short Summary:

This project results from contracts between INESC ID, Celfocus and Vodafone. These contracts are related with the development of voicemail applications and an IVR platform based on ASR and TTS in European Portuguese.

Title: INTERSPEECH 2005

Funding Institution: INESC-ID

Coordinator from INESC-ID: Isabel Maria Martins Trancoso

Short Summary:

Organization of the 2005 INTERSPEECH Conference.

Title: NLE GRID - Natural Language Engineering on a Computational GRID

Funding Institution: FCT

Coordinator from INESC-ID: Luís Miguel Veiga Vaz Caldas de Oliveira

Short Summary:

The main objective of this project is to create a framework for high performance NLE computing on a computational GRID by extending the structure of the Galinha system (Matos, 2003). The Galinha system was developed by the Spoken Language Laboratory (L2F) of INESC-ID in an effort to simplify the creation of NLE applications: an application is built through a web interface by creating a service chain from a pool of re-usable components. The current version includes components for morphological analysis, part-of-speech disambiguation and syntactic analysis, etc. In this project we plan to also include modules for speech processing tasks. In this project we will extend the Galinha architecture to include an interface to GRID services so that the components and data can be geographically and organizationally distributed. This requires a set of standard middleware protocols like the ones provided by the Globus toolkit to handle security, information discovery, resource and data management.

Title: LECTRA - Rich Transcription of Lectures for E-Learning Applications

Funding Institution: FCT

Coordinator from INESC-ID: Isabel Maria Martins Trancoso

Short Summary:

The goal of this project is the production of multimedia lecture contents for e-learning applications. We shall take as a pilot study a course for which the didactic material (e.g. text book, problems, viewgraphs) is already electronically available and in Portuguese. This is an increasingly more frequent situation, namely in technical courses. Our contribution to these contents will be to add, for each lecture in the course, the recorded video signal and the synchronized lecture transcription. We believe that this synchronized transcription may be especially important for hearing-impaired students.

Title: RICOBA - Rich Content Books for All

Funding Institution: FCT

Coordinator from INESC-ID: António Joaquim dos Santos Romão Serralheiro

Short Summary:

The project aims at making books more accessible and appealing to different audiences. The goals are supporting rich Digital Talking Book (DTB) generation, through the development of a production framework to assist in the building and enriching of the books, and rich DTB playback, by developing tools for non-visual platforms, and tools that adapt the book presentation and interaction, reacting to changes in the user, playback devices, and environment.

Title: MOBILE TRANS

Funding Institution: FCT

Coordinator from INESC-ID: Paulo Jorge Pires Ferreira

Short Summary:

The main goal of the MobileTrans project is to improve programming productivity and program reliability by providing transactional support for info-appliances.

Title: VICTEC - Virtual ICT with Empathic Characters

Funding Institution: European Commission - 5th Framework Program

Coordinator from INESC-ID: Ana Maria Severino de Almeida e Paiva

Short Summary:

The main aim of this project is to design believable interactive dramas within a virtual learning environment for children to explore. Particular emphasis on bullying and aggression in schools is the primary focal point for the virtual dramas.

Title: COLDEX - Collaborative Learning and Distributed Experimentation

Funding Institution: European Commission - 6th Framework Programme

Coordinator from INESC-ID: Ana Maria Severino de Almeida e Paiva

Short Summary:

COLDEX aims at developing and using new IT approaches and computational tools to foster scientific experimentation, modeling and simulation in distributed collaborative settings in an intercultural (European-Latin American) community of learners. The final result will consist in the creation of innovative pedagogical scenarios. The target group will range from higher secondary education to academic beginners.

Title: R&D in Digital Libraries

Funding Institution: Biblioteca Nacional

Coordinator from INESC-ID: Alberto Manuel Rodrigues da Silva

Short Summary:

Research in the broad area of Digital Libraries. This research involved the participation in several European projects, such as LEAF(<http://www.leaf-eu.org>), TEL (<http://www.europeanlibrary.org/>), as well as in the context of the Portuguese National Library, in particular in its PORBASE system(<http://www.porbase.org>). This research was driven by an action and concrete application approach, involved requirements engineering, large data bases and XML techniques.

Title: The StoryTeller

Funding Institution: FCT

Coordinator from INESC-ID: Ana Maria Severino de Almeida e Paiva

Short Summary:

The main aim of this project is to build a character - "Papous, O Contador de Histórias" (Papous, the Storyteller) - that tells stories in Portuguese using a European Portuguese TTT

(Text-to-Speech) system developed by the L2F (Spoken Language Laboratory) at INESC-ID. The character should be rich in terms of gestures and speaking in order to be believable.

Title: Haddock-FS

Funding Institution: Microsoft Research

Coordinator from INESC-ID: Paulo Jorge Pires Ferreira

Short Summary:

The main aim of this project is to design and implement "Haddock-FS", a replicated peer-to-peer distributed file system for Windows CE, designed to meet the information sharing requirements imposed by ad hoc networks of info-appliances (e.g. PDAs).

Title: HUMAINE - Human-Machine Interaction Network on Emotion

Funding Institution: European Commission - 6th Framework Programme

Coordinator from INESC-ID: Ana Maria Severino de Almeida e Paiva

Short Summary:

HUMAINE is a Network of Excellence in which 33 partners from 14 different countries join in together with the aim of contributing to "European development of systems that can register, model and/or influence emotional and emotion-related states and processes - 'emotion-oriented systems'". The Network aims at the intellectual integration of leading experts from key disciplines.

Title: KALEIDOSCOPE

Funding Institution: European Commission - 6th Framework Programme

Coordinator from INESC-ID: Ana Maria Severino de Almeida e Paiva

Short Summary:

Kaleidoscope is a Network of Excellence which brings together European teams in technology-enhanced learning. Its goal is to integrate 76 research units from around Europe, covering a large range of expertise from technology to education, from academic to private research. Altogether, it is a community of more than 800 researchers in 23 countries which have joined in their efforts to develop new concepts and methods for exploring the future of learning with digital technologies.

Title: GESTBARRAGENS - Integrated System for the Management of Dams

Funding Institution: LNEC - Laboratório Nacional de Engenharia Civil

Coordinator from INESC-ID: Alberto Manuel Rodrigues da Silva

Short Summary:

GESTBARRAGENS is an integrated Information System that manages the data required to control the safety of concrete dams. Data is manually or automatically collected by instruments (for instance, a plumbline) located in strategic points in the dam. Then, it must be stored and handled in order to produce results (e.g., displacements) that are required to support decisions concerning dam's safety. GESTBARRAGENS provides several features, namely: (1) Instrumentation: integrates new observation instruments, supports the dynamic management of new instruments, and manages metadata about instruments; (2) Types of observations: manages geodetic information, data concerning visual inspections, and observations automatically collected by appropriate systems without human interaction; (3) Data visualization and exploitation: data is accessed through a sophisticated set of reports designed to fulfil the types of data analyses required, and a set of graphics and diagrams able to spatially depict data; (4) Synchronization facility: the system can be deployed in one or more places (for example, LNEC and CPPE which is the owner of many dams) and information updates are synchronized between different instances.

Title: UbiRep

Funding Institution: FCT

Coordinator from INESC-ID: Paulo Jorge Pires Ferreira

Short Summary:

The objective of this project is to facilitate the development and execution of distributed applications, running on top of info-appliances (such as portable computers and PDAs) that support data sharing and collaborative work in ad-hoc networks.

Title: InStory

Funding Institution: FCT

Coordinator from INESC-ID: Joaquim Armando Pires Jorge

Short Summary:

The objective of this project is to define the architecture and system to support interactive narratives in mobile devices.

Title: GC-Portal

Funding Institution: Microsoft Research

Coordinator from INESC-ID: Paulo Jorge Pires Ferreira

Short Summary:

The objective of this project is to create a set of teaching materials on Garbage Collection, both local and distributed, that can be used by other professors in their classes both at undergraduate and postgraduate levels.

Title: EUROTOOLING 21

Funding Institution: European Commission - 6th Framework Program

Coordinator from INESC-ID: Joaquim Armando Pires Jorge

Short Summary:

EuroTooling21 aims to improve competitiveness in European Mouldmaking and Special Tooling Industries. The drive force of the project is to increase the added value integrated by these companies at different levels, from product and moulds design to production technologies and extended services with a relevant technological component, in a global supply chain context.

Title: IMPROVE

Funding Institution: European Commission

Coordinator from INESC-ID: João António Madeiras Pereira

Short Summary:

The aim of this project is to improve lightweight near-to-the-eye displays and tiled stereoscopic large size displays. The improvements on the hardware level consist in developing a unique stereoscopic head mounted display (HMD) using emerging display technology such as LCOS and OLEDs. For tiled stereoscopic large screen displays improved calibration techniques will be developed to ease and accelerate their use. On the software level improvements comprise the fidelity of the content to be displayed (rendering quality), the interfacing between the user and the displays through innovative 2D/3D interaction techniques for mixed realities and advanced tracking systems. The achievements of IMPROVE are integrated into a collaborative mixed reality product development environment, showcased and evaluated in two application scenarios: collaborative product design in the car industry and architectural design.

Title: IMPROVE - Improving Display and Rendering Technology for Virtual Environments

Funding Institution: European Commission

Coordinator from INESC-ID: Joaquim Armando Pires Jorge

Short Summary:

The aim of this project is to improve lightweight near-to-the-eye displays and tiled stereoscopic large size displays. The improvements on the hardware level consist in developing a unique stereoscopic head mounted display (HMD) using emerging display technology such as OLEDs. For tiled stereoscopic large screen displays improved calibration techniques will be developed to ease and accelerate their use. On the software level improvements comprise the fidelity of the content to be displayed (rendering quality), the interfacing between the user and the displays through innovative 2D/3D interaction techniques for mixed realities and advanced tracking systems. The achievements of IMPROVE are integrated into a collaborative mixed reality product development environment, showcased and evaluated in two application scenarios: collaborative product design in the car industry and architectural design. INESC-ID role is to develop multimodal interaction techniques to allow cooperative engineering and design tasks to be carried out using large-scale displays in automotive and architectural scenarios.

Title: MindRACES: from Reactive to Anticipatory Cognitive Embodied Systems

Funding Institution: European Commission - 6th Framework Programme

Coordinator from INESC-ID: Ana Maria Severino de Almeida e Paiva

Short Summary:

The general goal of the Mind RACES project is to investigate different anticipatory cognitive mechanisms and architectures in order to build Cognitive Systems endowed with the ability to predict the outcome of their actions, to build a model of future events, to control their perception anticipating future stimuli and to emotionally react to possible future scenarios.

Title: MGIPAI - Portucel

Funding Institution: Portucel

Coordinator from INESC-ID: Miguel Leitão Bignolas Mira da Silva

Short Summary:

In this project we apply the TOGAF methodology, typically used in complex socio-technical scenarios, to an industrial process at Portucel in order to plan, design, and manage the development of complex IT solutions. The final goal is to propose a novel technological infrastructure that can be used to optimize any industrial process. In order to validate this proposal, the infrastructure will be evaluated using a real-world case study.

Title: Project IT - New Approaches for Software Engineering (MDD and RE based)

Funding Institution: FCT

Coordinator from INESC-ID: Alberto Manuel Rodrigues da Silva

Short Summary:

The research involved in ProjectIT involves topics related with software engineering and software development processes, and in applying them to the daily projects in which it is involved. ProjectIT is an ambitious R&D program that integrates some concrete issues related with information systems design, development and operation problems or, in general, the problematic of "projects in the area of information technologies". Its main goal is to provide a complete software development workbench, with support for project management, requirements engineering, analysis, design and code generation features. ProjectIT intends to produce some results, namely (1) a collaborative tool with Web interface (i.e., with Web-client access) called ProjectIT-Enterprise; and (2) a rich-client tool (windows based) for improved productivity called ProjectIT-Studio. Both tools present

tight complementarities and integration mechanisms. The Studio version has as its main goal to provide mechanisms for higher productivity to requirements management and specification, models design, automatic code generation and software development. On the other hand, the "ProjectIT-Enterprise" version provides mechanism to collaborative support for team work, emphasizing project management activities, workflows and documents management.

Title: IBRID

Funding Institution: FCT

Coordinator from INESC-ID: Joaquim Armando Pires Jorge

Short Summary:

Nowadays, computer users must deal with a growing amount of information, in several formats (documents, emails, etc.). It is becoming increasingly harder to manage it all. The widespread usage of computers and other personal computing devices (Smartphones, PDAs, etc.) reveals that current systems are unable to deal with the hitherto unknown numbers of documents, mainly when trying to retrieve them. We will conduct valuable research in the emergent Personal Information Management area, showing how autobiographical information can be used for an effective personal document management and retrieving. We will handle this problem in novel ways, by taking into account not only information gathered at the users' computer but also from other devices such as PDAs or mobile phones. We will show how the gap between the physical and electronic worlds can be bridged with the help of RFID tags, a cost-effective and soon to be widespread technology, with which relevant paper documents and books can be related with electronic information. A user-centered design approach will ensure the validity of the results. We aim at developing an open-source system, to disseminate our results to a wider community. We expect that users will retrieve their documents by navigation or via short stories. Both ways are expected to be more efficient than current tools available for that end.

Title: CISE

Funding Institution: Câmara Municipal de Seia

Coordinator from INESC-ID: João António Madeiras Pereira

Short Summary:

The objective is to develop the Sistema de Realidade Virtual da Serra da Estrela - SRV-SE (Serra da Estrela Virtual Reality System) for Seia Municipality to be part of the Interpretation Center (CISE) of this important natural area. The SRV-SE is a multimedia system that permits navigation along the Serra da Estrela mountain range, exploring and visualizing 3D contents, taking the user into a virtual visit in real time to this important natural and historic place of Portugal. SRV-SE will be available at CISE installations in multimedia kiosks. CISE is a very important instrument for the execution of the Seia Municipality's environmental policy, whose main activities are the interpretation of Serra da Estrela Natural Park, the support to investigation and the promotion of sustainable Nature Tourism.

Title: DecorAR - Decorating Augmented Reality with NPR for Architectural Design

Funding Institution: FCT

Coordinator from INESC-ID: Joaquim Armando Pires Jorge

Short Summary:

We aim at making decoration design systems more usable both for the creation of new interior designs, by promoting the reuse of architectural plants and decoration components and for the visualization of the final result, reducing the total time from the initial request until the final solution. To this end we have been working on Sketch-Based Retrieval of

drawings. This work produced a framework that will be used as the basis to address the new challenge of classify and retrieve 3D objects. A second goal is to develop an Augmented Reality (AR) environment to improve the visualization of existing systems for conceptual interior design. We will develop novel interaction modalities based on finger and hand gesturing and tangible interfaces appropriate for interior design.

Title: IR-BASE - An Integrated Framework for the Research and Teaching of Information Retrieval Technologies

Funding Institution: FCT

Coordinator from INESC-ID: Pável Pereira Calado

Short Summary:

The main goal of this project is to create an environment for integrating tools, documentation and services to help IR teaching and research. The core of such environment is a modular and easily expandable IR system capable of (1) providing an illustrative example of a functioning IR system, (2) providing an experimental basis for IR research, and (3) providing a set of services useful for the research of new IR solutions.

Title: E-VOTING - A new Architectural Framework for Handling Risk in E-Voting Systems

Funding Institution: FCT

Coordinator from INESC-ID: Paulo Jorge Pires Ferreira

Short Summary:

The objective of this project is to develop an innovative architectural framework for handling risk in e-voting systems, addressing three areas of concern: security-related risks, community-related risks, and usefulness-related risks.

Title: Mobile Revs

Funding Institution: Portugal Telecom

Coordinator from INESC-ID: Paulo Jorge Pires Ferreira

Short Summary:

The objective of this project is to design and develop the software for electronic voting on the Internet using client mobile equipment such as mobile phones and PDAs. Besides the aspects concerning the security of all the system, other issues such as the amount of memory available in such devices has to be considered.

Title: TEDANCE

Funding Institution: FCT

Coordinator from INESC-ID: João António Madeiras Pereira

Short Summary:

The objective of this project is to explore Augmented Reality methods in the Dance Choreography field. In particular, the project intends: (1) To test and develop different methods of motion capture; (2) To build an extensive archive of motion capture data files; (3) To explore possible combinations and applications of the motion capture data files; (4) To create resources for professionals in the area of performing arts, such as researchers, choreographers, directors, performers and teachers; (5) To publish research results; (6) To organise conferences, lecture demonstrations, workshops and performances for specialists, some of which will be open to the general public.

Title: CLEANDRIVE - Environmental and Safe Driving Simulator for Educational Purposes

Funding Institution: FCT

Coordinator from INESC-ID: João António Madeiras Pereira

Short Summary:

The first objective of this project is to develop a game-like driving simulator package that will enable the education of drivers and future drivers to a safe and environmentally friendly driving behaviour. This package consists of simulation software and a physical support (computer, pedals, steering wheel, seating, sound system) enabling the players to use the simulator in a way similar to a regular vehicle. This simulator will not only be able to model vehicles using conventional technologies and fuels (diesel and gasoline) but also alternative technologies, such as natural gas, bio fuels, electric vehicles or even hydrogen vehicles. The second objective is to develop an experimental validation tool capable of registering events in real life trips in order to supply the simulator with validated realistic environment variables and to calibrate the scoring system. This tool is to be connected to the vehicle communications system (through the OBD - On Board Diagnostics - port).

Title: LPBIST

Funding Institution: FCT

Coordinator from INESC-ID: Marcelino Bicho dos Santos

Short Summary:

The objectives of this project are: (1) Develop a high quality, technology and library independent test preparation methodology; (2) Register Transfer Level (RTL) test preparation of both combinational and sequential circuits; (3) Automatic insertion of BIST.

Title: RECALL

Funding Institution: FCT

Coordinator from INESC-ID: Fernando Manuel Duarte Gonçalves

Short Summary:

This project aims at the development of: (1) an architecture that can be configured without the typical FPGA compilation steps (multi-FPGA partitioning and mapping, and FPGA placement and routing). Hence, all of these NP-complete problems are replaced by a single linear time pre-processing step; (2) An architecture that can be used for simulation of circuits larger than the available hardware platform; (3) An extremely fast hardware logic emulator/simulator, by using the dedicated architecture developed in this project. We estimate an overall acceleration of at least one order of magnitude for medium and large circuits, compared to the multi-FPGA platforms; (4) A prototype of the proposed architecture.

Title: ASSOCIATE - Advanced Solutions for SOC Innovative Testing in Europe, Medea+ A503 Project

Funding Institution: Adl - Agência de Inovação

Coordinator from INESC-ID: Carlos Francisco Beltran Tavares de Almeida

Short Summary:

The overall goal of this project is to shorten debugging and testing time and cost of electronic products throughout the product life cycle, while providing cost-effective testing methods for high-volume production. The European A503 MEDEA+ Project focus.

Title: BASE/TELEC - Integrated Electronic System for the Evaluation and Intelligent Management of Domestic Consumptions

Funding Institution: FCT

Coordinator from INESC-ID: Isabel Maria Silva Nobre Parreira Cacho Teixeira

Short Summary:

This project aims to manage and optimize electrical energy consumption in 'home context', taking into consideration a given set of confort parameters, the consumption profile of different equipemnt and tarification evolution along the day.

Title: CHIADO - Compilation of high-level computationally intensive algorithms to dynamically reconfigurable computing systems

Funding Institution: FCT

Coordinator from INESC-ID: João Manuel Paiva Cardoso

Short Summary:

The central focus of this project is the R&D of fast, efficient and automatic techniques for mapping the application's data and computation structures to the available dynamically RC resources. Our main goals are: to develop new mapping and estimation schemes; to support floating-point operations; and to develop module-generators for operations and specific memory interface components; The mapping will include temporal partitioning with exploitation of partial/full loop unrolling, both guided by high-level estimations. This design exploitation will be done without explicitly applying loop unrolling. The methods will be integrated in the compiler framework, which was developed in the context of previous projects, and will be benchmarked with three representative applications and demonstrated using a commercial RC board. We propose to reduce substantially the development time for RC systems, without sacrificing the performance too much and without a significant increase in the number of resources/configurations needed.

Title: PET

Funding Institution: Adl - Agência de Inovação

Coordinator from INESC-ID: Isabel Maria Silva Nobre Parreira Cacho Teixeira

Short Summary:

Breast cancer early detection is recognized as a worldwide priority, since it constitutes the most effective way to deal with this illness. This project aims at the development of the Data Acquisition Electronic (DAE) system for a PEM (Positron Emission Mamography) equipment.

Title: DYNATEST - Nano SoC Dynamic Test

Funding Institution: FCT

Coordinator from INESC-ID: João Paulo Cacho Teixeira

Short Summary:

This project aims high quality, high performance and highly dependable electronic systems, designed in new nanometer semiconductor technologies, require new design, test and diagnosis methodologies and tools. In this project, an emerging dimension of test - the power supply voltage, VDD - is used to increase the effectiveness of delay test and diagnosis. This project brings together dynamic BIST (Built-In Self Test) and VDD-based testing as pillars of novel solutions to dynamic faults (intermittent or permanent) testing of digital SoC, implemented in nanometer semiconductor technologies, and to enhanced tolerance of advanced IC products to environmental disturbances, such as Delta-VDD.

Title: CERN

Funding Institution: FCT

Coordinator from INESC-ID: Carlos Francisco Beltran Tavares de Almeida

Short Summary:

This project consists in collaborating with LIP in the production tests of the electronics boards for the ECAL trigger and data acquisition system of the CMS experiment.

Title: DCIS 2005

Funding Institution: e-Voting.at

Coordinator from INESC-ID: Fernando Manuel Duarte Gonçalves

Short Summary:

Organization of the 2005 DCIS Conference.

Title: EuroNGI - Design and Engineering of the Next Generation Internet

Funding Institution: European Commission - 6th Framework Programme

Coordinator from INESC-ID: Augusto Julio Domingues Casaca

Short Summary:

This project is mainly an European Network of Excellence having as objectives to integrate european research for the next generation Internet.

Title: SENSATION - Advanced Sensor Development for attention, stress

Funding Institution: European Commission - 6th Framework Program

Coordinator from INESC-ID: Teresa Maria Sá Ferreira Vazão Vasques

Short Summary:

The project is aimed to research and develop tools that support stress, vigilance & sleep/wakefulness Monitoring based on a advanced wireless sensor network.

Title: AIRNET - Airport Network for Mobiles Surveillance and Alerting

Funding Institution: European Commission - 6th Framework Program

Coordinator from INESC-ID: Augusto Julio Domingues Casaca

Short Summary:

AIRNET platform will enable the elaboration of airport situation by real-time acquisition of aircraft and vehicles position through a set of wireless networks. The performance and the reliability of the wireless communication network is a key driver to the "end-to-end" quality of service and will be extensively validated at Porto Airport.

Title: OPERA - Open Plc European Research Alliance

Funding Institution: European Commission

Coordinator from INESC-ID: Mário Serafim Nunes

Short Summary:

The objective of the project is to Offer low-cost broadband access service to all European citizens using the most ubiquitous infrastructure, Power Lines, through the development of a new PLC generation integrated with existing backbone technologies.

Title: Cadence

Funding Institution: Cadence Design Systems

Coordinator from INESC-ID: Luis Miguel Teixeira D Avila Pinto da Silveira

Short Summary:

This contract is an open-ended research contract, under which Cadence Design Systems is funding a functional research unit, the Lisbon Center of the Cadence Laboratories. The long term objectives are the development of advanced research on the area of CAD tools for VLSI.

Title: COOLCHIPS - An Environment for the Design and Analysis of Power Efficient Systems

Funding Institution: FCT

Coordinator from INESC-ID: José Carlos Alves Pereira Monteiro

Short Summary:

The objective of this project is to develop a framework for low power design at the system level. The focus will be on optimizing architectures for low power at the register-transfer level (RTL), and on techniques for ultra low-power core microprocessors both in terms of hardware and software. At the RTL, a few particular designs with well defined behavior,

such as FFT and FIR filters, will be implemented using different architectures. From the comparison of their power performance a methodology will be developed. Encoding in the system buses will be essayed both for RTL and microprocessor design, and the asymmetry of operands exploited in hardware and software. Memory system optimization will also be addressed. Power estimation tools will be developed to allow the evaluation of different alternatives at each design abstraction level. An RTL tool based on macromodels will be implemented that accounts for word level correlations, and uses models that include interconnect capacitance.

Title: ADEPT

Funding Institution: FCT

Coordinator from INESC-ID: João Paulo Marques da Silva

Short Summary:

The ADEPT research project addresses research working in Boolean Satisfiability (SAT) and Pseudo Boolean Optimization (PBO), exploring new ideas that are expected to prove useful in developing next generation advanced solvers.

Title: Data Mining

Funding Institution: Cadence Design Systems

Coordinator from INESC-ID: Arlindo Manuel Limede de Oliveira

Short Summary:

The objectives of this project are the development of new machine learning and data mining techniques for application in the domains of computer aided design, information retrieval and bioinformatics.

Title: PRACTIC

Funding Institution: FCT

Coordinator from INESC-ID: João Paulo Marques da Silva

Short Summary:

The project aims at improving the resolution of constraint solving problems (possibly with an optimising function) involving variables with discrete domains.

Title: BIOGrid - Parallel Algorithms for Gene Annotation

Funding Institution: FCT

Coordinator from INESC-ID: Arlindo Manuel Limede de Oliveira

Short Summary:

The objective of this project is to capitalize on the know-how of the research team on algorithms and complexity to develop an integrated system that uses grid computing to make available the full power of bioinformatics algorithms to a large community of users. In particular, we propose to improve existing approaches for motif identification, both by algorithmic improvements and by making use of the computing power made available by a grid.

Title: QAModel - Automatic Modeling and Simulation of Qualitative Systems Dynamics

Funding Institution: FCT

Coordinator from INESC-ID: José Alberto Batista Tomé

Short Summary:

This project is proposed as a sequence of project Automatic Implementation and Simulation of Qualitative Cognitive Maps, whose final teoretical objectives were similar to this one. The ultimate goal is the concretization and the extension of the theoretical results of the previous project by developing software tools to implement FBN and RB-FCM

mechanisms, and integrate them in order to allow the automatic modeling and simulation of Qualitative Dynamic Systems. More specifically, it is intended in this work to develop a system, which automatically generates the Qualitative Cognitive Map using RBD for the acquisition of rules from individual expert maps or directly from examples. This will allow a more correct methodology for acquisition of the Cognitive Maps, which nowadays rely on lengthy but simplistic processes of individual information collection.

Title: DBYeast: A Framework for the development and application of algorithms to the analysis and identification of gene regulatory networks

Funding Institution: FCT

Coordinator from INESC-ID: Arlindo Manuel Limede de Oliveira

Short Summary:

The objective of this project is the study of interaction networks and their underlying complexity, focusing on gene regulation networks. Research is centered on unveiling the gene regulatory mechanisms of a simple organism, the yeast (*Saccharomyces cerevisiae*), extensively used by the scientific community as an experimental platform.

Title: Eletronic Systems Power Planning

Funding Institution: FCT

Coordinator from INESC-ID: Luis Miguel Teixeira D Avila Pinto da Silveira

Short Summary:

This project is aimed at the research, study and development of accurate and efficient techniques for the verification of power grid networks in complex integrated circuit designs. To that end, we propose to combine new and existing knowledge in the areas of power, timing and signal integrity analysis, to enable efficient solutions to the problem of power grid planning. The final goal is the development of an environment for accurate and efficient planning and further analysis of power grids that integrates timing information to provide consistent and correlated input information to the analysis process.

Title: SATPOT

Funding Institution: FCT

Coordinator from INESC-ID: João Paulo Marques da Silva

Short Summary:

The SATPot project aims to contribute for the development of the next generation SAT and SAT extensions algorithms. Also, the project will actively pursue the practical utilization of SAT and SAT extensions in the real-world.

Title: ONTO - SeaWeb - Ontology Engineering for the Semantic Web

Funding Institution: FCT

Coordinator from INESC-ID: Helena Sofia Andrade Nunes Pereira Pinto

Short Summary:

This project is going to address two goals: (1) Regarding ontology learning, the goal is to develop the required techniques to build ontology about the structure of technical articles in a semi-automatic way. Since we aim at semi-automatic processes, besides the construction itself, the task of processing source files can be automated. This will allow processing large amounts of information. Among the applications of this work, there is the annotation of documents, allowing more powerful search forms, and the transformation of documents into other more structured formats. (2) Regarding risk analysis we are going to work on pilot experiences of controlled ontology building processes to identify and abstract the most critical risks that can affect them and identify the necessary measures and guidelines to prevent them. This will increase the success rates of these processes.

Title: EMONIC - Electromagnetics on Integrated Circuits

Funding Institution: Philips Research Laboratories

Coordinator from INESC-ID: Luis Miguel Teixeira D Avila Pinto da Silveira

Short Summary:

The objective of this project is to develop a prototype extraction/modeling tool for RF-ICs, which includes all essential EM effects and can be used to verify/simulate circuits (preferably using standard RF circuit simulation tools) at macro/block level against their RF performance.

Title: CHAMELEON-RF - Comprehensive High-Accuracy Modeling of Electromagnetic Effectics in Complete Nanoscale RF Blocks

Funding Institution: European Commission - 6th Framework Program

Coordinator from INESC-ID: Luis Miguel Teixeira D Avila Pinto da Silveira

Short Summary:

The aim of the CHAMELEON RF project is to develop methodologies and prototype tools for a comprehensive and highly accurate analysis of complete next-generation nanoscale functional IC blocks that will operate at RF frequencies of up to 60GHz.

Title: CVAM - Automatic Visual Classification of Polished Marble Stones

Funding Institution: FCT

Coordinator from INESC-ID: Moises Simões Piedade

Short Summary:

The objective of this project is: (1) To acquire and build a data base of visual information of polished marble stones; (2) To develop algorithms for automatic marble stone classification; (3) To choose the techniques appropriated for the design of a robust industrial automatic stone inspection system.

Title: COSME - Configurable Structures for Motion Estimation

Funding Institution: FCT

Coordinator from INESC-ID: Leonel Augusto Pires Seabra de Sousa

Short Summary:

This project aims the development of a new class of fully parameterizable multiple array VLSI architectures and dedicated processors for motion estimation in video sequences, based on the full search block matching (FSBM) algorithm.

Title: CORTIVIS - Cortical Visual Neuroprosthesis for the Blind

Funding Institution: European Commission - 5th Framework Program

Coordinator from INESC-ID: Moises Simões Piedade

Short Summary:

This project aims at develop prototypes in the field of visual rehabilitation and to demonstrate the feasibility of a cortical neuroprosthesis, interfaced with the visual cortex, through which an useful visual sense may be restored to profoundly blind people.

Title: IPTAADE-BACTERIA - Image Processing Techniques for Antibacterial Activity Detection and Evaluation

Funding Institution: FCT

Coordinator from INESC-ID: Moises Simões Piedade

Short Summary:

The objective of this project is the development of image processing algorithms for the automatic observation of bacterial growing inhibition zones. Techniques involve morphological filtering and wavelet-based segmentation.

Title: OSMIX

Funding Institution: FCT

Coordinator from INESC-ID: Jorge Manuel dos Santos Ribeiro Fernandes

Short Summary:

OSMIX is an investigation of combined oscillator-mixers for RF transceivers. The purpose of this project is to investigate a new approach to the realization of the oscillator and mixer in RF frontends. The new approach consists of using a cross-coupled relaxation oscillator with feedback into which the signal to be mixed with the oscillator signal is injected. Beside this main objective several other circuits were studied for comparison purposes or for demonstration purposes. It was also studied the LC-oscillator and the two-integrator oscillator as alternatives to produce quadrature outputs and to realize the mixing function. It was also studied hybrid frequency synthesizers, which would use the cross-coupled RC oscillator/mixer to do single-side band mixing with a digital DDS. Being the RC cross-coupled oscillator a wideband oscillator/mixer, wideband LNAs were also studied. Several integrated circuit prototypes were produced and evaluated.

Title: PET - Development of PET technology for mamography

Funding Institution: INOV

Coordinator from INESC-ID: Manuel de Medeiros Silva

Short Summary:

This project aims the development of the analog front-end of a Positron Emission Tomography (PET) system for mamography.

Title: INTEGRATION

Funding Institution: INESC-ID

Coordinator from INESC-ID: Jorge Manuel dos Santos Ribeiro Fernandes

Short Summary:

This project aims the development of analog and mixed-signal integrated circuits. The Integration project is a consultancy/research project in collaboration with Integration Portugal Lda. The activity varies according with ongoing projects, but mainly it has been focused on circuits for RF applications and on Analog-to-Digital Converters. It also has a strong collaboration at research level where PhD student's present seminars on their work and results, receiving feedback from industry designers. Integration has also sponsored an MSc scholarship.

Title: SECA - Development of a low-voltage, low-power, digitally self-calibrated pipeline ADC for video-frequency with on-chip self-testing capability

Funding Institution: FCT

Coordinator from INESC-ID: Manuel de Medeiros Silva

Short Summary:

The objective of this project is to Design, to integrate and to evaluate experimentally a self-calibrated pipeline ADC with 1.5 V, 12 to 13 bit 40 Msample/s, using only 1 pJ of energy per conversion.

Title: FLOW - Advanced Control of Processes with Transport phenomena

Funding Institution: FCT

Coordinator from INESC-ID: João Manuel Lage de Miranda Lemos

Short Summary:

The FLOW project aims the development of Advanced Non-Linear and Adaptive Control methodologies for distributed parameter systems with transport phenomena. These methods are to be applied in different case studies such as (1) the control of car density in highway traffic flow; (2) the control of water flow in a water distribution channel system; (3) the control of temperature in large-scale distributed heat-exchangers.

Title: BIOCHIP-PLATFORM - Magnetoresistive Biochip Microarray Platform for Biomolecular Recognition

Funding Institution: FCT

Coordinator from INESC-ID: Bertinho Manuel D'Andrade da Costa

Short Summary:

The project aims to build a fully integrated, portable and addressable, magnetoresistive biochip microarray for DNA recognition or microorganism/cell identification, where target biomolecules are labelled with magnetic nanoparticles.

Title: AMEP - Motion Estimation Processor for Mobile and Battery Supplied Devices

Funding Institution: FCT

Coordinator from INESC-ID: Leonel Augusto Pires Seabra de Sousa

Short Summary:

The main goal of this research project is the development of a new motion estimation algorithm suitable for mobile and battery supplied devices. To develop this new algorithm, based on a modified block matching processing scheme, an optimized processing core and several enhancements and optimizations to the search strategy will be considered, so as to adapt it to the intrinsic characteristics of video signals and target application devices. The improvements will consider the movement of the terminal in the prediction of the candidate motion vector to reduce the set of search candidates and dynamic adaptation to the current motion field pattern of the target application (e.g. enhancing the resolution of the search in the inner area for video-conference like applications). Moreover, the estimation procedure will also be dynamically adjusted to the terminal battery resources using efficient power management techniques such as computational budgets for arithmetic operations, reduction of the precision level and tuning of the clock frequency. A dedicated architecture will be designed to implement the optimized ME algorithm in an ASIC device to be embedded as a co-processor in video coding systems, for which a standard cell library for deeper sub-micron technology (e.g. CMOS 0.13um technology process) will be used.

Title: RNC - Retina Neural Code: Accurate Modelling

Funding Institution: FCT

Coordinator from INESC-ID: Leonel Augusto Pires Seabra de Sousa

Short Summary:

Classic models for modelling the human visual system are simple but still a crude approach to the visual system, giving just the average firing rate in a deterministic way. New models will be investigated from scratch by applying white noise analysis to describe the system. A different approach will be considered by deriving system kernels, with reverse correlation techniques, for further use in parametric models. Different approaches will be exploited using Artificial Neural Networks abilities. To accomplish these objectives, automatic classification methods will be developed for distinguish different cell types according to their responses. Moreover, an exhaustive experimental evaluation of the retina models will be conducted in the scope of this project, based on a huge database of retina responses

provided by the Instituto de Bioingenieria of Facultad de Medicina of Universidad Miguel Hernandez. Computational complexity of the proposed models will be analyzed and hardware architectures for its implementation developed.

Title: OFDM - Power Line Communication System using Adaptive OFDM

Funding Institution: FCT

Coordinator from INESC-ID: José António Beltran Gerald

Short Summary:

This project aims at developing a simulation system for power line communication (PLC). The first work in this project respects to the power line characterization, confirming the experimental results already obtained by this team, in what respects the line impedance, the observed noise and attenuation. Then, we will develop a simulation system for PLC using adaptive OFDM with precoding, for data rates above 1 Mbps, enough versatile to optionally characterize the line channel, and self sustained in order to be an independent block in the global simulation system. In order to mitigate the adverse effects of the PLC medium, new OFDM transmission schemes will be developed. The effort will be aimed in two directions: on one hand, techniques to deal with the spectral nulls in the channel transfer function and on the other, techniques to address the fading time-dispersive nature of the channel.

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International Journal Articles

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Isabel Alexandre and Ana Paiva and Paul Brna, **Tell Me a Story**, *Virtual Reality*, 9 (1), pp. 34 - 48, Dec. 2005, Springer-Verlag London.

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Leonel Sousa and Ricardo Chaves, **A Universal Architecture for Designing Efficient Modulo 2^{n+1} Multipliers**, *IEEE Transactions on Circuits and Systems-I: Regular Papers*, 52(6), pp. 1166- 1178, Jun. 2005, IEEE.

Oliver Sinnen and Leonel Sousa, **Communication Contention in Task Scheduling**, *IEEE Transactions on Parallel and Distributed Systems*, 16(6), pp. 503-515, Jun. 2005, IEEE.

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Inês Lynce and João Marques Silva, **Efficient data structures for backtrack search SAT solvers**, *Annals of Mathematics and Artificial Intelligence*, 43(1), pp. 137-152, Jan. 2005, Kluwer Academic Publishers.

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