



# **Annual Academic Report Course 2007 – 2008**

**Institute for Research in Technology**

**Instituto de Investigación  
Tecnológica**



# Index

1 Introduction .....	1
2 Organization.....	3
2.1 Management.....	3
2.2 Council.....	3
2.3 Academic Staff.....	4
2.4 Research Assistants .....	14
2.5 Services Staff.....	16
3 Teaching.....	17
3.1 Doctoral Program .....	17
3.2 Seminars.....	25
3.3 Other activities .....	26
4 Research .....	27
4.1 Areas of Interest.....	27
4.2 Research Projects.....	28
4.3 Publications.....	83
4.4 Research Sufficiency Degree.....	99
4.5 Doctoral Theses.....	100
5 Other Activities.....	105
5.1 International Exchanges.....	105
5.2 Consultancy and Courses.....	106
5.3 Software Products .....	109
5.4 Other activities .....	110
6 Relations with other institutions .....	115
6.1 European institutions .....	115
6.2 ICAI Engineers' Association .....	117
7 Economic Results.....	119



## *Director's greeting*

Dear friend,

It is my pleasure to present to you the Annual Report of the Institute for Research in Technology (IIT) corresponding to the academic year 2007-2008. This report provides comprehensive information on the research that the Institute has carried out, the results obtained and the people that have made them possible.

The level of activity surrounding this memory is a clear sign of the firm positioning of the Institute on the postgraduate and the research and development, with a permanent focus and priority to align with the reality of Spanish and International Industry.

I take advantage of the occasion to thank all the professionals who have supported us all these years: teachers, researchers and administratives, postgraduate students, and the representatives from the industry. They all have made possible the reality of the University Institute. Without a doubt today, thanks to them all, the IIT is a national and international reference in many of the fields in which it works.

We are determined in the future to continue and enrich this path, working hard and professionally in order to maintain the confidence placed in us by the national and foreign companies with whom we collaborate to achieve our research, for example the ICAI, the University and the Association of ICAI Engineers whose support we are grateful for and appreciate.

I would like to end this foreword with an invitation to learn more about us by reading this report.



*Antonio Muñoz San Roque*



# 1 Introduction

The IIT, Institute for Research in Technology, belongs to the School of Engineering (ICAI) of Comillas Pontifical University of Madrid (Comillas). Its main aim is to promote research and postgraduate training in diverse technological fields through participation in specific projects of interest for Industry and the Government. It is a non-profit Institute, which aims to be flexible and pragmatic in the way it works. It is essentially financed by projects contracted by companies, and thus responds to a clear social demand.

The results of the research projects can be grouped according to the following categories:

- New engineer equipment design, computer science applications (generally developed according to client specifications) used by an increasing number of companies.
- Analyses, studies, and consultancy developed for companies and institutions in different countries.
- Doctoral theses read at the University and publications at international conferences and in international journals.

Research in the IIT is conducted by the academic staff (Professors and Researchers) as well as by a group of postgraduates following a Research Training Program. Postgraduate students are generally funded by IIT scholarships and work as Research Assistants exclusively at the Institute. Work teams are formed from both groups to develop research projects, sometimes resulting in doctoral theses.



## 2 Organization

### 2.1 Management

The IIT board of directors was formed by the following researchers:

- **Michel Rivier Abbad**, Director, until August 2008.
- **Antonio Muñoz San Roque**, Director, from September 2008.
- **Efraim Centeno Hernáez**, Deputy Director of Electrical Energy Systems Area.
- **José Villar Collado**, Deputy Director of Industrial Systems Area.

### 2.2 Council

The IIT Council has been constituted by the next group:

- **Michel Rivier Abbad**, President
- **Eduardo Pilo de la Fuente**, Secretary,
- **Efraim Centeno Hernáez**,
- **Rafael Cossent Arín**,
- **Antonio Fernández Cardador**,
- **Tomás Gómez San Román**,
- **Jesús Jiménez Octavio**,

- **Antonio Muñoz San Roque,**
- **Andrés Ramos Galán,**
- **José Villar Collado.**

## 2.3 Academic Staff

IIT permanent Academic Staff during this academic year has been formed by:

- **Sadot Alexandres Fernández,** Tenured Associate Professor  
Telecommunications Engineering, PhD (UPM)  
*Areas of interest:* Microelectronic design, digital signal processing, industrial communications, field busses, wireless systems.
- **Angel de Andrés Martínez,** Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Fracture mechanics. Computational mechanics. Machine design. Finite elements.
- **Julián Barquín Gil,** Tenured Associate Professor  
Industrial Engineering, PhD (Comillas)  
Physics (UNED)  
*Areas of interest:* Electric power systems. Non-linear dynamic systems. Numerical methods for dynamics and partial derivatives equations. Environmental engineering for electric power production and transport. Electromagnetic field theory.
- **Carlos Batlle López,** Tenured Assistant Researcher  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Economics and regulation of the electricity industry. Modelling of electricity markets. Risk analysis and management.
- **Francisco Alberto Campos Fernández,** Assistant Research Professor  
Industrial Engineering, PhD (Comillas)  
Mathematics (UCM)

*Areas of interest:* Nash equilibriums, Possibility theory, Optimization under uncertainty, electricity markets.

- **Alberto Carnicero López**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Continuum Mechanics. Numerical Methods in Engineering. Earthquake Engineering. Wavelets.
- **Efraim Centeno Hernáez**, Tenured Associate Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Electric power system operation models. Hydrothermal coordination. Electric power markets.
- **Santiago Cerisola López de Haro**, Adjunct Professor  
Industrial Engineering, PhD (Comillas)  
Mathematics (UCM)  
*Areas of interest:* Pure mathematics, optimization techniques, stochastic programming and stochastic models, decomposition techniques, risk management, financial mathematics.
- **Fernando de Cuadra García**, Tenured Full Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Large-scale modelling, simulation and optimisation problems. Knowledge engineering. Intelligent CAD. Control theory. Power systems. Computer Aided Software Engineering (CASE).
- **Asunción Paloma Cucala García**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Modelling, simulation, design, management and control of railway systems, and their safety and quality analysis.
- **Francisco Miguel Echavarren Cerezo**, Assistant Research Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Modeling, analysis and simulation of power systems.

- **Ignacio Egido Cortés**, Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* System modeling and control. Power system stability.
- **Fidel Fernández Bernal**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Dynamics of electrical systems, motor control and applications on electric vehicles, and power electronics.
- **Antonio Fernández Cardador**, Tenured Associate Professor  
Industrial Engineering, PhD (Comillas)  
Physics (UCM)  
*Areas of interest:* Systems modelling, analysis and simulation. Simulation techniques for optimisation and control problems. Design, management and control of railway systems.
- **Mercedes Fernández García**, Tenured Assistant Professor  
Economics, PhD (Comillas)  
Bachelor in Law (Comillas)  
*Areas of interest:* Economics, Finance, Business Administration, Multivariate Data Analysis.
- **Cesáreo Fernández Martínez**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
Industrial Engineering (UPM)  
*Areas of interest:* Software for Real-time control. Parallel architectures in control. HV line protection. Control in electric power substations.
- **Pablo Frías Marín**, Assistant Research Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Operation and planning of Electric Power Systems. Power economics. Optimisation techniques. Integration of distributed generation in power systems. Advanced electric machines.

- **Aurelio García Cerrada**, Tenured Full Professor  
PhD, Electrical & Electronic Engineering (University of Birmingham, UK)  
Industrial Engineering (UPM)  
*Areas of interest:* Power electronics. Control of electrical drives. FACTS. System identification and control.
- **Javier García González**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
Industrial Engineering (UPC)  
*Areas of interest:* Economy and optimization of electric power systems.
- **Pablo García González**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Control, Power Electronics, Power Electronics applied to the Electric Power Systems (FACTS devices, Active Filters, HVDC etc.) and Electric Power Systems stability and control.
- **Romano Giannetti**, Tenured Associate Professor  
Electronic and Computer Engineering, PhD (Padua University, Italy)  
Electronic Engineering (Pisa University, Italy)  
*Areas of interest:* Measurement instrumentation and methodology. Biomedical instrumentation. Noise measurements.
- **Tomás Gómez San Román**, Tenured Full Professor  
Industrial Engineering, PhD (UPM)  
Industrial Engineering (Comillas)  
*Areas of interest:* Analysis and design of electric power systems. Control, operation and planing of transmission and distribution systems. Restructuring and economics of the electricity industry. Non-linear dynamic systems. Control of large-scale systems. Optimisation techniques.
- **Yolanda González Arechavala**, Assistant Professor  
Industrial Engineering, PhD (Comillas)  
Computer Engineering (UPV-EHU)  
*Areas of interest:* Software engineering: software development process, programming paradigms, software quality assurance and control, CASE tools.

RAMS: standards and analysis. Safety critical and real time systems. Railway systems.

- **Damián Laloux Dallemagne**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Modelling, Analysis and Control of Electric Power Systems. Sustainable Development.
- **Jesús Latorre Canteli**, Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Operations research and modeling, stochastic programming, parallel and distributed computing, algorithms and numerical methods, etc.
- **Pedro Linares Llamas**, Tenured Associate Professor  
Agricultural Engineering, PhD (UPM)  
*Areas of interest:* Multiple criteria decision making. Energy economics. Energy planning models. Integration of renewable energies. Environmental economics. Environmental policy instruments.
- **Enrique Lobato Miguélez**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Analysis, planning, operation and economics in electric power systems.
- **Carlos Maté Jiménez**, Tenured Assistant Professor  
Mathematics, PhD (UCM)  
*Areas of interest:* Forecasting. Time Series Analysis. Symbolic Data Analysis. Reliability. Life Testing. Nonparametrics Bayesian Statistics. Multivariate Analysis. Marketing Research. Customer Satisfaction Measurement. QoS.
- **Carlos Mateo Domingo**, Assistant Research Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Ultrasound and models of electricity distribution networks.

- **Claudia Meseguer Velasco**, Assistant Professor  
Industrial Engineering, PhD (Comillas)  
Industrial Engineering (UPM)  
*Areas of interest:* Regulation, economics, operation and planning of electric power systems.
- **José Daniel Muñoz Frías**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Digital systems design, computer architecture, motor drives control and design of embedded systems for automatic control applications.
- **Antonio Muñoz San Roque**, Tenured Associate Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Analog electronics. Artificial Intelligence. Modelling and diagnosis of industrial processes. Power systems. Digital signal processing. Neural networks, Machine learning. Genetic algorithms.
- **Francisco Nieto Fuentes**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Robotics. Reliability and safety. Mechanical design.
- **Luis Olmos Camacho**, Assistant Research Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Regulation of the energy sector, transmission of electricity, power economics, system identification.
- **Susana Ortiz Marcos**, Assistant Professor  
Industrial Engineering, PhD (UPM)  
*Areas of interest:* Business administration, financial accounting, production management, costing accounting; regulation and organizational structure of the electricity market and cost of capital estimation for companies of the electricity sector. Renewable fuels.

- **Francisco Luis Pagola y de las Heras**, Tenured Full Professor  
Industrial Engineering, PhD (UPM)  
Industrial Engineering (Comillas)  
*Areas of interest:* Theory and applications of automatic control; digital and adaptive control. Electric power systems: stability, control, modeling, measuring and relaying techniques. Power electronics and electrical drives.
- **Rafael Palacios Hielscher**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Failure detection, diagnosis, vibration analysis, optical handwritten character recognition, image processing.
- **José Ignacio Pérez Arriaga**, Tenured Full Professor  
PhD and Master of Science in Electrical Engineering (Massachusetts Institute of Technology (MIT), USA).  
Industrial Engineering (Comillas)  
*Areas of interest:* Economics, regulation and models of the electric power industry.
- **Eduardo Pilo de la Fuente**, Assistant Research Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Railways, Power systems, Optimization, Design methods, Computing.
- **Andrés Ramos Galán**, Tenured Full Professor  
Industrial Engineering, PhD (UPM)  
Industrial Engineering (Comillas)  
*Areas of interest:* Development of new algorithms and computer implementation, modeling of complex systems. Mathematical techniques of operations research and their application to large-scale problems. Large-scale optimization techniques. Stochastic optimization. Benders decomposition. Planning and operation of electric energy systems -models for generation and transmission network planning, generation operation models-. Economy of the electric sector. Computational techniques and analytical methods for planning, operations, and control. Economics, market organization, cost structures, pricing, and risk management. Reliability, uncertainty, and probability and stochastic system applications. Emerging methods for restructured systems.

Generation system resource planning. Transmission system planning. Industry restructuring planning and policy issues.

- **Javier Reneses Guillén**, Assistant Research Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Operation, simulation models and planning of electric energy systems and risk management strategies in electricity markets.
- **Juan Rivier Abbad**, Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Regulation, operation and planning of distribution systems. Power quality and reliability issues.
- **Michel Rivier Abbad**, Tenured Full Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Electric power systems analysis, optimisation, regulation economic, operation and planning. Optimisation techniques.
- **José Antonio Rodríguez Mondéjar**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* communication and control in electric power systems and railway systems.
- **Carlos Rodríguez-Morcillo García**, Assistant Research Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* On board Communications, embedded Systems, wireless communications, programmable logic, digital systems.
- **Ramón Rodríguez Pecharromán**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Control theory, adaptive control, power electronics and its applications.

- **Luis Rouco Rodríguez**, Tenured Full Professor  
Industrial Engineering, PhD (UPM)  
*Areas of interest:* Electric power systems stability and control. System identification. Simulation of electromagnetic transients.
- **Pedro Sánchez Martín**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Transmission and Generation Electric System Modeling, Industrial Process Planning and Scheduling, Work System Design and Manufacturing and Logistics Simulation.
- **Álvaro Sánchez Miralles**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Intelligent electricity networks for a sustainable energetic system: Network planning with distributed generation, FDIR: Fault Detection Isolation and Restoration, Tariffs design for efficient use of power distribution networks and integrated with active management of demand; Mobile robotics: Autonomous land vehicles: all terrain robots, manipulators, and transportation mobile robots, Unmanned and Autonomous helicopters: aerial vision; Artificial vision: 3D reconstruction, Objective detection and following; Embedded systems, electronics and automation.
- **Eugenio Francisco Sánchez Úbeda**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Data mining, Artificial Intelligence (automatic learning, decision trees, neural networks, fuzzy logic, genetic algorithms, heuristic search). Biometrics (optical character, image and speech recognition). Electric energy systems (bidding in competitive markets, forecasting, dynamic security assessment, transmission and subtransmission planning). Multi-agent systems.
- **Miguel Angel Sanz Bobi**, Tenured Full Professor  
Industrial Engineering, PhD (UPM)  
*Areas of interest:* Monitoring and analysis of industrial processes. Modelling and simulation of industrial components performance. Expert systems, neural networks, fuzzy logic, genetic algorithms, failure detection techniques, reliability, predictive maintenance, image and voice processing.

- **Mariano Ventosa Rodríguez**, Tenured Associate Researcher  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Operations, planning and economy of electric energy systems and application of operations research in electric energy markets.
- **José Villar Collado**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Monitoring, diagnosis and maintenance of industrial processes. Artificial Intelligent techniques (fuzzy logic, neural nets, etc.). Process modelling and signal processing techniques. Electronics and control. Power systems. Electric energy markets.
- **Juan Luis Zamora Macho**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Drive control, system identification and signal processing.

Also participating in research projects, as Associate Researcher:

- **Mario Castro Ponce**, Tenured Assistant Professor  
Physics, PhD (UCM)  
*Areas of interest:* Statistical Mechanics. Nonlinear Physics. Fractals. Neural Networks.
- **Luis Manuel Mochón Castro**, Tenured Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Computacional Fluid Dynamic, Fluid Control, Hydraulic Energy.
- **Julio Montes Ponce de León**, Associate Researcher  
Physics, PhD (UCM)  
Nuclear Engineering (Harwell, UK)  
*Areas of interest:* Energy environmental impact. Instruments for environmental regulation of electrical sector. Multicriteria decision methods. Environmental economy.

- **José Porrás Galán**, Assistant Professor  
Industrial Engineering, PhD (Comillas)  
*Areas of interest:* Manufacturing, Machining, Robotics, Mechanical design, Artificial intelligence, Acoustics.
- **María Ana Sáenz Nuño**, Assistant Professor  
Industrial Engineering, PhD (Comillas)  
Physics (UCM)  
*Areas of interest:* Dimensional Metrology.
- **Ángel Sarabia Viejo**, Tenured Full Professor  
Mathematics, PhD (UCM)  
Mathematics (UCM)
- **Juan Antonio Talavera Martín**, Assistant Professor  
Industrial Engineering, PhD (UPM)  
Industrial Engineering (Comillas)  
*Areas of interest:* Signal processing and voice analysis.

## 2.4 Research Assistants

The students that have taken part in the Research Training Program as Research Assistants are listed below:

- **Manuel Alvar Miró**, Industrial Engineering (Comillas), Arts and Manufactures Engineering (École Centrale de Paris, France)
- **Álvaro Arranz Domingo**, Industrial Engineering (Comillas)
- **Ana Berzosa Muñoz**, Industrial Engineering (UPM)
- **Adela Conchado Rodríguez**, Industrial Engineering (Comillas)
- **Rafael Cossent Arín**, Industrial Engineering (Comillas)
- **Alberto Miguel Cruz García**, Computing Engineering (Comillas)
- **Andrey da Costa Lopes**, Graduate and Master of Science in Electrical Engineering (Para Federal University, Belém, Brazil)

- **Renato Dias Bleasby Rodrigues**, Bachelor in Economic Sciences and Master in Economics of Industry and Technology (Rio de Janeiro Federal University, Brazil)
- **Cristian Andrés Díaz Duran**, Electrical Engineer (Santander Industrial University, Colombia)
- **Kristin Dietrich**, Industrial Engineering (Dresden Technologic University, Germany)
- **María Domínguez Gago**, Industrial Engineering (Comillas)
- **Félix Fernández Menéndez**, Industrial Engineering (Comillas)
- **Pablo Dueñas Martínez**, Industrial Engineering (Comillas)
- **Sergey Galushin**, Nuclear Physics and Technologies Engineer (Tomsk Polytechnic University, Russia)
- **Alezeia González García**, Industrial Engineering (Comillas)
- **Esther Gutiérrez Alonso**, Industrial Engineering (Comillas)
- **Ignacio de Loyola Hierro Ausin**, Industrial Engineering (Comillas)
- **Cristina Ibáñez Llano**, Mathematics (UAM)
- **Jesús Jiménez Octavio**, Industrial Engineering (Comillas)
- **Álvaro López-Peña Fernández**, Industrial Engineering (Comillas)
- **Juan Marín Bernal**, Industrial Engineering (Comillas)
- **Omar Pinzón Ardila**, Electrical Engineering (Santander Industrial University, Colombia)
- **Pablo Rodilla Rodríguez**, Industrial Engineering (Comillas)
- **Beatriz Ruiz Castelló**, Chemical Engineering (UCM)
- **Pablo Ruiz Castelló**, Industrial Engineering (Comillas)
- **Juan José Sánchez Domínguez**, Industrial Engineering (Comillas)
- **Rafael Santodomingo Berry**, Industrial Engineering (Comillas)
- **Carlos María Sicre Vara del Rey**, Industrial Engineering (Comillas)
- **Lukas Sigríst**, Electrical and Electronics Engineering (École Polytechnique Fédérale de Lausanne (EPFL), Switzerland)
- **Javier Taberero Rodríguez-Belvis**, Industrial Engineering (Comillas)
- **Miguel Vázquez Martínez**, Industrial Engineering (UPM)

## **2.5 Services Staff**

### **2.5.1 Systems Administration**

The person who manages the networks and the computer systems is:

- **Julián Martín Tena**, PC Computer Technician

### **2.5.2 Administrative Staff**

The administrative staffs that manage the documentation, technical secretary and PhD are:

- **Pilar Barrado Moreno**, Bachelor's Degree in Documentation (Universitat Oberta de Catalunya)
- **Cristina Ruiz González-Mateo**, Bachelor in Law (Comillas)
- **Isabel Tamudo González**, Criminology (UCM)

## 3 Teaching

In addition to an intense research activity, IIT plays an important teaching role as a part of Comillas School of Engineering. This teaching activity is focused on the Doctoral Program including doctorate courses (in collaboration with departments of the School of Engineering), doctoral theses based on applied research projects, and Seminars. Additionally, IIT Researchers are active in the undergraduate program of Comillas School of Engineering, including the supervision of graduation projects.

Finally, IIT organizes courses and seminars that are attended by both academics and practitioners.

### 3.1 Doctoral Program

The Doctoral Program in Computer Science and Industrial Engineering includes several courses, focusing on the rigorous study of relevant technical and management problems faced by industry utilities. Analysis and solution methods, based on the latest research, are also presented. These courses are developed in co-operation with departments of the School of Engineering.

IIT academic staff is also involved in the following Master Programs in collaboration with Comillas Postgraduate Institute: Master in Electric Power Industry, Master in Electric Power, Master in Electric Technology ENDESA-ICAI, Master in Railways Systems and Master on Integral Logistics.

More detailed information can be found at correspondent information brochures of Comillas and at the University web page.

### **3.1.1 Courses from Doctoral program in Computer Science and Industrial Engineering**

- *Advanced Data Analysis*  
Lecturers: Carlos Maté Jiménez, Eugenio Francisco Sánchez Úbeda
- *Advanced topics in regulating the electricity sector*  
Lecturer: José Ignacio Pérez Arriaga
- *Analysis of advanced power systems*  
Lecturer: Luis Rouco Rodríguez
- *Environmental and Renewable Energy*  
Lecturer: Pedro Linares Llamas
- *Internacional experiences in the energy sector I*  
Lecturer: Pablo García González
- *Internacional experiences in the energy sector II*  
Lecturer: Pablo García González
- *Microeconomic analysis of the electricity sector*  
Lecturer: Mariano Ventosa Rodríguez
- *Models of decision support in the electricity sector*  
Lecturers: Javier García González, Mariano Ventosa Rodríguez
- *Models of planning and operation of rail traffic*  
Lecturers: Antonio Fernández Cardador, Asunción Paloma Cucala García
- *New fuels: Characterization, applications and avoided emissions*  
Lecturer: Francisco Nieto Fuentes
- *Optimization*  
Lecturer: Andrés Ramos Galán

- *Regulation of the electricity sector*  
Lecturer: José Ignacio Pérez Arriaga
- *Security in computer networks*  
Lecturer: Rafael Palacios Hielscher
- *Seminars on research methods and tools*  
Lecturer: Eugenio Francisco Sánchez Úbeda
- *Simulation*  
Lecturer: Pedro Sánchez Martín
- *Stability of electric power systems*  
Lecturer: Luis Rouco Rodríguez
- *Strategies in energy markets from the perspective of game theory*  
Lecturers: Javier García González, Julián Barquín Gil
- *The business of electricity distribution*  
Lecturer: Tomás Gómez San Román
- *The business of electricity transmission*  
Lecturer: Michel Rivier Abbad
- *Writing technical papers in English*  
Lecturer: Aurelio García Cerrada

### **3.1.2 Courses from University Master's degree in Electric Power**

- *Advanced Data Analysis*  
Lecturers: Carlos Maté Jiménez, Eugenio Francisco Sánchez Úbeda
- *Advanced topics in regulating the electricity sector*  
Lecturer: José Ignacio Pérez Arriaga
- *Decision Support Models in Electric Power Systems*  
Lecturer: Andrés Ramos Galán

- *Environmental and Renewable Energy*  
Lecturer: Pedro Linares Llamas
- *Internacional experiences in the energy sector I*  
Lecturer: Pablo García González
- *Internacional experiences in the energy sector II*  
Lecturer: Pablo García González
- *Microeconomic analysis of the electricity sector*  
Lecturer: Mariano Ventosa Rodríguez
- *Models of decision support in the electricity sector*  
Lecturers: Javier García González, Mariano Ventosa Rodríguez
- *New fuels: Characterization, applications and avoided emissions*  
Lecturer: Francisco Nieto Fuentes
- *Optimization*  
Lecturer: Andrés Ramos Galán
- *Regulation of the electricity sector*  
Lecturer: José Ignacio Pérez Arriaga
- *Seminars on research methods and tools*  
Lecturers: Eugenio Francisco Sánchez Úbeda
- *Simulation*  
Lecturer: Pedro Sánchez Martín
- *Stability of electric power systems*  
Lecturer: Luis Rouco Rodríguez
- *Strategies in energy markets from the perspective of game theory*  
Lecturer: Julián Barquín Gil, Javier García González
- *The business of electricity distribution*  
Lecturer: Tomás Gómez San Román
- *The business of electricity transmission*  
Lecturer: Michel Rivier Abbad

- *Writing technical papers in English*  
Lecturer: Aurelio García Cerrada

### **3.1.3 Courses from University Master's degree in Electric Power Industry (Erasmus Mundus)**

- *Analysis of advanced power systems*  
Lecturer: Luis Rouco Rodríguez
- *Decision Support Models in Electric Power Systems*  
Lecturer: Andrés Ramos Galán
- *Electric Energy Systems*  
Lecturers: Michel Rivier Abbad, Damián Laloux Dallemagne
- *Environmental and Renewable Energy*  
Lecturer: Pedro Linares Llamas
- *Fundamentals on Electrical Engineering and Optimization Techniques*  
Lecturers: Andrés Ramos Galán, Javier García González, Pablo Frías Marín, Michel Rivier Abbad, Francisco Miguel Echavarren Cerezo, Damián Laloux Dallemagne, Javier Reneses Guillén
- *Microeconomic analysis of the electricity sector*  
Lecturer: Mariano Ventosa Rodríguez
- *Models of decision support in the electricity sector*  
Lecturers: Javier García González, Mariano Ventosa Rodríguez
- *Regulation of the electricity sector*  
Lecturer: José Ignacio Pérez Arriaga
- *The business of electric energy transmission*  
Lecturers: Michel Rivier Abbad, Carlos Vázquez Martínez
- *The business of electricity distribution*  
Lecturer: Tomás Gómez San Román

### **3.1.4 Courses from University Master's degree in Electric Technology ENDESA-ICAI**

- *Analysis of advanced power systems*  
Lecturer: Luis Rouco Rodríguez
- *Economy electricity sector: The Spanish case*  
Lecturer: Carlos Batlle López
- *Economy electricity sector: The traditional regulation of the electricity sector.  
The regulation of free market*  
Lecturer: José Ignacio Pérez Arriaga
- *Electric power systems: Auxiliary systems for power generation*  
Lecturer: Luis Rouco Rodríguez
- *Electric power systems: Processors*  
Lecturer: Luis Rouco Rodríguez
- *Electric power systems: Regulation. Voltage regulation. Frequency regulation-  
power*  
Lecturer: Luis Rouco Rodríguez
- *Electric power systems: The synchronous generator*  
Lecturer: Luis Rouco Rodríguez
- *Electricity Sector Economics: Economic Fundamentals*  
Lecturer: Mariano Ventosa Rodríguez
- *Environmental impact electricity industry: Electromagnetic fields due to power  
lines*  
Lecturer: Julián Barquín Gil
- *Fundamentals thermal generation: Cooling Towers: physical processes,  
operation, forced draft and natural draft*  
Lecturer: Luis Mochón Castro
- *Fundamentals thermal generation: Heat exchangers: typology, methods, e-  
NTU, DTLM*  
Lecturer: Luis Mochón Castro

- *High-voltage grids: Architecture and design*  
Lecturer: Tomás Gómez San Román
- *High-voltage grids: HV lines*  
Lecturers: Eduardo Pilo de la Fuente, Francisco Miguel Echavarren Cerezo
- *High-voltage grids: HV substations*  
Lecturers: Eduardo Pilo de la Fuente, Luis Rouco Rodríguez
- *High-voltage grids: Models for the analysis of networks of HV*  
Lecturer: Luis Rouco Rodríguez
- *High-voltage grids: Monitoring and controlling networks of HV*  
Lecturer: Luis Rouco Rodríguez
- *Hydropower generation: Fundamentals of Hydraulic*  
Lecturer: Luis Mochón Castro
- *Introduction to Electrical*  
Lecturers: Mariano Ventosa Rodríguez, Damián Laloux Dallemagne
- *Medium-voltage and low voltage grids: Architecture and design of MV and LV grids*  
Lecturer: Tomás Gómez San Román
- *Medium-voltage and low voltage grids: Isolation*  
Lecturer: Luis Rouco Rodríguez
- *Medium-voltage and low voltage grids: Monitoring and controlling networks of MV and LV*  
Lecturer: Francisco Miguel Echavarren Cerezo
- *Medium-voltage and low voltage grids: MV and LV lines*  
Lecturer: Francisco Miguel Echavarren Cerezo
- *Medium-voltage and low voltage grids: Protection of MC and LV facilities*  
Lecturers: Eduardo Pilo de la Fuente, Luis Rouco Rodríguez
- *Medium-voltage and low voltage grid: Quality of service*  
Lecturers: Tomás Gómez San Román, Pablo García González

- *Reliability: Reliability of the generation system*  
Lecturer: Andrés Ramos Galán
- *Reliability: Reliability Techniques*  
Lecturer: Ángel Sarabia Viejo

### **3.1.5 Courses from Master's degree on Integral Logistics**

- *Optimization*  
Lecturer: Pedro Sánchez Martín
- *Simulation*  
Lecturer: Pedro Sánchez Martín

### **3.1.6 Courses from Master's degree on Railway Systems**

- *Infrastructure*  
Lecturers: Alberto Carnicero López, Eduardo Pilo de la Fuente
- *Introduction to the rail systems*  
Lecturer: Eduardo Pilo de la Fuente
- *Management and operation*  
Lecturers: Andrés Ramos Galán, Antonio Fernández Cardador, Asunción Paloma Cucala García
- *Signs and computer systems*  
Lecturers: Sadot Alexandres Fernández, José Antonio Rodríguez Mondéjar, Antonio Fernández Cardador, Yolanda González Arechavala, Asunción Paloma Cucala García

## 3.2 Seminars

### 3.2.1 Applied Science Seminars

Every course, a number of seminars are organized by IIT members in which results of specific research projects are presented or current science topics are discussed. The following seminars have taken place during this academic year:

- Roberto Limao, *"Monitorización y diagnóstico de equipos eléctricos. Aplicación al caso de un compensador síncrono de una compañía eléctrica de Brasil"*, 19 October 2007.
- Rafael Palacios Hielscher, *"Seminario-Café: Uso eficiente de tu navegador"*, 30 November 2007.
- Trevor Gaunt, *"Power Supply in Southern Africa"*, 13 February 2008.
- Rafael Palacios Hielscher, *"Sincronización de datos"*, 6 March 2008.
- Pedro Linares Llamas, *"El sistema universitario estadounidense: Una visión personal (y parcial)"*, 7 March 2008.
- Iain MacGill, *"Australia's restructured electricity industry and resource adequacy"*, 21 May 2008.
- Luiz Barroso, *"Sweet dreams are made of this: Ethanol and bioelectricity achievements in Brazil"*, 27 May 2008.
- Iain MacGill, *"Market-based environmental regulation in the Australian National Electricity Market"*, 28 May 2008.
- João Abel Peças Lopes, *"Microgeneration and Demand Side Management with Smart Metering"*, 19 June 2008.

### **3.2.2 Doctoral Seminars**

The goal of the doctoral seminars is to provide students with basic information on a range of useful research techniques in Industrial Engineering and Computer science. Students have to be able to evaluate them correctly in order to use them in the appropriate context.

## **3.3 Other activities**

### **3.3.1 Graduation projects**

In collaboration with the School of Engineering, IIT research members have coordinated and supervised several projects of engineering students. These projects typically explore new issues and fields of interest, thus offering to undergraduate students a first contact with research techniques and frequently resulting in attractive collaborations with industrial partners.

### **3.3.2 Grants**

IIT supports a grant program to promote research activities among undergraduates students. These grants are awarded for specific research tasks relating to research projects at the Institute.

## 4 Research

### 4.1 Areas of Interest

The IIT is divided into two main areas of research:

- 1) **Electrical Energy Systems (SEE)**, that is mainly aimed at subjects related to the electricity and energy sector and in particular to the generation, transportation, and distribution of electrical energy. It is subdivided into four areas:
  - *Modelling, analysis and control of the electric power Systems (MAC)*, dedicated to the development of computer tools for electrical studies related to such aspects as load flows, stability, transients, frequency-power control, power plant regulators, voltage control, design of systems of electric feeding, protection, harmonics, and the impact of the distributed generation.
  - *Regulation and Economy of the Electric Sector (RYE)*, centred on research into the organization, remuneration and regulation of the power systems (sector structure, market models, economic signals, tariffs and quality of service, etc.).
  - *Planning and operation of the electric power Systems (PYO)*, focusing on the design of mathematical models created to support decision-making processes in planning and operation of power systems. This applies both to traditional regulation and liberalized markets (offer strategies, risks/contracts administration, technical analysis of the market, etc.).
  - *Managerial and Environmental Administration (GEM)*, focusing on the efficiency improvement of companies and public bodies from an economic and environmental point of view, through the application of a variety of

techniques such as industrial statistics, decision theory, economy and finance, environment, and organization of production processes.

2) **Industrial Systems (SI)**, which is focused on activities in other technical sectors. This area is divided into four different technical areas:

- *Analysis and Design in Engineering (ADI)*, is dedicated to mechanical elements design and to running complex simulations using a computer, specially for general mechanical purposes as well as electromagnetism, wind grounds, etc.
- *Software Engineering Area (AIS)*, aims to develop application computer tools, specifically those for analysis, design, simulation and control. It also serves as a computer science support system for other areas.
- *Electronics and Control Group (GEA)*, works to develop electronic instrumentation and microprocessors, power electronics, control engineering applications, signal analysis, electronic design, automatization and digital communications.
- *Intelligent Systems Area (ASI)*, deals with the monitoring, diagnosis, reliability and maintenance of industrial processes, and modelling and prediction of industrial and economic systems.
- *Railway Systems Area (ASF)*, aims to develop models and other custom-made software tools, safety analysis and quality control, related with different topics of railway systems. These topics include the infrastructure design and management, the power systems planification and operation, as well as the railway traffic planification and operation.

## 4.2 Research Projects

This section presents the list of the research projects that have been developed during this academic year. They are organized according to the area they belong to and to the origin of their funds. The list indicates for each project the entity for which it was developed, its duration, the researchers involved and a brief description.

## 4.2.1 Electrical Energy Systems

### A) *Research and Development*

#### A.1. *Private funding*

- **Application of a booster cap in static excitation system for stability improvement of synchronous generators**  
 Alstom. September 2008-August 2009. (Luis Rouco Rodríguez)  
 Alstom has developed a booster capacitor to add to static excitation system to improve the stability of the synchronous generator in case of faults. We will support Alstom in the modelling and simulation of this system so its value is shown. This project will be undertaken in cooperation with EPFL.
- **Design of load shedding schemes in isolated power systems with high penetration on renewables**  
 Red Eléctrica de España. July 2008-June 2009. (Luis Rouco Rodríguez, Ignacio Egido Cortés, Lukas Sigrist)  
 The aim of this project is the design of load shedding schemes in isolated power systems with high penetration of renewables to maintain the frequency stability in case of generation outages. We will develop a method to obtain the settings of the frequency protections and we will explore the application of protections that combine underfrequency and rate-of-change of frequency measurements.
- **Criteria and procedures for procurement of electricity**  
 OSINERGMIN. July 2008-December 2008. (Carlos Batlle López, Michel Rivier Abbad, Pablo Rodilla Rodríguez)  
 The project is to design auctions to purchase electricity adapted to the reality of the power sector in Peru. The project has conducted a review of similar international experiences, has studied the Peruvian electricity auction experience and has proposed a design of auctions dealing the objective of ensuring the power supply at the lowest price and compatible with the Peruvian legislative reality.
- **Optimal operation of a frequency regulating reserve plant in the Spanish Electricity Market**  
 Global 3. June 2008-July 2008. (Javier Reneses Guillén)  
 The primary aim of this project is the development of a model for the optimisation of the operation of a frequency-regulating-reserve plant in the

Spanish Electricity Market. The optimisation model includes the representation of the day-ahead market, as well as the reserve market and the intradaily markets.

- **Optimal management of wind power generation in the Spanish electricity market**

EGL España S.L. May 2008-November 2008. (Antonio Muñoz San Roque, José Villar Collado, Michel Rivier Abbad, Rocío Herranz Pindado)

The main objectives of this project are (1) the evaluation of short term wind power forecasting models that use recent measurements of wind generation as input variables in order to improve the available meteorological forecasts and (2) the analysis of different bidding strategies for the optimal management of wind energy in the Spanish electricity market.

- **Division of the network costs into an energy charge and a demand charge: methodology and computation**

Comisión Nacional de la Energía. May 2008-July 2008. (Javier Reneses Guillén, Tomás Gómez San Román, Pablo Frías Marín, Carlos Mateo Domingo)

The aim of this project is to divide the electric network costs into two components, in order to design the final transmission and distribution network tariffs. A Network Reference Model will be used to compare the total network cost with the cost corresponding to a network designed only to supply the maximum demand. The detailed representation of transmission and distribution networks will allow computing the percentage of the cost to be recovered through an energy charge and a demand charge.

- **Extensions of a computer tool of distribution network reconfiguration**

Iberdrola Distribución. May 2008-April 2009. (Luis Rouco Rodríguez, Francisco Miguel Echavarren Cerezo, Alezeia González García)

The aim of this project is the addition of new capabilities to the computer tool for distribution network reconfiguration developed by IIT for Iberdrola. The new capabilities are aimed at the increase of reliability and the reduction of losses.

- **Maintenance and new capabilities for Viesgo Tools 2008**

Viesgo. May 2008-November 2008. (Enrique Lobato Miguélez, Eduardo Pilo de la Fuente, Pedro Sánchez Martín, Francisco Alberto Campos Fernández)

The aim of this project consists of incorporating new capabilities identified by Viesgo that might be required due to the market evolution (regulatory and operational changes). The computer tools developed for Viesgo by IIT are

GRIMEL, GRIMEL CORTO PLAZO, PLAMER OFERTAS and PLAMER CASACION. GRIMEL OFERTAS creates the bids that Viesgo submits into the market. GRIMEL CORTO PLAZO plans the electricity production by Viesgo assess in a variable time scope (from one week to a month), and PLAMER OFERTAS and PLAMER CASACION simulates the electricity market with an annual time scope.

- **Development of new algorithms for monitoring the Spanish electricity market**  
Endesa. February 2008-February 2009. (Eugenio Francisco Sánchez Úbeda, Antonio Muñoz San Roque, Juan Marín Bernal)

The primary aim of this project is the consolidation of a methodology for the analysis of the Spanish electricity market operation and the characterization of participants bidding strategies. In particular, a new information system implementing this methodology will be developed.

Taking as input the information published by the Market and System Operators, the proposed methodology will establish the most appropriate mechanisms of advanced analysis for its treatment, with the purpose of analyzing the bidding behaviour of firms and their pricing of the different generation technologies.

- **New advanced analysis and developments in MORSE (simplified model of the electricity Spanish sector) and in SGP (Forecast Management System)**

Endesa. February 2008-February 2009. (José Villar Collado, Francisco Alberto Campos Fernández, Cristian Andrés Díaz Durán)

MORSE is a complete but simplified model of the Spanish electricity industrial sector, which has being developed by the Instituto de Investigación Tecnológica (IIT) in collaboration with Endesa. It is intended for strategic analysis of the evolution of this sector, especially when changes of the utilities structure, new regulations, or new generation technologies take place. Its core is EQUITEC, a market Nash equilibrium model, where the generation has been represented at the technology level, instead of considering generation units individually. This new collaboration focuses on several advanced aspects, such as the analysis of the behavior of the power market calculation algorithm, the distribution bids modeling, or the consideration of probabilistic criterion to improve the modeling of particular technologies such as the eolic generation. Other operative improvements will also be undertaken, such as for example the extension of the algorithm for adjusting inputs to reach predefined sector targets to include iterative execution of EQUITEC if needed.

MORSE has been developed to be compatible with the Forecast Management System of Endesa (SGP), also developed by IIT, for medium and long term planning. Some of the tasks of this collaboration are directly related with SGP,

focusing mainly on the statistic analysis of the past electricity sector forecasts and the final outcomes.

- **ANDREA: An interactive planning tool for HV networks in the long-term**

Iberdrola. January 2008-December 2008. (Tomás Gómez San Román, Álvaro Sánchez Miralles, Esther Gutiérrez Alonso)

The objective of this research project is to develop a planning tool, called ANDREA, for High Voltage electricity networks in a long-term horizon, 10 to 20 years ahead.

- **Electricity regulation for isolated rural areas in Guatemala**

Energía Sin Fronteras. January 2008-July 2009. (Pedro Linares Llamas, Juan José Sánchez Domínguez, Kristin Dietrich, Álvaro López-Peña Fernández)

The objective of this project is to facilitate access to electricity services for the population living in isolated rural areas in Guatemala. To that end, IIT has developed a basic regulation proposal, and has analyzed the economic regime associated to this proposal. The final results have been discussed with the relevant stakeholders in Guatemala.

- **Reviewing the methodology for setting tariffs for access to networks electricity and the development of charges of last resort for gas and electricity**

Comisión Nacional de la Energía. January 2008-July 2008. (Carlos Batlle López, José Ignacio Pérez Arriaga, Tomás Gómez San Román, Julián Barquín Gil, Javier Reneses Guillén, Luis Olmos Camacho, Pablo Rodilla Rodríguez)

The main tasks faced were:

- International analyses of tariff design methodologies
- Assessment of the Review of the access tariffs design methodology of the CNE: allocation of costs of transmission and distribution of electricity, distributors' retail costs, renewables extracosts, capacity payments, etc.
- Methodology for the rate of last resort tariff design methodology , costs of last-resort suppliers, energy price calculation (auctions for the purchase of energy for last resort supply), etc.

- **Additional development of hydroelectric models. Year 2008**

Iberdrola. January 2008-December 2008. (Andrés Ramos Galán, Jesús María Latorre Canteli)

The objective of the collaboration is the improvement of the simulation tool of the Iberdrola's hydroelectric system. This tool is integrated into the current use of the decision support models for the market operation planning. Besides, it is also included the new developments of the stochastic hydrothermal planning tool. The tasks developed are the following ones:

- a) Validation of the simulation model for other hydro basins.
- b) Modeling improvements of the stochastic hydrothermal model.
- c) Maintenance of existing applications.

- **Assistance for strategic studies**

Endesa. January 2008-December 2008. (Efraim Centeno Hernández, Julián Barquín Gil, Juan José Sánchez Domínguez, Álvaro López-Peña Fernández, Miguel Vázquez Martínez)

This project is the continuation of a line of cooperation between IIT and Endesa about Strategic Analysis of Generation Capacity Expansion. The main work is about analysis and improvement of the algorithms and study methods used by Endesa in order to elaborate its yearly expansion plan and other studies associated to it. The result of this work is the tool EXPANDE. One of the main important tasks in this project is the analysis of the impact of wind power in the long-term planning of the system.

- **MIBEL-08 Medium term planning**

Endesa. January 2008-December 2008. (Julián Barquín Gil, Javier Reneses Guillén, Pablo Dueñas Martínez)

This project is included in the framework of a continuous research for the Energy Planning Division of Endesa. It is aimed in the development of models for medium term planning for generation power systems. More specifically the research is focused on six main issues: analysis of the merit order, natural gas contracts, wind generation, trans-boundary transportation, carbon emissions and hyperannual reservoirs management.

- **Helps management MIBEL**

Endesa. January 2008-December 2008. (Julián Barquín Gil, Javier Reneses Guillén, Pablo Dueñas Martínez)

This project addresses the peninsular Spanish electricity market simulation, including its expansion to an Iberian market. The proposal is framed into the on-going cooperation line followed by Endesa and IIT since 1998, under which VALORE, AGM and HEPLASE projects have been made.

Specifically, AGM-08 is the follow-up of project AGM-07. It is focused in Montecarlo analysis, procurement of regulated demand auctions analysis, network constraints analysis and other tasks.

- **Contribution to the book "Energía y regulación en Iberoamérica" backed by the Asociación Iberoamericana de Entidades Reguladoras de Energía (ARIAE)**  
Comisión Nacional de Energía (CNE). December 2007-January 2008. (José Ignacio Pérez Arriaga, Carlos Batlle López, Tomás Gómez San Román, Michel Rivier Abbad)  
The Spanish Regulatory Commission (Comisión Nacional de Energía) has commissioned the academicians José Luis García Delgado y Juan Carlos Jiménez to edit a book titled "Energía y Regulación en Iberoamérica". The structure and content of the book was approved by the Asociación Iberoamericana de Entidades Reguladoras de Energía (ARIAE) within its september 2007 General Meeting. IIT has been entrusted with the writing of the chapter devoted to "Expansion of supply and electric power system infrastructures in Iberoamérica: Generation, Transmission and Distribution".
- **Design of the active components of distribution power transformers of very low power losses and modelling of short circuit conditions**  
COTRADIS. December 2007-December 2009. (Miguel Ángel Sanz Bobi, Alberto Carnicero López, Francisco Nieto Fuentes, Rafael Palacios Hielscher, Luis Rouco Rodríguez, Andrey da Costa Lopes, Jesús Jiménez Octavio)  
The project objectives are the following:
  - Development of a power distribution transformer of low power losses by a new design of its active components. The cost of this new transformer has to be as low as possible depending of the materials used and their processing techniques. The life of this new distribution transformer has to guarantee for at least 30 years.
  - Optimization of the power transformer in short circuit conditions.
- **Modeling impact of intermittent generation in electric system operation**  
REE (Red Eléctrica de España). November 2007-October 2008. (Andrés Ramos Galán, Luis Olmos Camacho, Jesús María Latorre Canteli, José Ignacio Pérez Arriaga)  
Development of a model where analyzing and assessing the impact of high penetration of intermittent generation in electric system operation. The expected results will be the plant operation, general behavior of the system, reliability measures and electricity marginal costs. On the other hand, the model will allow studying potential operating measures and tactics that would be needed to operate the system with a high penetration of intermittent generation. Among these measures we can think of peaking units, pumping storage units, new hydro management strategies, active demand mechanisms, and security criteria. The model is conceived as a workbench for studying all these measures.

- **Development of models for estimating the quality of an intelligent distribution network**

Eliop. September 2007-December 2009. (Álvaro Sánchez Miralles, Carlos Mateo Domingo, Álvaro Arranz Domingo, Manuel Alvar Miró, Tomás Gómez San Román)

This project is a part of the global CENIT DENISE project. One of the aims of the project is to develop a model, CIM compatible, for distribution networks considering traditional electrical equipments and the future ones, which will be designed in the global DENISE project. Finally, two algorithms should be developed, one for faults localization and another for optimal service restoration and fault isolation.

- **Tuning of the power system stabilizers of the combined cycle power plants**

REE (Red Eléctrica de España). September 2007-December 2007. (Luis Rouco Rodríguez, Lukas Sigríst)

This project will address the tuning of the power system stabilizers of the combined cycle power plants to contribute to the damping of the slowest electromechanical oscillation of the European power system. The tuning approach will be based on the sensitivities of the eigenvalues of the linear model of the power system.

- **Improvement of the Social Optimal Outcome of Market Integration of DG/RES in European Electricity Markets**

European Commission. September 2007-February 2010. (Tomás Gómez San Román, Luis Olmos Camacho, Carlos Mateo Domingo)

The IMPROGRES project analyses a number of DG energy scenarios up to 2020/2030 that are transferred into current network practices. With three case studies an assessment is made of how distribution system operators (DSOs) cope with these increased DG shares and what are the expected costs and benefits. These case studies are compared to enhanced network response alternatives. IMPROGRES will assess how technology and tool solutions can be implemented by new policy and regulatory responses, in the end leading to cost-minimisation of energy supply with increased DG share all over the EU.

- **Active management of demand**

REE (Red Eléctrica de España). July 2007-December 2009. (Luis Rouco Rodríguez, Enrique Lobato Miguélez, Francisco Miguel Echavarren Cerezo, Alezeia González García)

The aim of this project is the development of work package 1.3 'Network Analysis' for Red Electrica de España within Cenit-GAD project. The purpose of this work package is the development of methods to incorporate the active

management of demand into the short-term planning and operation of the transmission network.

- **Transmission capacity of underground cables**

Unión Fenosa Distribución. June 2007-May 2008. (Luis Rouco Rodríguez, Francisco Miguel Echavarren Cerezo)

The aim of the project is the extension of the compatibilities of the tool to compute the transmission capacity of underground cables that share the same conduct developed by IIT for Union Fenosa Distribucion. Such extension will include: (1) a general representation of the sheaths, (2) the computation of the maximum short circuit current, (3) the computation of the electrical parameters and (4) other electrical calculations.

- **Simulation models for intelligent electricity distribution networks**

EVERIS. June 2007-September 2009. (Álvaro Sánchez Miralles, Juan Rivier Abbad, Tomás Gómez San Román, Carlos Mateo Domingo, Manuel Alvar Miró, Álvaro Arranz Domingo, José Villar Collado)

In this project, it is proposed to develop models for helping suppliers to do their task. The first treated task is to design specific energy offers to clients, with the aim of inducing a consumption pattern, for optimising the distributor installations. The second task is to asses clients for making them easiest to find the better connection to the electricity network, in such a way that clients are informed of the service quality and energy prices at different locations.

- **New capabilities for Viesgo Tools 2007**

Viesgo. April 2007-May 2008. (Enrique Lobato Miguélez, Eduardo Pilo de la Fuente, Pedro Sánchez Martín, Francisco Alberto Campos Fernández)

The aim of this project consists of incorporating new capabilities identified by Viesgo that might be required due to the market evolution (regulatory and operational changes). The computer tools developed for Viesgo by IIT are GRIMEL, GRIMEL-SEMANAL and PLAMER for the short term and long term electricity market simulation. GRIMEL creates the bids that Viesgo submits into the market. GRIMEL-SEMANAL plans the electricity production by Viesgo assess in the following week. PLAMER simulates the electricity market with an annual time scope.

- **Future scenarios within the Framework DENISE (Intelligent, Secure and Efficient distribution of electricity)**

Endesa Servicios. April 2007-March 2008. (Enrique Lobato Miguélez, Tomás Gómez San Román, Rafael Cossent Arín)

The project CENIT-DENISE is a project financed by CDTI developed by a consortium of firms and research centers whose objective is the research of the future electricity networks that will enable an intelligent, secure and efficient production and distribution of electricity. The consortium is led by Endesa Servicios.

The activity Future Scenarios within DENISE corresponds with subtask 2.1 integrated in task 1 "Reference framework for future networks" coordinated by Endesa Servicios. Among the participants of the consortium several research Centers (AICIA, CIRCE, Institut Futur, and IIT of Comillas University) are participating in the task.

The project will describe future networks (including distributed generation, active response of demand, and networks), in the different components (regulation, technology, economy) by a comprehensive review of different national and international initiatives. As a result long term future scenarios of an integrated intelligent grid will be outlined.

- **Analysis of the operation of the Spanish electricity market**

Indra-Endesa. February 2007-December 2007. (Julián Barquín Gil, Eugenio Francisco Sánchez Úbeda, Antonio Muñoz San Roque)

The primary aim of this project is the definition of a methodology for the analysis of the Spanish electricity market operation and the characterization of participants bidding strategies.

Taking as input the information published by the Market and System Operators, the proposed methodology will establish the most appropriate mechanisms of advanced analysis for its treatment, with the purpose of analyzing the bidding behaviour of firms and their pricing of the different generation technologies.

- **MORSE: Simplified model of the electricity Spanish sector, for strategic medium and long term analysis**

Indra-Endesa. February 2007-February 2008. (José Villar Collado, Francisco Alberto Campos Fernández, Cristian Andrés Díaz Durán)

MORSE is a complete but simplified model of the Spanish electricity industrial sector, which is being developed by the Instituto de Investigación Tecnológica (IIT) in collaboration with the Energetic Planning Subdirection (SPE) of the Spanish electricity utility Endesa. It is intended for strategic analysis of the evolution of this industrial sector, especially when changes of the utilities structure, new regulations, or new generation technologies take place. Its core is EQUITEC, a market Nash equilibrium model, where the generation has been represented at the technology level, instead of considering generation units individually. These tools are integrated in the SPE information system, which

provides advanced tools for sensitivity analysis, multi scenario simulation, and advanced report mechanisms.

- **IDEA Study of the mechanical and environmental impact of using mixtures of bioethanol and fossil fuels (diesel) in a captive transport float in Seville**

Abengoa, Ministerio de Industria. January 2007-December 2009. (Julio Montes Ponce de León, Pablo Ruiz Castelló, Beatriz Ruiz Castelló)

Tussam, Municipal public transport society of Seville has the intention of use different mixtures of bioethanol and diesel in a short number of transport public busses. The engine behaviour and the environmental impact of the new fuel are going to be studied taking as reference the existing experience.

- **New developments of the ANDREA model for High Voltage distribution network planning**

Iberdrola Distribución Eléctrica S.A. January 2007-December 2007. (Tomás Gómez San Román, Álvaro Sánchez Miralles, Gonzalo de la Serna Salto, Esther Gutiérrez Alonso)

The aim of this project is to continue developing new tools for High Voltage distribution network planning in a long-term horizon. The modules that have been developed until now: DEMAND, EVALUATION and INVESTMENT, and the prototype of ANDREA will be implemented in the computer systems of Iberdrola. They will be improved in order to facilitate their use by the Iberdrola planning team.

- **Assistance for strategic studies**

Endesa. January 2007-December 2007. (Efraim Centeno Hernández, Julián Barquín Gil, Juan José Sánchez Domínguez, Álvaro López-Peña Fernández)

This project is the continuation of a previous cooperation between IIT and Endesa about Strategic Analysis of Generation Capacity Expansion. The main work is about analysis and improvement of the algorithms and study methods used by Endesa in order to elaborate its yearly expansion plan and other studies associated to it. The result of this work is the tool EXPANDE. New aspects of Spanish regulation of electric markets will be considered to be included in this model.

- **Advances in the development of hydroelectric simulators. Year 2007**

Iberdrola. January 2007-December 2007. (Andrés Ramos Galán, Jesús María Latorre Canteli)

The objective of the collaboration is the improvement of the simulation tool of the Iberdrola's hydroelectric system. This tool is integrated into the current use

of the decision support models for the market operation planning. Besides, it is also included the development of a stochastic hydrothermal planning tool.

The tasks developed are the following ones:

- a) Validation of the simulation model for other hydro basins.
- b) Modeling improvements and maintenance of the model.
- c) New optimal operation tables for hydro and pumping storage units.
- d) Desegregation by basins of the results of the MPO model.
- e) Maintenance of existing applications.

- **Management MIBEL**

Endesa. January 2007-December 2007. (Julián Barquín Gil, Javier Reneses Guillén, Natalia Mosquera Osorio, Pablo Dueñas Martínez)

This project addresses the peninsular Spanish electricity market simulation, including its expansion to an Iberian market. The proposal is framed into the on-going cooperation line followed by Endesa and IIT since 1998, under which VALORE, AGM and HEPLASE projects have been made.

Specifically, AGM-07 is the follow-up of project AGM-2006, which was jointly made with the Forecasting and Analysis Division during the year 2006, as well as of other previous projects. It is focused in the medium-term planning of the Spanish electricity market.

- **Economic and regulatory analysis for an active demand management**

Consortio GAD. January 2007-December 2010. (Pedro Linares Llamas, Juan Rivier Abbad, Carlos Batlle López, Adela Conchado Rodríguez, Pablo Rodilla Rodríguez, Miguel Vázquez Martínez, Renato Dias Bleasby Rodrigues)

The objective of this research project is to perform the economic and regulatory analyses included in the CENIT project for Active Demand Management. This includes an analysis of the economic costs and savings associated to those active demand management actions which may contribute to optimize the net social benefit, i.e., both from the customer and from the system point of view; and an analysis and design of the different regulatory alternatives required to achieve the maximum efficiency levels. To that end, an exhaustive analysis of the international experience in this area is carried out, and an integral model to allow and incentive an active demand management is designed, as well as its implementation strategy.

- **Price estimation in the Italian electricity market - Valore Italia 2007**

Endesa Italia. January 2007-December 2007. (Javier Reneses Guillén, Eugenio Francisco Sánchez Úbeda, Natalia Mosquera Osorio)

This project continues the collaboration between the IIT and Endesa Italia during the last years, which has achieved adapting the medium-term model

Valore to the representation of the Italian Electricity Market. The main objective of this project is to combine the existing market model with statistic techniques, such as regression analysis, or time series. A tool will be programmed and installed in order to help the users in carrying out price estimations periodically.

- **MIBEL Medium term planning**

Endesa. January 2007-December 2007. (Julián Barquín Gil, Carlos Batlle López, Félix Fernández Menéndez, Miguel Vázquez Martínez)

This project is included in the framework of a continuous research for the Energy Planning Division of Endesa. It is aimed in the development of models for medium term planning for generation power systems. More specifically the research is focused on six main issues: inclusion of new regulatory aspects, improvement of algorithms used to solve the equilibrium models, connection between relaxed and integer solutions, hydro management, medium term equilibrium models including network constraints, and modelling stochastic variables through multivariate scenario trees.

- **Maintenance and development of new capabilities of ARO, ARO-OPF, ESAF and ESLA in 2007**

Indra. January 2007-December 2007. (Luis Rouco Rodríguez, Enrique Lobato Miguélez, Francisco Miguel Echavarren Cerezo)

The aim of this project is the maintenance and the development of new capabilities of several tools jointly developed by IIT and Indra for Red Eléctrica de España in 2007. The tools are: a system for analysis and solutions of power system constraints (ARO), an optimal power flow for voltage-reactive power control (ARO-OPF), a system to build short term scenarios (ESAF) and a system to build long term scenarios (ESLA).

- **Economic and distributive effects in Spain of alternative allocations of carbon-dioxide emission tradeable permits**

Fundación BBVA. October 2005-September 2007. (Pedro Linares Llamas, José Ignacio Pérez Arriaga, Francisco Javier Santos Pérez)

We propose in this project the construction of a model capable of providing in a rigorous and comprehensive manner the economic and distributive effects derived from the application of the European carbon-dioxide emissions trading market to the Spanish economy. We will combine three different approximations: i) an integrated model of applied general equilibrium (macro) and residential energy demand (micro) specifically designed for the study of environmental policies in Spain; ii) an oligopolistic supply model of the Spanish electricity system, specially suited for studying in detail the effects of

environmental regulations in this sector; and iii) a theoretical model of the emissions trading market in which large and small emitters interact and in which there is a possibility to save permits, with which the resulting international prices are simulated.

The major objective of the project is to reproduce in a credible and realistic way the effects of different intensities in the global and sectoral control of GHG emissions, that is, of different national allocation plans. Therefore the approach proposed is highly recommended, since it allows for the interactions between supply and demand, between the different producing sectors and consumers, between energy products, and also studies the effects of the international permit market on Spanish participants.

## A.2. *Public funding*

- **SUSPLAN: Development of regional and Pan-European guidelines for more efficient integration of renewable energy into future infrastructure**

European Commission. September 2008-August 2011. (Tomás Gómez San Román, Pablo Frías Marín, Luis Olmos Camacho)

The SUSPLAN project is a collaborative Project of the seventh framework programme, included in theme 5: Energy. SUSPLAN will develop, during a period of 3 years, a comprehensive set of robust guidelines for more efficient integration of renewable energy into future infrastructures. These guidelines will address political, infrastructure and network decision makers and power distributors regionally and across Europe.

The guidelines, established on the basis of extensive regional and trans-national scenario studies, consist of strategies, recommendations, criteria and benchmarks for more efficient integration of renewable energy sources (RES) into future infrastructures. The time perspective of the study is 2030-2050, with special emphasis on Pan-European harmonisation.

- **Active distribution networks with full integration of demand and distributed energy resources**

European Commission. June 2008-May 2012. (Pedro Linares Llamas, Pablo García González, José Antonio Rodríguez Mondéjar, Carlos Batlle López, Renato Dias Bleasby Rodrigues)

ADDRESS will research, develop and deploy technologies and processes to increase usage of distributed Generation and Renewable Energy Resources thereby engaging in a new relationship between customers, generators and network operators. ADDRESS aims to develop new innovative architectures for

Active Distribution Networks (ADN) able to balance in real time power generation and demand allowing network operators, consumers, retailers and stakeholders to benefit from the increased flexibility of the entire system. Innovative use of communications, automation and household technologies will be combined with new trading mechanisms and algorithms providing ADN with low cost and reliable solutions. Customers will be encouraged into active participation enabling them to change their consumption habits, adopting a smarter use of energy and saving money. A cost/benefit analysis of different solutions will be developed: the most promising will be tested in three sites with different geographic, demographic and generation characteristics.

- **Feasibility study of energy crop bioethanol production using new crops for utilization as transport fuel. Environmental and socioeconomic studies of the life cycle of all the biofuels**

Ministry of Education and Science. June 2007-June 2009. (Julio Montes Ponce de León, Pablo Ruiz Castelló, Miguel Ángel Sanz Bobi, Luis Manuel Mochón Castro, Yolanda González Arechavala, Beatriz Ruiz Castelló)

This project financed by the Spanish Administration, consists in two sub-projects.

- A) Feasibility study of energy crop bioethanol production using new crops for utilization as transport fuel. Environmental and socioeconomic studies of the life cycle of all the biofuels.

The main goal of the first subproject is to prove the feasibility of producing bioethanol from a new crop. New agroenergetical crops are going to be tested in order to reduce the cost of the ethanol production as well as the energy balance and environmental impact. The control of the fermentation process is going to be improved in order to increase the efficiency of the production. The bioethanol is going to be mixed with diesel oil in order to test to its combustion characteristics in a captive bus fleet. A new catalyst has been developed in order to use bioethanol as fuel in future fuel cells.

In the second project, the life cycle analysis of all the biofuels obtained in Spain will allow to compare their environmental and socioeconomics impacts as well as the energy balance and cost production.

- B) Environmental and socioeconomical analysis of the biomass production and use in Spain, with two main parts:
- Analysis of Life Cycle of the production and use of different biomass crops for electrical production
  - Analysis of the Life Cycle of the production and use of biomass crops for biofuels.

- **Renewable electricity supply interactions with conventional power generation, networks and demand**

European Commission. January 2007-July 2009. (Tomás Gómez San Román, Enrique Lobato Miguélez, Luis Olmos Camacho, Pablo Frías Marín, Rafael Cossent Arín)

The growing amount of RES-E and DG supply affects the electricity system, and could only be economically efficiently integrated if it provokes economically efficient, market-based responses by different stakeholders. The RESPOND project aims at identifying efficient market response options that actively contribute to an efficient integration of (intermittent) RES-E and DG in the European electricity system and it recommends policy and regulation framework improvements that effectively support these market response options. The RESPOND project puts emphasis on the market side of the electricity system. Efficient response options that (may) arise from the market form the basis on which policy on RES-E and DG should be based. It specifically considers the interactions between different segments of the electricity system: generation, demand, trade, and the networks. The electricity system is a “complex network” in which the constituent segments dynamically interact with each other.

- **Coordinating energy security of supply actions**

European Commission. January 2007-December 2008. (José Ignacio Pérez Arriaga, Julián Barquín Gil)

CESSA consists in creating and managing a European energy policy forum. It aims at contributing to an economically feasible, socially acceptable and environmentally friendly energy policy in the EU. CESSA involves high-level decision-makers from industry and business area as well as from public authorities and European and international organizations. Committed Stakeholders of CESSA (48 in total) include inter alia 10 national regulatory authorities and 2 international energy organizations; 5 transmission system operators or associations of energy infrastructure; associations of energy consumers; 14 large European energy companies and 6 associations of energy companies. CESSA groups more than 20 experts or first-ranked scholars who are also experienced with policy assessment and expertise in more than 15 countries. To nurture the forum, the leading CESSA research institutions will address the following issues: (i) Nuclear Contribution to EU Energy, Environment and Security Needs (ii) Economic Mechanisms and Policy Guidance for Sustaining a Robust Development of European Gas Supply (iii) Barriers and Prospects towards a European Hydrogen Economy (iv) Coordinating Security of Supply in the EU. For all those issues, CESSA will review the existing national and international studies, will point out the costs of

the lack of a coordinated energy policy in Europe, will identify where there is room to develop such cooperative actions, and will draw guidelines for implementing them. In doing so, CESSA will deliver a contribution to the "Strategic EU Energy Review" announced in the March 2006 Green Paper "Energy Strategy for Europe".

- **Design and assessment of climate change policies in Spain; Kyoto and afterwards**

Ministry of Education and Science. October 2006-September 2009. (Pedro Linares Llamas)

This research project is devoted to quantify the environmental, economic and distributional effects from the application of public policies to control greenhouse gas emissions. In order to do so, we carry out an extension of the integrated macro-micro model developed by the participants to take account of two key sectors for this type of policies: electricity and transportation. We also propose to incorporate all regulated pollutants and the future international market for emission permits, given its relevance with the application of the Kyoto Protocol. A fundamental issue in the proposal is the analysis of hybrid pricing (taxes) and quantity (emissions markets) climate change policies, explicitly accounting for welfare gains and distributional changes from this approximation when compared to a market approach only circumscribed to some sectors or activities.

- **SOLID-DER: Coordinated action to consolidate RTD activities for large scale integration of DER into the European electricity market**

European Commission. November 2005-March 2008. (Tomás Gómez San Román, Juan Rivier Abbad, Pedro Linares Llamas, Pablo Frías Marín, Rafael Cossent Arín)

The project SOLID-DER, a Coordination Action, will assess the barriers for further integration of DER, overcome both the lack of awareness of benefits of DER solutions and fragmentation in EU R&D results by consolidating all European DER research activities and report on its common findings. In particular awareness of DER solutions and benefits will be raised in the new Member States, thereby addressing their specific issues and barriers and incorporate them in the existing EU DER integration R&D community.

The key objectives of the SOLID-DER project are:

- Identify, evaluate and assess the critical developments, innovations and findings in EU R&D on large-scale integration of DER.
- Provide and assess costs/benefits and the application of DER supply solutions in different Member States and recommend on applicable concepts

of business models for DER and pro-active networks securing viable business and operation of networks in the future.

- Raising the awareness of benefits of DER in general and organising dissemination and transfer of knowledge from EU-15 R&D community and stakeholders towards the stakeholders in the New Member States (NMS).

- **Computation of the wear of the overhead system of high speed railways**

Ministry of Education and Science. December 2004-December 2007. (Luis Rouco Rodríguez, Alberto Carnicero López, Óscar López García, Eduardo Pilo de la Fuente)

The high speed European railroad raise involves a technical challenge in the development of the railway systems which must fulfil more demanding requirements. The overhead system wear is governed by two main contributions: friction, which is determined by the contact forces, and the electric arcs that appear in the contact losses. Considering the importance of overhead system wear in the maintenance planning, and the increase of the number of high speed trains lines in Spain in the following years, the development of numerical tools to take into account maintenance criteria in the catenary design is extremely useful. The goal of the project is to develop the aforementioned tool which is an innovation in the current catenary pattern design.

## ***B) Consultancy and Technological Support***

### ***B.1. Private funding***

- **Reactive power compensation in Clacham Flats wind farm**

Iberdrola Renovables. September 2008-December 2008. (Luis Rouco Rodríguez, Lukas Sigrist)

The aim of this study is to determine if the Gamesa G52 wind generators to be installed in the wind farm La Venta III (Mexico) will remain connected to the grid in case of the solid fault in the common coupling point.

- **Active and Reactive power control in wind generation**

Acciona Energía. September 2008-October 2009. (Fidel Fernández Bernal, Francisco Miguel Echavarren Cerezo, Ignacio Egido Cortés, Enrique Lobato Miguélez)

The goal is the design, implementation and control of pilot actions to control the active and reactive power generated by a wind generating park in

accordance with the criteria of the System Operator to any conventional generating plant.

Additionally, the IIT will supply Acciona Energia with technical support in all technical aspects in relation with the integration of the eolic wind energy into the grid power system.

- **Elevator assembly time study at buildings under construction**

ATISAE. July 2008-September 2008. (Pedro Sánchez Martín)

This project studies standard times for different elevator assembly operations at buildings under construction. These assembly activities are divided into mechanic and electric assembly phases. These activities initiate at materials reception and finish at elevator's commissioning. Mechanic phase requires timing two operators and electric phase requires timing only one operator. To evaluate task efficiency the most critical operations are evaluated timing different operators.

- **Analysis of several methods for the computation of inter-TSO payments associated with the external use of the grid of each country**

REE (Red Eléctrica de España). July 2008-December 2008. (Luis Olmos Camacho, Kristin Dietrich)

This project is aimed at defining a method to compute compensations among countries belonging to the Internal Electricity Market of the EU for the use that external agents make of the grid of each system. We shall analyze both qualitatively and quantitatively, those inter-TSO payment methods that are deemed to be more interesting. Based on this analysis, we shall recommend the implementation of a specific method. This project is the 3rd phase of a longer one that started in June 2007.

- **Panama transmission expansion under uncertainty**

Banco Interamericano de Desarrollo. June 2008-September 2008. (Julián Barquín Gil)

This one is a joint project with the Inter-American Development Bank. The main outcome is a proposal regarding which one of the presently processes and methodologies available in the market is more adequate in order to support the transmission planning made by the Panama's regulatory authorities.

- **Electrical parameters of the 220kV evacuation electric of the combined cycle power plant Lantarón (Gas Natural)**

Elecnor. June 2008-June 2008. (Eduardo Pilo de la Fuente, Francisco Miguel Echavarren Cerezo)

In order to perform protection adjustments of the substation Puentelarrá (Álava), it is necessary to calculate for both the aerial and the buried line the values of the impedances: resistance, reactance and capacity (direct and homopolar).

- **Electrical parameters of the 400kV evacuation electric of the combined cycle power plant Compostilla (Endesa)**

Elecnor. June 2008-June 2008. (Eduardo Pilo de la Fuente, Francisco Miguel Echavarren Cerezo)

In order to perform protection adjustments of the substation Compostilla (León), it is necessary to calculate for the aerial line the values of the impedances: resistance, reactance and capacity (direct and homopolar).

- **Assessment of the Maglev train of AMT**

Semi. June 2008-September 2008. (Luis Rouco Rodríguez, Eduardo Pilo de la Fuente)

This project is aimed at cooperating with SEMI in the technical assessment of the Maglev train developed by American Maglev Technology, Inc (AMT). AMT has developed a magnetically levitating train base on electromagnetic suspension and linear induction motors.

- **Mid-term evaluation of the SIEPAC Project**

Banco Interamericano de Desarrollo. June 2008-July 2008. (José Ignacio Pérez Arriaga)

The purpose of the project is to prepare a high-level evaluation report, which is named mid-term evaluation, for the Interamerican Development Bank (IDB). It is established that this evaluation has to be performed once the first half of the money that is borrowed from the IDB to build the SIEPAC electricity transmission line has been delivered. The report evaluates, under a comprehensive perspective, the results have been obtained so far in the creation of the Regional Electricity Market (MER): its institutions, the performance of the several agencies that have participated, the lessons learned and the instruments that have been proposed to ensure that the goals of the electricity regional integration project will be achieved.

- **Analysis of the Chilean Network 2008 for the CNE, using the IIT Network Reference Model**

SYNEX Ingenieros Consultores Ltda. June 2008-October 2008. (Carlos Mateo Domingo, Pablo Frías Marín, Álvaro Sánchez Miralles, Tomás Gómez San Román)

The goal of this project is to assist Synex in the use of the Network Reference Model, named PECO, for the determination of the Aggregated Distribution Value of Chile. The results will be submitted to the Chilean Regulator (CNE) in order to perform the 2008 Tariff Revision.

The Chilectra's network will be modelled and several reliability scenarios will be performed. Both the street map and the orography of the area will be taken into account in full detail. The street map will be built automatically by the model.

- **Reactive power compensation in Clacham Flats wind farm**

Iberdrola Renovables. June 2008-July 2008. (Luis Rouco Rodríguez)

The aim of the study is to confirm the reactive power compensation scheme proposed by Iberdrola Renovables in the Clacham Flats wind farm (Scotland) from the detailed steady state simulation of the wind farm. The aim of the compensation scheme is to fulfil the requirements of the UK Grid Code.

- **Study of the impact on the power network of Ecoener wind farms**

Ecoener. May 2008-June 2008. (Luis Rouco Rodríguez, Francisco Miguel Echavarren Cerezo)

The project studies the impact on the power network of the wind farms proposed by Ecoener. They will incorporate 20 MW of wind power generation to the 132 kV busbar of Frieira substation. The study also evaluates the dynamic and reactive power compensation capabilities of ENERCON E82 wind power generators.

- **Study on the impact of Os Catroventos do Noroeste wind farms on the power network**

Ecoener. May 2008-June 2008. (Luis Rouco Rodríguez, Francisco Miguel Echavarren Cerezo)

The project studies the impact on the power network of the wind farms proposed by Ecoener. They will incorporate 102 MW of wind power generation to the 220 kV busbar of Tibo substation. The study also evaluates the dynamic and reactive power compensation capabilities of REPOWER MM92 wind power generators.

- **The hydro generation in the secondary reserve and load following service**

Iberdrola. April 2008-May 2008. (Tomás Gómez San Román, Ignacio Egidio Cortés, Enrique Lobato Miguélez, Luis Olmos Camacho, Pablo Frías Marín)

The aim of this study is to write a report for Iberdrola about the role of the hydro generation in the secondary reserve and load following service in Spain. This report is focussed on the analysis of the technical and economic

conditions that should be met to ensure that this service is provided in competitive conditions by the market participants. In addition, it is analyzed if under the current conditions in the Spanish market, the hydro generation is able to exercise market power in this market.

The report has the following chapters:

1. Overview of the secondary reserve and load following market in Spain: technical conditions and market structure and organization
  2. Technical characteristics to provide secondary reserve and load following: hydro, combined cycle, coal and fuel thermal, gas turbine and demand side management
  3. Experience in Europe: organization of the service and involved generation technologies
  4. History of the secondary reserve market in Spain: generation technologies, market participants, bids and prices.
  5. Conclusions
- **Report of the consequences of the Sectorial Plan of maintenance flows in the hydroelectric plants of internal river basins of Catalonia**  
Endesa Generación. April 2008-April 2008. (Javier García González)  
The objective of this project is to ratify in the Supreme Court of Justice of Catalonia, the technical report about the main implications that would be derived from the application of the "Pla sectorial de cabals de manteniment de les conques internes de Catalunya", approved by agreement of the Govern of the Generalitat de Catalunya of 4 of 2006 July.
  - **Electrical parameters of the 220kV evacuation electric of the combined cycle power plant Málaga (Gas Natural)**  
Elecnor. April 2008-April 2008. (Eduardo Pilo de la Fuente, Francisco Miguel Echavarren Cerezo)  
In order to perform protection adjustments of the substation Los Ramos (Malaga), it is necessary to calculate for both the aerial and the buried line the values of the impedances: resistance, reactance and capacity (direct and homopolar).
  - **Analysis of Chilectra's network using the IIT Network Reference Model**  
Systep Ingeniería y Diseños Ltd. April 2008-November 2008. (Carlos Mateo Domingo, Tomás Gómez San Román, Álvaro Sánchez Miralles, Pablo Frías Marín)  
The goal of this project is to assist SYSTEP in the determination of the Aggregated Distribution Value of Chilectra (a Chilean distribution utility that supplies Santiago). The Network Reference Model, named PECO, will be used.

The results will be submitted to the Chilean Regulator (CNE) in order to perform the 2008 Tariff Revision.

The Chilectra's network will be modelled and several reliability scenarios will be performed. Both the street map and the orography of the area will be taken into account in full detail. The street map will be built automatically by the model.

- **Implementation of voltage control strategies for generation power plants**

INVEYSDE. February 2008-February 2009. (Pablo Frías Marín, Tomás Gómez San Román)

The objectives of this project are the design and implementation of strategies for the voltage control in generation power plants. The project analyzes both power plants connected to the transmission network and those under the Spanish special regime scheme.

- **Preparation of a proposal on load modeling for Dubai Electricity and Water Authority**

Endesa Ingeniería. February 2008-February 2008. (Luis Rouco Rodríguez)

The aim of this work has been the preparation of a proposal for Endesa Ingeniería for load modeling in the Dubai Electricity and Water Authority.

- **Technical assistance in the factory and site tests of AGC system for the energy management system of Global3**

Eliop. February 2008-March 2008. (Luis Rouco Rodríguez, Fidel Fernández Bernal, Ignacio Egidio Cortés)

This work will provide technical assistance during the factory and site tests of the AGC system developed by IIT for the energy management system of Global 3 supplied by Eliop. Factory tests will be performed in the Eliop headquarters. Site tests will be performed in the Global 3 power plant.

- **Control system of the hydro eolic power plant of El Hierro**

Unelco Generación. January 2008-September 2008. (Luis Rouco Rodríguez, Ignacio Egidio Cortés)

The aim of this project is the specification of the control system of the hydroeolic power plant of the El Hierro Island. Precisely, it will comprise: (1) the structure of the SCADA and control and protection systems will be defined, (2) the operation modes, (3) the control system of the pumps (fixed and variable speed) will be established, (4) the protection system and (5) the operation assistance functions.

- **Analysis of several methods for the computation of inter-TSO payments associated with the external use of the grid of each country**

REE (Red Eléctrica de España). January 2008-June 2008. (Luis Olmos Camacho, Kristin Dietrich)

This project is aimed at defining a method to compute compensations among countries belonging to the Internal Electricity Market of the EU for the use that external agents make of the grid of each system. We shall analyze both qualitatively and quantitatively, those inter-TSO payment methods that are deemed to be more interesting. Based on this analysis, we shall recommend the implementation of a specific method. This project is the 2nd phase of a longer one that started in June 2007.

- **Consultancy for the design of the Centroamerican Regional Market clearing algorithms**

Indra. January 2008-June 2008. (Julián Barquín Gil, Carlos Batlle López)

The aim of this consultancy project is to provide support to Indra in order to specify the dispatch and transportation rights allocation algorithms.

- **Consultancy on modal analysis, model reduction and damping inter-area oscillations**

RTE (Gestionaire du Réseau du Transport d'Electricité). December 2007-November 2010. (Luis Rouco Rodríguez)

This project consists of providing RTE consultancy services in the fields of modal analysis, model reduction and damping inter-area oscillations. RTE requires these services in the framework of a number of studies perform for the UCTE.

- **Grid access of new wind power generation in 2007-2016**

Iberdrola Renovables. November 2007-November 2008. (Luis Rouco Rodríguez)

The aim of this project is the study of grid access of new wind power generation in the period 2007-2016.

- **Support and maintenance in the use of the Network Reference Models of the National Electricity System**

Comisión Nacional de la Energía (CNE). November 2007-October 2008. (Tomás Gómez San Román, Álvaro Sánchez Miralles, Carlos Mateo Domingo, Pablo Frías Marín)

The aim of this project is to provide support and maintenance in the use of the Network Reference Models of the National Electricity System under two different versions: i) the basic model, and ii) the incremental model. These two

models are used by the CNE as an input to determine the allowed revenues of the electricity distribution companies.

- **Motion and time study at traffic signal pressing line**

ATISAE. September 2007-October 2007. (Pedro Sánchez Martín)

This project consists of a Motion and Time Study at pressing line operations. This pressing line provides the metal base of traffic signals. This project has been developed for API FABRICACIÓN S.A. at Aranjuez.

This project distinguishes among different sizes and shapes of traffic signals. Next, results obtained from the analysis of the pressing line:

1. Process diagrams at pressing, cutting and drilling operations.
2. Timekeeping repetitive operations.
3. Analyzing main factors on operations.
4. Quantification of factor's influences.
5. Providing operation standard times.
6. Comparison between obtained results and historic values.

- **Analysis of electrical faults in the EDESUR subtransmission network in Buenos Aires city**

Universidad Nacional de la Plata (Argentina). July 2007-September 2007. (Tomás Gómez San Román, Luis Rouco Rodríguez, Javier Tabernero Rodríguez-Belvís)

The aim of this project is to analyze past events in the subtransmission 132 kV underground network and substations of the system Central Puerto, Azopardo, Pozos, Once and Independencia in Buenos Aires city, that were the origin of long duration supply interruptions. The objective is to carry out a diagnosis of the fault origins and to propose some corrective actions to mitigate their effects in the future.

A comparative analysis on international experience will be performed about recommendations and planning and operational security criteria used in large cities. The case studies of Spain, United Kingdom, France and Italy will be analyzed.

- **Short circuit study of the Cementos Especiales plant in Gran Canaria**

Cobra. July 2007-September 2007. (Luis Rouco Rodríguez, Pablo García González)

The aim of this study is the calculation of the short circuit currents through the circuit breakers of the Cementos Especiales plant in Gran Canaria. The computation will be done according to the standard UNE 21-239-94.

- **Writing of the Unión Fenosa's manual on quality of the electrical service**  
Unión Fenosa. July 2007-October 2007. (Pablo García González, Juan Rivier Abbad)  
The objective of this collaboration is to write a manual on Quality of Service. IIT and Unión Fenosa have performed together several studies and analysis on different aspects of quality of service since quite a few years. As a result of these collaborations, several reports have been produced that cover the theoretical experience cumulated by Unión Fenosa on quality of service. On the other hand, Unión Fenosa has a long practical experience on quality of service matters. Unión Fenosa has asked IIT to use all this work to produce a document summary of all these experiences and knowledge that might be used by Unión Fenosa for internal courses.
- **Power system studies of the IPP Mesaieed**  
Iberinco. July 2007-January 2008. (Luis Rouco Rodríguez, Enrique Lobato Miguélez, Lukas Sigríst)  
This project comprises the power system studies of the Independent Power Producer Mesaieed (Qatar). Several studies will be performed: load flow studies, contingency analysis, fault calculations, voltage stability analysis, transient stability analysis and electromagnetic transient simulations.
- **Analysis of several methods for the computation of inter-TSO payments associated with the external use of the grid of each country**  
REE (Red Eléctrica de España). June 2007-December 2007. (Luis Olmos Camacho, Kristin Dietrich)  
This project is aimed at defining a method to compute compensations among countries belonging to the Internal Electricity Market of the EU for the use that external agents make of the grid of each system. We shall analyze both qualitatively and quantitatively, those inter-TSO payment methods that are deemed to be more interesting. Based on this analysis, we shall recommend the implementation of a specific method.
- **Study on the disturbance occurred in Argüelles substation of July 16, 2006**  
Iberdrola Distribución Eléctrica. April 2007-June 2008. (Luis Rouco Rodríguez)  
This project has studied the disturbance occurred on Argüelles substation in July 16, 2006.
- **Power system studies of the IPP Mesaieed**  
Iberdrola Ingeniería y Consultoría. April 2007-December 2007. (Luis Rouco Rodríguez)

This project comprises the insulation coordination studies of the GISs of the Independent Power Producer Mesaieed (Qatar). It will be determined if the proposed surge arresters provide enough protection capability of the GISs.

- **Wind energy trading in the new context of the electricity market in Spain**  
Iberdrola, S.A. March 2007-February 2008. (Tomás Gómez San Román, Juan Rivier Abbad, Javier García González, Miguel Vázquez Martínez)  
The aim of this project is to analyze the trading strategies of wind energy generation in the new context of the electricity market in Spain, by considering the energy auctions where distribution companies buy part of their energy consumption.
- **Consultancy to update the market study carried out for the Copalar project**  
Hydrocopalar MidAmericas Ltd. January 2007-December 2007. (Tomás Gómez San Román, Javier Reneses Guillén)  
In this study, the contents of previous market and regulatory studies elaborated in 2006 for the projected Copalar hydro plant in Nicaragua will be updated.
- **Settings of the protection systems of Tenerife subway**  
Ardanuy Ingeniería. July 2006-November 2007. (Luis Rouco Rodríguez)  
This project has determined the settings of the protection systems of Tenerife subway. The settings of the protections of the AC system (transformers 66/20kV and 20 kV lines) have been provided. In addition, the settings of the protections of the DC system (catenary and rectifiers) have been also determined.

### 4.2.2 Analysis and Design in Engineering

#### *A) Research and Development*

##### *A.1. Private funding*

- **Design of the active components of distribution power transformers of very low power losses and modelling of short circuit conditions**  
COTRADIS. December 2007-December 2009. (Miguel Ángel Sanz Bobi, Alberto Carnicero López, Francisco Nieto Fuentes, Rafael Palacios Hielscher, Luis Rouco Rodríguez, Andrey da Costa Lopes, Jesús Jiménez Octavio)  
The project objectives are the following:

- Development of a power distribution transformer of low power losses by a new design of its active components. The cost of this new transformer has to be as low as possible depending of the materials used and their processing techniques. The life of this new distribution transformer has to guarantee for at least 30 years.
- Optimization of the power transformer in short circuit conditions.
  
- **Municipal waste digester trommel. Design verification**  
Ecoparc. November 2007-January 2008. (Francisco Nieto Fuentes, Alberto Carnicero López)  
Municipal waste digester trommel. Design verification. Endurance verification. Stress and strain analysis of the drum structure. Fatigue stress analysis. Rolling calculations. Contact stress. Wear.
  
- **Windowlift motoreducer**  
Grupo Antolín. April 2007-October 2007. (Francisco Nieto Fuentes)  
Present windowlifts are composed of a conventional DC motor and a screw-gear reducer. This assembly is bulky and it has poor power efficiency. Both motor and reducer can be improved. This project looks for a new reducer design more efficient and flat. Screw-gear reducers are very quiet. New one should not loose this.
  
- **Study of the C-350 catenary performance according the new Technical Specifications for Interoperability (TSIs)**  
Cosemel Ingeniería. April 2007-February 2008. (Alberto Carnicero López, Jesús Jiménez Octavio)  
The new criteria gathered in the new Technical Specifications for Interoperability (TSIs), establish new requirements for the homologation of catenary wires according to this norm. The project intends to verify the fulfilment of the new requirements of the C-350 catenary and in case necessary to propose it improvements necessary to fulfil the established requirements.

## A.2. *Public funding*

- **Modelling and quantifying maintenance strategies and human actions**  
Consejo de Seguridad Nuclear. November 2005-November 2008. (Francisco Nieto Fuentes, Cristina Ibáñez Llano, María José López Pérez-Valiente)  
The present project is the prolongation of a previous project dedicated the assimilation of the methodology of probabilistic safety assessment (PSA). It intends initiate a long term collaboration between both parts in the fields of

Probabilistic Safety Analysis and Dynamic System Simulation. The new objectives are the examination and study of new methodologies for the quantification of the probability of failure due to maintenance strategies, and the extension to the study of the probability of failure due to human actions. The impact of those actions into organizational issues will be considered. The application of this work will be the Probabilistic Incident Analysis (Precursor Analysis). This will consolidate the work done in the previous project "Development of a methodology for Probabilistic Analysis and Dynamic simulation" sponsored from the CSN at 2004. The tasks for this project are:

- Consolidation and implementation of the tools developed in the previous project.
- Integration of those tools into the set of computational tools and codes used and developed at the CSN.
- Development of applications for those new methodologies, and assessment of their convenience into those applications.
- Investigation and generalization of quantification techniques.

- **Computation of the wear of the overhead system of high speed railways**

Ministry of Education and Science. December 2004-December 2007. (Luis Rouco Rodríguez, Alberto Carnicero López, Óscar López García, Eduardo Pilo de la Fuente)

The high speed European railroad raise involves a technical challenge in the development of the railway systems which must fulfill more demanding requirements. The overhead system wear is governed by two main contributions: friction, which is determined by the contact forces, and the electric arcs that appear in the contact losses. Considering the importance of overhead system wear in the maintenance planning, and the increase of the number of high speed trains lines in Spain in the following years, the development of numerical tools to take into account maintenance criteria in the catenary design is extremely useful. The goal of the project is to develop the aforementioned tool which is an innovation in the current catenary pattern design.

## ***B) Consultancy and Technological Support***

### ***B.1. Private Funding***

- **Study on the design of the roof structure of silos**

Symaga S.A. September 2008-December 2008. (Alberto Carnicero López, Jesús Jiménez Octavio)

This is a preliminary study which aims to check the validity of the calculations currently performed by the company and the possibility of using more precise calculation, reducing the weight of the structures that manufacture at present.

- **Study of electrostatic fields in cable connection terminals**  
Unión Fenosa Distribución. June 2008-September 2008. (Alberto Carnicero López, Jesús Jiménez Octavio)  
The goal of the project is the study, by means of the finite element method, of the cable connection terminals. It will be tried to determine the reliability of the connection design under different configurations.
- **Computer simulation of a thermic cycle in a "black box" for railways**  
LETS. May 2008-July 2008. (Francisco Nieto Fuentes, Alexis Cantizano González)  
The project consists on a computer simulation of a thermic cycle in a "black box" for railways. The black box should protect an electronic data card from an accident. The conditions of the accident are simulated in the tests the black box should pass.
- **Study of electrostatic fields in connection terminals transformer-cable**  
Unión Fenosa Distribución. February 2008-June 2008. (Alberto Carnicero López, Jesús Jiménez Octavio)  
The goal of the project is the study, by means of the finite element method, of the connection terminals transformer-cable. It will be tried to determine the electric field in the zone of the deflector of field spheres that exists in the connection between the terminal bottle of the transformer and the line.

### 4.2.3 Software Engineering Area

#### A) *Research and Development*

##### A.1. *Public funding*

- **SISCANT II - Development and certification of advanced systems of control for UAV (Unmanned Aerial Vehicles)**  
Ministerio de Industria, Turismo y Comercio. December 2005-December 2007. (Yolanda González Arechavala, José Antonio Rodríguez Mondéjar, Ignacio Egido Cortés)

Project SISCANT II supposes continuity to the begun investigation and development with project SISCANT (Exp. FIT-330101-2004-0013).

While SISCANT must like objective cover the necessity to develop new solutions of control of aerospace critical systems that allow a greater survival to failures during the flight; SISCANT II will try to take advantage of the results SISCANT to elaborate solutions that allow the use of aerial systems in workings of interest for the society as they are: environmental workings, monitoring of borders, rescue in adverse climatologic conditions, terrestrial and marine systematic prospection, traffic control of the land, etc.

SISCANT II in addition will center their efforts in the certification system level of critical systems, like a System of Control of Flight; complementing the effort that is being made in SISCANT on the certification of software. It is in this scope where it is going to more actively participation the Instituto de Investigación Tecnológica of the ETSI ICAI of the Universidad Pontificia Comillas. The objective is to elaborate and to implement the methodology, with its processes and necessary techniques for the certification of critical systems according to the standards used in civil aviation (ARP 4761 and ARP 4754).

### 4.2.4 Electronics and Control Group

#### *A) Research and Development*

##### *A.1. Private funding*

- **Design and development of the control FPGA for the project SPU-MOET**

CRISA. December 2007-October 2008. (José Daniel Muñoz Frías, Sadot Alexandres Fernández, Carlos Rodríguez-Morcillo García)

This work is included into the European project MOET (More Open Electrical Technologies), which belongs to the sixth framework program. MOET aims to establish the new industrial standard for commercial aircraft electrical system design. These standards will allow the substitution of current pneumatic and hydraulic actuators by new electrical actuators. This will lead to a better energy efficiency and enhance aircraft design. The project develops the energy generation, energy distribution and electrical actuators.

This project will consist in the specification in VHDL of a digital circuit to control an electrical drive to move an aircraft aileron. The circuit will be implemented in a FPGA and will have a CPU block to execute the control algorithms and various I/O interfaces: PWM generation, ADC and DAC, etc.

- **Active vibration control in cryocoolers**

CRISA. December 2007-July 2008. (Aurelio García Cerrada, Luis Manuel Mochón Castro, Juan Luis Zamora Macho, José Daniel Muñoz Frías)

Dual-piston compressors for Stirling-cycle cryocoolers consists of an expander piston (or master) and a balancer piston (or slave). In normal operation, the former is moved using an electric servomotor commanded by the cold-tip temperature controller while the latter is moved in the opposite direction with a different servomotor to cancel the vibration forces (caused by the master's movement) that would produce an undesirable mechanical vibration of the compressor. The synchronized piston movement described so far, greatly improves the vibration level with respect to the use of a single piston but the problem is still quite important in practical system and further improvement is necessary. Otherwise, the remaining vibration may affect the stability of the platform upon which the compressor is placed and/or may deteriorate the performance of sensitive electronic systems mounted on the same platform.

Although the exact model that relates a compressor-motor movement and the compressor vibration is not fully known at this moment, an active-vibration-control system is going to be investigated in this project.

The available literature shows that compressor vibration can be measured or estimated so that a control algorithm can modify the feeding voltage of the balancer piston of Stirling compressors in order to provide active damping of that vibration. Specialized load-cell-based dynamometers or accelerometers have been proposed to measure compressor-generated vibration.

Several active-vibration-control algorithms will have to be considered in this project. To start with, an algorithm proposed by Astrium/CRISA will be studied in detailed. As shown bellow, the main advantages of this algorithm are that (a) it does not required a detailed model to describe the vibration mechanism and (b) it does not apply a classical closed-loop control system and stability is easily guaranteed. On the other hand, the exact attenuation level of the vibration problem cannot be established easily.

According to the specifications received from Astrium/CRISA, this project comprises the implementation and validation of active-vibration-control algorithms for cryogenic compressors to be proposed in future space missions.

- **Control for a radiant-floor heating system**

Euroestudios. November 2007-September 2008. (Aurelio García Cerrada, Juan Luis Zamora Macho, Ramón Rodríguez Pecharromán, Luis Manuel Mochón Castro, Alexis Cantizano González)

The main objective of this project is the design of an efficient controller for a radiant-floor heating system. Therefore, work will progress as follows:

1. Detailed analysis of a typical radiant-floor heating system. Characterization of the main aspects involved in a simplified model to be used for control purposes.
2. System modelling for control.
3. Investigation of suitable control algorithms.
4. Algorithm validation in a experimental set-up.

The work carried out by IIT will be complemented with detailed simulation done by Euroestudios using finite-element techniques.

- **Harmonization of CIM and IEC 61850 models within the Framework DENISE (Intelligent, Secure and Efficient distribution of electricity)**

EVERIS. October 2007-March 2009. (José Antonio Rodríguez Mondéjar, Eduardo Pilo de la Fuente, Yolanda González Arechavala, Rafael Santodomingo Berry)

The project CENIT-DENISE is a project financed by CDTI developed by a consortium of firms and research centers whose objective is the research of the future electricity networks that will enable an intelligent, secure and efficient production and distribution of electricity. The consortium is leaded by Endesa Servicios.

The activities around Harmonization of CIM and IEC 61850 models within DENISE correspond with subtasks 2.1 integrated in task 2 "Intelligence Logic" coordinated by Everis. Among the participants of the consortium several research Centers (AICIA and IIT of Comillas University) are participating in the task.

The project will study how to merge the CIM model with the IEC 61850 at power distribution networks. Also, the project studies the requirements of a physical platform to link of the two models.

- **IEC 61850 within the Framework DENISE (Intelligent, Secure and Efficient distribution of electricity)**

TELVENT. October 2007-December 2010. (José Antonio Rodríguez Mondéjar, Sadot Alexandres Fernández, Carlos Rodríguez-Morcillo García, Rafael Santodomingo Berry)

The project CENIT-DENISE is a project financed by CDTI developed by a consortium of firms and research centers whose objective is the research of the future electricity networks that will enable an intelligent, secure and efficient production and distribution of electricity. The consortium is leaded by Endesa Servicios.

The activities around IEC 61850 within DENISE corresponds with subtasks 3.1 and 3.3 integrated in task 3 "Intelligent Networks" coordinated by Eliop.

Among the participants of the consortium several research Centers (AICIA and IIT of Comillas University) are participating in the task.

The project will study the application of IEC 61850 to power distribution networks, the development of 61850 controllers and configuration software.

- **Design and integration of embedded systems in trains**

SEPSA (Sistemas Electrónicos de Potencia, S.A.). July 2007-June 2010. (Sadot Alexandres Fernández, Yolanda González Arechavala, Carlos Rodríguez-Morcillo García, José Daniel Muñoz Frías, José Antonio Rodríguez Mondéjar)

This project is aimed to the R&D and the integration of embedded systems in railways. The project is an agreement between the company Sistemas Electrónicos de Potencia S.A. (SEPSA) and IIT. The research lines are the following:

- 1- Design of electronic controllers based on the MVB: TCN-MVB-C0 class Controller (MVB bus repeater)
- 2- Research in broadband systems: Ethernet Bridge based on OFDM
- 3- Evaluation and compliant of the events register software with the standard CENELEC 50128 for SIL 1.

- **Development of a dynamic simulator for the transport gas network**

Socoin Ingeniería y Construcciones Industriales. June 2007-October 2007. (Rafael Palacios Hielscher, Eugenio Francisco Sánchez Úbeda, Aurelio García Cerrada, Juan Luis Zamora Macho, Luis Manuel Mochón Castro, Ana Berzosa Muñoz)

The project consists on developing a simulator of a nation-wide natural gas network. The system reads the topology of the network from a database and allows the user to define the operational parameters of each network node as a function of the time. Then, a simulation of the dynamic behavior of the network is performed by solving many quasi-static scenarios and the results are shown graphically.

An optimization module is included in order to obtain the operational parameters that yield the best performance for a given scenario. In addition, fluid dynamics equations are analyzed and finite element tools will be used to determine in which conditions the simulator can be used to study the behavior of the network it run with CO<sub>2</sub> instead of natural gas.

- **Interconnection control center requirements of railway power system**

ADIF. December 2006-December 2008. (José Antonio Rodríguez Mondéjar, Yolanda González Arechavala, Eduardo Pilo de la Fuente, Rafael Santodomingo Berry, Rafael Palacios Hielscher)

The operational and commercial needs of the Spanish railway operator (RENFE) require the interconnection of power control centers to not only perform traditional functions (supervisory & control) but also support many of the new functions, specifically to meet the needs of competition with deregulation. The aim of this project is to establish the requirements of new RENFE power control centers. The proposal architecture must take into account the requirements of real-time data, security, availability, scalability, information exchange, etc.

- **Neutral zone supervision and control requirements of railway power system**

ADIF. December 2006-December 2008. (José Antonio Rodríguez Mondéjar, Yolanda González Arechavala, Eduardo Pilo de la Fuente, Rafael Santodomingo Berry, Rafael Palacios Hielscher)

The operational and commercial needs of the Spanish railway operator (RENFE) require that neutral zone supervisory and control equipment to not only perform traditional functions (supervisory & control) but also support many of the new functions, specifically to meet the needs of competition with deregulation. The aim of this project is to establish the requirements of new RENFE power control centers. The proposal architecture must take into account the requirements of real-time data, security, availability, scalability, information exchange, etc.

- **Development of an auto-pilot system for the VISICOPTER helicopter. Application to aerial image acquisition to support precision agriculture.**

Univ. Pontificia Comillas. October 2005-October 2007. (Álvaro Sánchez Miralles, Juan Luis Zamora Macho, Cesáreo Fernández Martínez, Rafael Palacios Hielscher)

The analysis of aerial images can be applied to optimise plantation's fumigation. In order to decrease image acquisition costs, a system based on a small helicopter is being developed to identify regions requiring additional fumigation by image processing of photography taken with onboard cameras. The objective of the current proposal is to develop an auto-pilot system able to stabilise the helicopter and able to guide the helicopter in the region of study without needing to have any expert on piloting helicopters. The auto-pilot proposed is mainly based on gyroscopes for stabilisation and GPS satellite signals for guidance. It is crucial to develop a dynamic model of the helicopter in order adjust control algorithms that will stabilise the aircraft under weather perturbation. A good model will also allow for successful landing and takeoff operations.

## A.2. Public funding

- **Collaboration for design and development of the emulator channel system for integrated project OPERA-2**

Ministry of Education and Science. January 2008-December 2008. (Sadot Alexandres Fernández, Carlos Rodríguez-Morcillo García, José Daniel Muñoz Frías)

Complementary funds of the MEC for the OPERA-2 integrated project. These funds have been employed to study common mode current at a point of an electric installation, as a function of differential mode voltage and common mode current injected at the transmitter end of the installation. This work has been developed collaborating with EPFL and HEIG-VD at Switzerland.

- **Open PLC European research alliance for new generation PLC integrated network - Phase 2 - Contract no.: 26920**

European Commission. January 2007-December 2008. (Sadot Alexandres Fernández, José Daniel Muñoz Frías, Carlos Rodríguez-Morcillo García, José Antonio Rodríguez Mondéjar)

Power Line Communication (PLC) is a broadband telecommunication technology able to use the existing electricity networks for data transmission purposes, allowing any user connected to the power grid to benefit from Information Technology based services easily and avoiding expensive and pollutant new wiring in their houses and cities.

The strategic objective of this Opera proposal is to push PLC technology in all the different and relevant aspects (standardization, technology improvement, installation tools and processes, telecom services, intelligent grid services, dissemination) so as to allow the technology to become a competitive alternative that offers broadband access service to all European citizens using the most ubiquitous infrastructure.

This future development of the PLC technology will contribute to develop the European Information Society in full concordance with the proposed objectives in the plan eEurope 2005 by means of:

- Increase of competition in the internet broadband access network: PLC networks can be quickly and easily deployed without large investments by using the existing electricity networks. PLC is an alternative, competitive, and ubiquitous solution for access and in-home distribution that will contribute to have a real alternative last-mile access network.
- Fostering Mass Services availability: PLC features such as transparent integration with different communication technologies (WiFi, etc.) and complete end-user coverage will contribute to the deployment of value-

added-services over broadband such as: smart home, video streaming, e-health, VoIP, etc.

- European Industry Leadership: PLC technology know-how and technical excellence are currently located in Europe. It represents an extraordinary opportunity for the development, competitiveness and leadership of European Broadband Industry that will contribute to the creation of employment, to the development of the Information Society Technologies in Europe and to the socio-economic prosperity in EU.

The OPERA project had an estimated duration of 48 months. The project was divided into two phases, 24 months each. The 1st phase was funded by European Commission.

- **Control of active power filters for uninterruptible power supply systems**

Ministry of Education and Science. October 2006-September 2009. (Aurelio García Cerrada, Pablo García González, Ramón Rodríguez Pecharromán, José Daniel Muñoz Frías)

This project will develop a pre-industrial prototype for an active power filter (APF) to be used to improve the electromagnetic compatibility of uninterruptible-power supplies (UPS's). The device should also provide flexible reactive-power control at the point of coupling with the mains. This action intends to consolidate the results of a previous project (DPI2002-03962) by means of one of its possible industrial applications. The project will go along three main lines:

- (a) First of all, the research team will consolidate the existing experimental-design platform which has been used for power-electronics-control development. It is based on a microprocessor system compatible with a commercial PC, a simulation, analysis and design environment with code-translation tools for real-time applications and a real-time operating system. The design platform must remain open so that the user can customise it to suit each application.
- (b) Secondly, the realistic specifications for the compensating device must be established to cover applications in a wide power range. All the specifications must be investigated experimentally in the prototype.
- (c) Thirdly, the addition of the active-filter capabilities to the front-end of the UPS system must be investigated.
- (d) Finally, the use of new semiconductor devices (i.e. Silicon Carbide) in the high-power UPS market must also be investigated.

- **PRO-TVD. Integral Research Project on Digital Television**

Community of Madrid. January 2006-December 2009. (Sadot Alexandres Fernández, Carlos Rodríguez-Morcillo García, José Daniel Muñoz Frías, José Antonio Rodríguez Mondéjar)

Digital Television (specifically Digital Terrestrial Television - DTT), in the establishment and deployment phases, in the development of all its potentiality is, from a scientific-technological and economic point of view, one of the biggest challenges of the Comunidad Autónoma of Madrid -CAM in the forthcoming 4 years. This challenge affects all the authors that participate in the process, from content acquisition (production), content diffusion, home reception and, last but not least, and probably the most important of the chain, the user access to the information.

The switch-off of the analog signal is foreseen for 2010 year. This implies that all actors must start now deploying solutions to digitize the emission. Technologically, there are currently available basic solutions for a fast deployment. However, those solutions are currently in revision phase, according to the interesting international research activities carried out, looking for the optimization of all the process: from acquisition with more quality, lower bandwidth in the diffusion, better reception with more efficient equipment (more memory, more computing power, and certain “service interoperability”), the establishment of interactive applications (through return channels) for the user, and the provision of a better accessibility service for everyone.

The research groups that participate in the proposal contribute with solid experience in the field of Digital Television and Communications, covering the four different blocks that imply the deployment of the DTT, as it is shown in initiatives such as the Forum of Digital Television launched by the Ministry of Industry, Tourism and Commerce of Spain. This forum is participating by the key companies of the sector, as well as universities, associations, etc. The forum activities reflect the research lines of this project, and its working groups are participated very actively by the researchers of this proposal, as it can be shown in the many documents and minutes of meetings already issued.

This proposal is, therefore, a research plan to tackle the evaluation of the current technological solutions that are implied by the deployment of the DTT, and also in the inevitable evolution in the forthcoming years (as it is published in the more reputed international publications of the field), trying to provide a better quality service, more complete, and more universal for every kind of people.

- **Development of Peltier effect-based air-conditioning equipment for buildings**

Ministry of Education and Science. December 2004-December 2007. (Francisco Luis Pagola y de las Heras, Antonio Arenas Alonso, Rafael Palacios Hielscher, Ramón Rodríguez Pecharromán, Jorge Vázquez Arias)

This project attempts to develop improvements in the air-conditioning of buildings by means of the implementation of two kinds of thermoelectricity - based (Peltier effect) equipments. In the first class small devices are included, whose function is to improve the local temperature control; they are conceived to offset the effect of local thermal loads, or to address special needs. The second class consists of a window-glass surface with embedded thermoelectric devices that can be used to obtain thermal insulation or even be used as primary air-conditioning system.

Thermoelectricity offers the following assets for the envisioned applications: they are reversible, their efficiency does not drop in very small power situations, they can be accurately controlled by electronic means, have no moving parts and are quiet, they use no thermal fluids, have small size and weight, the equipments can be easily planned as standard units. On the other hand, thermoelectric air-conditioning systems are generally much less efficient than compression-based systems. This project proposes to research electronic control techniques that insure that the system will work always near the optimum operating point (as a function of temperature drop and thermal load).

The proposed objectives are: The development of prototypes of thermoelectric window-glass, to obtain from them experimental data and models of dynamic behavior, and the development of electric supply systems and electronic control. In parallel and in an analogous way, local air-conditioning equipment will be developed, experimental data and dynamic models will be obtained, and electric supply systems with electronic control will be developed.

## ***B) Consultancy and Technological Support***

### ***B.1. Private funding***

- **Defining a monitoring and maintenance management system for electrical substations**

ELDU. June 2008-September 2008. (Rafael Palacios Hielscher, Carlos Rodríguez-Morcillo García, Sadot Alexandres Fernández)

The objective of the collaboration is the development of a specification for a monitoring and management system of electrical installations that will allow for remote monitoring states, failures and anomalies, and also allow for better

maintenance management. It should include alarms management as well as the ability to detect problems in a preventive manner, in order to avoid critical failures. All detections must be accompanied by an analysis of criticality or impact, for optimizing maintenance actions.

For the definition of the system, communications technologies for remote monitoring and remote management will be evaluated, as well as the data model and information flows.

- **Analysis of the Chilean Network 2008 for the CNE, using the IIT Network Reference Model**

SYNEX Ingenieros Consultores Ltda. June 2008-October 2008. (Carlos Mateo Domingo, Pablo Frías Marín, Álvaro Sánchez Miralles, Tomás Gómez San Román)

The goal of this project is to assist Synex in the use of the Network Reference Model, named PECO, for the determination of the Aggregated Distribution Value of Chile. The results will be submitted to the Chilean Regulator (CNE) in order to perform the 2008 Tariff Revision.

The Chilectra's network will be modelled and several reliability scenarios will be performed. Both the street map and the orography of the area will be taken into account in full detail. The street map will be built automatically by the model.

- **Analysis of Chilectra's network using the IIT Network Reference Model**

Systep Ingeniería y Diseños Ltd. April 2008-November 2008. (Carlos Mateo Domingo, Tomás Gómez San Román, Álvaro Sánchez Miralles, Pablo Frías Marín)

The goal of this project is to assist SYSTEP in the determination of the Aggregated Distribution Value of Chilectra (a Chilean distribution utility that supplies Santiago). The Network Reference Model, named PECO, will be used. The results will be submitted to the Chilean Regulator (CNE) in order to perform the 2008 Tariff Revision.

The Chilectra's network will be modelled and several reliability scenarios will be performed. Both the street map and the orography of the area will be taken into account in full detail. The street map will be built automatically by the model.

- **Analysis and consulting in the systems design for BoxWeb**

Boxweb S.L. December 2007-March 2008. (Sadot Alexandres Fernández)

The objective of this project is the consulting, the design and the development of an advertising video edition system for Boxweb. Besides, a digital

input/output supervisory module for failures detection in the actuators will be developed.

- **Control center requirements of high-speed railway power system**

ADIF. December 2007-December 2010. (José Antonio Rodríguez Mondéjar, Yolanda González Arechavala, Eduardo Pilo de la Fuente, Rafael Santodomingo Berry)

The operational and commercial needs of the Spanish railway operator (ADIF) require power control center to not only perform traditional functions (supervisory & control) but also support many of the new functions, specifically to meet the needs of competition with deregulation. The aim of this project is to establish the requirements of new high speed railway power control centers. The proposal architecture must take into account the requirements of real-time data, security, availability, scalability, information exchange, etc.

- **Writing of the Unión Fenosa's manual on quality of the electrical service**

Unión Fenosa. July 2007-October 2007. (Pablo García González, Juan Rivier Abbad)

The objective of this collaboration is to write a manual on Quality of Service. IIT and Unión Fenosa have performed together several studies and analysis on different aspects of quality of service since quite a few years. As a result of these collaborations, several reports have been produced that cover the theoretical experience cumulated by Unión Fenosa on quality of service. On the other hand, Unión Fenosa has a long practical experience on quality of service matters. Unión Fenosa has asked IIT to use all this work to produce a document summary of all these experiences and knowledge that might be used by Unión Fenosa for internal courses.

#### **4.2.5 Intelligent Systems Area**

##### ***A) Research and Development***

###### ***A.1. Private funding***

- **Optimal management of wind power generation in the Spanish electricity market**

EGL España S.L. May 2008-November 2008. (Antonio Muñoz San Roque, José Villar Collado, Michel Rivier Abbad, Rocío Herranz Pindado)

The main objectives of this project are (1) the evaluation of short term wind power forecasting models that use recent measurements of wind generation as input variables in order to improve the available meteorological forecasts and (2) the analysis of different bidding strategies for the optimal management of wind energy in the Spanish electricity market.

- **Effective planning of the maintenance applied to a distributed electrical system by integration of information coming from exploitation of the systems, its maintenance and the quality of service to reach**

Endesa Distribución. March 2008-March 2010. (Miguel Ángel Sanz Bobi, Rafael Palacios Hielscher)

The objective of the project is to perform a dynamic scheduling of the maintenance to be applied to transformers and interrupters belonging to a distributed electrical system. This dynamic planning will take into account the operation of the electrical system and the maintenance applied, and will guarantee the best possible level of quality of service for the clients connected to the system.

- **Development of new algorithms for monitoring the Spanish electricity market**

Endesa. February 2008-February 2009. (Eugenio Francisco Sánchez Úbeda, Antonio Muñoz San Roque, Juan Marín Bernal)

The primary aim of this project is the consolidation of a methodology for the analysis of the Spanish electricity market operation and the characterization of participants bidding strategies. In particular, a new information system implementing this methodology will be developed.

Taking as input the information published by the Market and System Operators, the proposed methodology will establish the most appropriate mechanisms of advanced analysis for its treatment, with the purpose of analyzing the bidding behaviour of firms and their pricing of the different generation technologies.

- **New advanced analysis and developments in MORSE (simplified model of the electricity Spanish sector) and in SGP (Forecast Management System)**

Endesa. February 2008-February 2009. (José Villar Collado, Francisco Alberto Campos Fernández, Cristian Andrés Díaz Durán)

MORSE is a complete but simplified model of the Spanish electricity industrial sector, which has been developed by the Instituto de Investigación Tecnológica (IIT) in collaboration with Endesa. It is intended for strategic analysis of the evolution of this sector, especially when changes of the utilities structure, new regulations, or new generation technologies take place. Its core is EQUITEC, a market Nash equilibrium model, where the generation has been represented at the technology level, instead of considering generation units

individually. This new collaboration focuses on several advanced aspects, such as the analysis of the behavior of the power market calculation algorithm, the distribution bids modeling, or the consideration of probabilistic criterion to improve the modeling of particular technologies such as the eolic generation. Other operative improvements will also be undertaken, such as for example the extension of the algorithm for adjusting inputs to reach predefined sector targets to include iterative execution of EQUITEC if needed.

MORSE has been developed to be compatible with the Forecast Management System of Endesa (SGP), also developed by IIT, for medium and long term planning. Some of the tasks of this collaboration are directly related with SGP, focusing mainly on the statistic analysis of the past electricity sector forecasts and the final outcomes.

- **Design of the active components of distribution power transformers of very low power losses and modelling of short circuit conditions**

COTRADIS. December 2007-December 2009. (Miguel Ángel Sanz Bobi, Alberto Carnicero López, Francisco Nieto Fuentes, Rafael Palacios Hielscher, Luis Rouco Rodríguez, Andrey da Costa Lopes, Jesús Jiménez Octavio)

The project objectives are the following:

- Development of a power distribution transformer of low power losses by a new design of its active components. The cost of this new transformer has to be as low as possible depending of the materials used and their processing techniques. The life of this new distribution transformer has to guarantee for at least 30 years.
- Optimization of the power transformer in short circuit conditions.

- **Load and distributed generation forecasting for an efficient management of distribution networks**

EVERIS. September 2007-March 2009. (Antonio Muñoz San Roque, Eugenio Francisco Sánchez Úbeda, Ana Berzosa Muñoz, Alberto Miguel Cruz García, Juan Marín Bernal)

The objective of this project is the development of zonal electricity demand and distributed generation forecasting models with two time horizons: the medium term, with a range of one year and the short-term horizon (24 hours).

These two horizons are hierarchically managed and coordinated to ensure the consistency of the forecasts and the considered scenarios (temperature, wind, number of customers, equipment reliability, etc.).

The ultimate goal of these models is to facilitate the efficient management of the future distribution networks.

- **Development of models for estimating the quality of an intelligent distribution network**

Eliop. September 2007-December 2009. (Álvaro Sánchez Miralles, Carlos Mateo Domingo, Álvaro Arranz Domingo, Manuel Alvar Miró, Tomás Gómez San Román)

This project is a part of the global CENIT DENISE project. One of the aims of the project is to develop a model, CIM compatible, for distribution networks considering traditional electrical equipments and the future ones, which will be designed in the global DENISE project. Finally, two algorithms should be developed, one for faults localization and another for optimal service restoration and fault isolation.

- **Simulation models for intelligent electricity distribution networks**

EVERIS. June 2007-September 2009. (Álvaro Sánchez Miralles, Juan Rivier Abbad, Tomás Gómez San Román, Carlos Mateo Domingo, Manuel Alvar Miró, Álvaro Arranz Domingo, José Villar Collado)

In this project, it is proposed to develop models for helping suppliers to do their task. The first treated task is to design specific energy offers to clients, with the aim of inducing a consumption pattern, for optimising the distributor installations. The second task is to asses clients for making them easiest to find the better connection to the electricity network, in such a way that clients are informed of the service quality and energy prices at different locations.

- **Development of a dynamic simulator for the transport gas network**

Socoin Ingeniería y Construcciones Industriales. June 2007-October 2007. (Rafael Palacios Hielscher, Eugenio Francisco Sánchez Úbeda, Aurelio García Cerrada, Juan Luis Zamora Macho, Luis Manuel Mochón Castro, Ana Berzosa Muñoz)

The project consists on developing a simulator of a nation-wide natural gas network. The system reads the topology of the network from a database and allows the user to define the operational parameters of each network node as a function of the time. Then, a simulation of the dynamic behavior of the network is performed by solving many quasi-static scenarios and the results are shown graphically.

An optimization module is included in order to obtain the operational parameters that yield the best performance for a given scenario.

In addition, fluid dynamics equations are analyzed and finite element tools will be used to determine in which conditions the simulator can be used to study the behavior of the network it run with CO<sub>2</sub> instead of natural gas.

- **Design, prototype, and experimental tests for a thermoelectric device able to supply electrical energy to domestic gas heating systems**

Mondragón Componentes. May 2007-December 2007. (Rafael Palacios Hielscher, Antonio Arenas Alonso)

Gas powered heating systems for domestic use, such as water heaters or stoves, require an electrical power supply. This electrical power supply is necessary, according to the type of equipment, for several devices like ignition, flame control, and electronic temperature control. In the case of equipment where electrical power is higher than 100 W, the usual solution is to connect the equipment to the mains, whereas in the case of equipment of low power (lower than 10 W) diverse solutions can be adopted to avoid electrical network dependency. These solutions are not free of disadvantages and include batteries or hydroelectric generators.

The work to be done consists of designing thermoelectrical devices that will turn part of the heat of the equipment into electrical energy, so that those equipments can work without requiring other electrical power sources.

- **Platform for integral intelligent management of offers and demands of parking places**

Tuplaza Movilidad y Desarrollo S.L. May 2007-March 2008. (José Villar Collado, Álvaro Sánchez Miralles, Álvaro Arranz Domingo, Manuel Alvar Miró)

The main objective is to develop a platform with multiple types of access for the integral intelligent management of parking places, and is the second phase of the project started in the middle of 2006. The platform must behave as a service provider for those companies that may need to manage their own garages in an easy way. To do so the platform must be:

- An integrated information system, for booking, accessing, paying and exchanging parking places, dynamically managing, with automatic learning mechanisms, the offers and the demands.
- A system with multiple types of access for users to reach the platform, using mobile and fixed devices, to get information and book parking places.
- A platform with remote access (ASP type) to provide services to small operators, not able to have their own information and management system, to increase business capabilities of the platform.

- **Analysis of the operation of the Spanish electricity market**

Indra-Endesa. February 2007-December 2007. (Julián Barquín Gil, Eugenio Francisco Sánchez Úbeda, Antonio Muñoz San Roque)

The primary aim of this project is the definition of a methodology for the analysis of the Spanish electricity market operation and the characterization of participants bidding strategies.

Taking as input the information published by the Market and System Operators, the proposed methodology will establish the most appropriate mechanisms of advanced analysis for its treatment, with the purpose of analyzing the bidding behaviour of firms and their pricing of the different generation technologies.

- **MORSE: Simplified model of the electricity Spanish sector, for strategic medium and long term analysis**

Indra-Endesa. February 2007-February 2008. (José Villar Collado, Francisco Alberto Campos Fernández, Cristian Andrés Díaz Durán)

MORSE is a complete but simplified model of the Spanish electricity industrial sector, which is being developed by the Instituto de Investigación Tecnológica (IIT) in collaboration with the Energetic Planning Subdirection (SPE) of the Spanish electricity utility Endesa. It is intended for strategic analysis of the evolution of this industrial sector, especially when changes of the utilities structure, new regulations, or new generation technologies take place. Its core is EQUITEC, a market Nash equilibrium model, where the generation has been represented at the technology level, instead of considering generation units individually. These tools are integrated in the SPE information system, which provides advanced tools for sensitivity analysis, multi scenario simulation, and advanced report mechanisms.

- **Price estimation in the Italian electricity market - Valore Italia 2007**

Endesa Italia. January 2007-December 2007. (Javier Reneses Guillén, Eugenio Francisco Sánchez Úbeda, Natalia Mosquera Osorio)

This project continues the collaboration between the IIT and Endesa Italia during the last years, which has achieved adapting the medium-term model Valore to the representation of the Italian Electricity Market. The main objective of this project is to combine the existing market model with statistic techniques, such as regression analysis, or time series. A tool will be programmed and installed in order to help the users in carrying out price estimations periodically.

- **Development of an auto-pilot system for the VISICOPTER helicopter. Application to aerial image acquisition to support precision agriculture.**

Univ. Pontificia Comillas. October 2005-October 2007. (Álvaro Sánchez Miralles, Juan Luis Zamora Macho, Cesáreo Fernández Martínez, Rafael Palacios Hielscher)

The analysis of aerial images can be applied to optimise plantation's fumigation. In order to decrease image acquisition costs, a system based on a small helicopter is being developed to identify regions requiring additional fumigation by image processing of photography taken with onboard cameras. The objective of the current proposal is to develop an auto-pilot system able to stabilise the helicopter and able to guide the helicopter in the region of study without needing to have any expert on piloting helicopters. The auto-pilot proposed is mainly based on gyroscopes for stabilisation and GPS satellite signals for guidance. It is crucial to develop a dynamic model of the helicopter in order adjust control algorithms that will stabilise the aircraft under weather perturbation. A good model will also allow for successful landing and takeoff operations.

### **A.2. Public funding**

- **System based in a small helicopter and mobile robots for efficient generation of resources maps. Application to the precise spreading and minimization of pesticides**

Ministry of Education and Science. October 2007-October 2010. (Álvaro Sánchez Miralles, Juan Luis Zamora Macho, Rafael Palacios Hielscher, Cesáreo Fernández Martínez, Manuel Alvar Miró, Álvaro Arranz Domingo, José Porras Galán, Fidel Fernández Bernal)

This project will develop a system to generate georeferenced fumigation maps of crops that will help farmers in getting better product, reducing expenses in pesticides and minimizing environmental impact.

The system comprises a small helicopter, autonomous ground vehicles and a central station. The helicopter is equipped with remote control, motion/position sensors, auto-pilot electronics, wireless communication and digital cameras. The ground vehicles are unmanned autonomous robots used as georeferenced landmarks. They are equipped with navigation devices (GPS or Galileo) and linked wirelessly to communicate their position. The central station is a laptop computer in charge of the system coordination during image acquisition and communicates with the helicopter and ground vehicles. After data acquisition, it performs image processing to generate fumigation maps.

In order to make the system efficient and feasible (low cost) for extensive utilization, the project includes the development of control algorithms to help helicopter manoeuvres, such as hover, and also the development of mobile ground landmarks that allows for immediate field analysis without requiring manual installation of fixed georeferenced marks. Previous work of the

research team has demonstrated the feasibility of obtaining fumigation coordinates from georeferenced aerial images.

- **Integrated management for diagnosis and maintenance of power systems based on intelligent multi-agent systems**

Ministry of Education and Science. January 2007-December 2008. (Miguel Ángel Sanz Bobi, Antonio Muñoz San Roque, Sadot Alexandres Fernández, José Daniel Muñoz Frías)

The current competence in the electrical industry, the complexity and criticality of the power systems require to know as well as possible the health condition of their most important components. However there is a very wide heterogeneity in equipments, control systems and management systems that difficult sometimes to take quick decisions and without and global perspective. In order to improve these weak points, the project will analyse and propose the design of an open system based on an intelligent multi-agent system able to integrate different aspects of the diagnosis and maintenance of the most important components in a power system.

The design to perform will allow crossing information from different sources of information about monitoring and diagnosis of different types of components and systems. This includes the re-use of existing systems and the addition of new ones in order to facilitate the coherence and efficiency of the diagnoses to be issued. Also, the new architecture will allow having more detailed information about the health condition of the main components of the electrical system.

The platform to be designed will use several technologies from the diagnosis and maintenance fields, intelligent systems, multi-agent systems and new information technologies.

- **Integrate platform for automatic analysis and validation of highway traffic images**

Ministry of Industry Tourism and Trade. January 2007-December 2008. (Eugenio Francisco Sánchez Úbeda, Rafael Palacios Hielscher, Ana Berzosa Muñoz)

The launch of this project arises from the need to develop an automated system capable of extracting features of the cars from images taken on the road, in order to improve the accuracy of automatic recognition as much as possible. Despite the widespread use of automatic number plate recognition, there are a number of limitations in several elements that make up such systems, which yield to small but undesirable level of recognition errors.

The proposed platform integrates new image acquisition devices, semantic analysis of features, clustering and classification based on neural networks, and

a database management system. The main objective is to improve the capabilities of automatic recognition to the point of obtaining results in situations in which human recognition is not able to read the plate correctly. When plate is not completely available in the image of the car, the system would be able to identify the vehicle if there is a collection of images from the same vehicle available in the system database, reasonable situation for vehicles that use the infrastructure frequently.

The project involves a preliminary analysis, functional development and implementation of a prototype that demonstrates the degree of reliability attained by the platform.

### ***B) Consultancy and Technological Support***

#### ***B.1. Private funding***

- **Review of the state of the art about Asset Management in transport and distribution in the electrical industry**

Unión Fenosa. September 2008-October 2008. (Miguel Ángel Sanz Bobi, Rafael Palacios Hielscher, Luis Rouco Rodríguez)

The objective of the project is the analysis and review of the state of the art about Asset Management in transport and distribution in the electrical industry.

- **Defining a monitoring and maintenance management system for electrical substations**

ELDU. June 2008-September 2008. (Rafael Palacios Hielscher, Carlos Rodríguez-Morcillo García, Sadot Alexandres Fernández)

The objective of the collaboration is the development of a specification for a monitoring and management system of electrical installations that will allow for remote monitoring states, failures and anomalies, and also allow for better maintenance management. It should include alarms management as well as the ability to detect problems in a preventive manner, in order to avoid critical failures. All detections must be accompanied by an analysis of criticality or impact, for optimizing maintenance actions.

For the definition of the system, communications technologies for remote monitoring and remote management will be evaluated, as well as the data model and information flows.

- **Analysis of the Chilean Network 2008 for the CNE, using the IIT Network Reference Model**

SYNEX Ingenieros Consultores Ltda. June 2008-October 2008. (Carlos Mateo Domingo, Pablo Frías Marín, Álvaro Sánchez Miralles, Tomás Gómez San Román)

The goal of this project is to assist Synex in the use of the Network Reference Model, named PECO, for the determination of the Aggregated Distribution Value of Chile. The results will be submitted to the Chilean Regulator (CNE) in order to perform the 2008 Tariff Revision.

The Chilectra's network will be modelled and several reliability scenarios will be performed. Both the street map and the orography of the area will be taken into account in full detail. The street map will be built automatically by the model.

- **Analysis of Chilectra's network using the IIT Network Reference Model**

Systep Ingeniería y Diseños Ltd. April 2008-November 2008. (Carlos Mateo Domingo, Tomás Gómez San Román, Álvaro Sánchez Miralles, Pablo Frías Marín)

The goal of this project is to assist SYSTEP in the determination of the Aggregated Distribution Value of Chilectra (a Chilean distribution utility that supplies Santiago). The Network Reference Model, named PECO, will be used. The results will be submitted to the Chilean Regulator (CNE) in order to perform the 2008 Tariff Revision.

The Chilectra's network will be modelled and several reliability scenarios will be performed. Both the street map and the orography of the area will be taken into account in full detail. The street map will be built automatically by the model.

- **Analysis of the natural gas demand**

Comisión Nacional de la Energía. September 2007-July 2008. (Eugenio Francisco Sánchez Úbeda, Ana Berzosa Muñoz)

The main objective of this project is the development of a methodology for the analysis and forecasting for the Spanish natural gas consumption.

The demand is one of the most important variables needed to estimate the amount of additional capacity required to ensure a sufficient supply of energy. Therefore, the ultimate goal of this methodology is to facilitate the analysis of future scenario to determine whether the supply to end users of natural gas can be made safely and reliably.

- **Report module to visualize the forecast of natural gas demand**

ENAGAS. January 2007-December 2007. (Eugenio Francisco Sánchez Úbeda, Álvaro Sánchez Miralles, Ana Berzosa Muñoz)

The primary objective of this project is to incorporate new features to the system Patrones, a complete information system for the analysis and forecasting of the Spanish natural gas demand, developed by the IIT in previous collaborations with Enagas.

#### **4.2.6 Railway Systems Area**

##### ***A) Research and Development***

###### ***A.1. Private funding***

- **Timetable analysis of new sceneries in Ferrocarrils de la Generalitat de Catalunya lines**

Dimetronic Signals. September 2008-May 2009. (Asunción Paloma Cucala García, Antonio Fernández Cardador)

In this project railway planning capacity models are used to support train programming in Ferrocarrils de Catalunya. The new scenery includes 32 trains per hour in Plaza de Catalunya station, and new arrival/departure patterns have to be proposed.

In addition the maximum capacity is analysed in order to value the advantages of future infrastructure works in Plaza de Catalunya.

- **Railways capacity analysis of Metro de Valencia network in 2010**

Ferrocarrils de la Generalitat Valenciana. February 2008-September 2008. (Asunción Paloma Cucala García, Antonio Fernández Cardador, Carlos María Sicre Vara del Rey)

The objective of this project is to analyse the railways capacity of Metro de Valencia, considering the future offered services in 2010-v2. Two kinds of models will be developed: a high level model of the whole metro network, and other detailed models of those points considered as bottlenecks. These models will be implemented in a software tool in order to obtain conclusions about the network capacity in different cases. The detailed models are focused on Alameda, Alboraiá and Tavernes stations.

- **Railway capacity analysis of Ferrocarrils de la Generalitat de Catalunya lines**  
Dimetric Signals. February 2008-September 2008. (Antonio Fernández Cardador, Asunción Paloma Cucala García)  
In this project railway planning capacity models are developed to analyse high density railway networks where a terminal station restricts the line. The goal of these models is to maximise the number of trains per hour, generating the whole timetable for the network. The models are implemented in a simulation tool, and applied to increase the number trains per hour in Ferrocarrils de la Generalitat de Catalunya lines.
- **Traffic regulation system for Metro de Madrid**  
Dimetric Signals. October 2007-July 2009. (Antonio Fernández Cardador, Asunción Paloma Cucala García)  
The objective of this project is the functional specification and design of the new traffic regulation system for Metro de Madrid, as well as the validation of the functionality once the system is in service. The new system will substitute the SIRAT system, and new functions will be provided: management of terminal stations, supervision of commercial speed, and management of multiple terminal stations. The system will be validated analysing the historical data generated by the new regulation system.
- **Analysis of railways capacity of Metro de Valencia network in 2010**  
Metro de Madrid, S.A. September 2007-March 2008. (Asunción Paloma Cucala García, Antonio Fernández Cardador, Carlos María Sicre Vara del Rey)  
The objective of this project is to analyse the railways capacity of Metro de Valencia, considering the future offered services in 2010, enlargement of metro lines, and modifications in railways signalling systems. Two kinds of models will be developed: a high level model of the whole metro network, and other detailed models of those points considered as bottlenecks. These models will be implemented in a software tool in order to obtain conclusions about the network capacity in different cases.
- **Energy efficiency in train timetables planification**  
Indra. April 2007-July 2008. (Asunción Paloma Cucala García, Antonio Fernández Cardador, Carlos María Sicre Vara del Rey)  
The main goal of this project is the investigation and development, in collaboration with ADIF, of new models to calculate train timetables. The main module will optimise the distribution of recovery times to minimise the energy consumption. In addition, simulation based models will be developed to compute the maximum load of a train along a line, and the characteristic slope of a line.

- **Neutral zone supervision and control requirements of railway power system**

ADIF. December 2006-December 2008. (José Antonio Rodríguez Mondéjar, Yolanda González Arechavala, Eduardo Pilo de la Fuente, Rafael Santodomingo Berry, Rafael Palacios Hielscher)

The operational and commercial needs of the Spanish railway operator (RENFE) require that neutral zone supervisory and control equipment to not only perform traditional functions (supervisory & control) but also support many of the new functions, specifically to meet the needs of competition with deregulation. The aim of this project is to establish the requirements of new RENFE power control centers. The proposal architecture must take into account the requirements of real-time data, security, availability, scalability, information exchange, etc.

- **Interconnection control center requirements of railway power system**

ADIF. December 2006-December 2008. (José Antonio Rodríguez Mondéjar, Yolanda González Arechavala, Eduardo Pilo de la Fuente, Rafael Santodomingo Berry, Rafael Palacios Hielscher)

The operational and commercial needs of the Spanish railway operator (RENFE) require the interconnection of power control centers to not only perform traditional functions (supervisory & control) but also support many of the new functions, specifically to meet the needs of competition with deregulation. The aim of this project is to establish the requirements of new RENFE power control centers. The proposal architecture must take into account the requirements of real-time data, security, availability, scalability, information exchange, etc.

### ***b. Public Funding***

- **Analysis of energy consumption on metropolitan railways, commuter railways and high speed lines**

Ministerio de Fomento (CEDEX). December 2007-December 2009. (Asunción Paloma Cucala García, Antonio Fernández Cardador, Eduardo Pilo de la Fuente, Andrés Ramos Galán, Carlos María Sicre Vara del Rey, Ramón Rodríguez Pecharromán)

Adjustable simulation models are developed to analyse consumption reduction strategies involving the efficient design of both railway timetables and train operation. Particularly, focussed on the operation of high speed lines, and specific models for metropolitan lines and commuter trains. The results of these simulation-based studies will be tested in two actual cases.

In addition, all aspects related to energy supply are analysed: electrification voltage, electrical diagrams, cogeneration, returning energy, static storage, etc.

- **Energy-saving in railways operation. Efficient regenerative breaking**

Ministry of Education and Science. January 2007-December 2008. (Antonio Fernández Cardador, Asunción Paloma Cucala García, Andrés Ramos Galán, María Domínguez Gago, Rafael Santodomingo Berry, José Antonio Rodríguez Mondéjar, Fernando de Cuadra García, Francisco Nieto Fuentes)

The main goal of this project is the energy cost reduction in railways operation optimising the use of regenerative break in metropolitan lines. Two models are developed:

1. A optimisation model of commercial timetables to maximize the synchronisation periods between the breaking process of a train and the speed up process of another train in the same electric section.
2. The optimal design of train control actions during the running time between stations, generating the ATO configuration parameters: coasting points, deceleration rates, etc.

- **Development of a model for calculating and predicting the transport system's energy consumptions and emissions, with a view to assessing the effect of infrastructure investment and transport policy decisions on these consumptions**

Cedex. December 2006-November 2008. (Eduardo Pilo de la Fuente, Antonio Fernández Cardador, Asunción Paloma Cucala García, José Ignacio Pérez Arriaga, Luis Rouco Rodríguez, Ignacio de Loyola Hierro Ausin, Alberto Ruiz Rodríguez)

The aim of the project is to construct, develop, adjust and implement a model that will allow us to explain and predict energy consumption (and associated emissions) in the Spanish transport system by using a coherent methodology for all modes of transport, considering all energy uses (construction, operation, maintenance, movement) and the whole energy cycle, starting from source. This will allow us to anticipate and evaluate the effects of the results of the infrastructure or transport policy. As a secondary aim, the work carried out and the dissemination activity envisaged in the project will allow us to determine and evaluate this energy consumption and assess the impact of any type of measure aimed at reducing said consumption, which will be useful for all transport operators.

The project includes new aspects such as taking into consideration the different routes between two points for various modes of transport, or separating consumption from coefficients of occupancy or use of space.

The project will be carried out over a period of 24 months by a group of public and private entities (universities, companies and institutions) which encompass all modes of transport and which will combine theoretical analysis with verification in practice, and physical aspects with econometric aspects.

### ***B) Consultancy and Technological Support***

#### ***a. Private Funding***

- **Control center requirements of high-speed railway power system**

ADIF. December 2007-December 2010. (José Antonio Rodríguez Mondéjar, Yolanda González Arechavala, Eduardo Pilo de la Fuente, Rafael Santodomingo Berry)

The operational and commercial needs of the Spanish railway operator (ADIF) require power control center to not only perform traditional functions (supervisory & control) but also support many of the new functions, specifically to meet the needs of competition with deregulation. The aim of this project is to establish the requirements of new high speed railway power control centers. The proposal architecture must take into account the requirements of real-time data, security, availability, scalability, information exchange, etc.

- **Optimal design of ATO driving parameters**

Metro de Madrid. November 2007-June 2008. (Antonio Fernández Cardador, Asunción Paloma Cucala García, María Domínguez Gago)

The objective of this project is the design and implementation of ATO speed commands in Metro de Madrid lines. These ATO speed commands will be selected and sent to the train by the traffic regulation system in real-time. For each inter-station a set of 4 speed commands are designed, the flat out command and 3 commands parameterised by coast/re-motor speed or by the regulation speed, as well as the brake deceleration. The new ATO speed commands must comply with technical, operational and comfort restrictions and will minimise the energy consumption.

## 4.3 Publications

### 4.3.1 Books

- Efraim Centeno Hernández, José María Maidagan Palenque, Enrique Lobato Miguélez, Mario Castro Ponce, *“Problemas de introducción al electromagnetismo”*. Editorial: Universidad Pontificia Comillas. ISBN: 978-84-8468-226-4. January 2008.

### 4.3.2 Chapters in books

- Pedro Linares Llamas, M. Pérez Plaza, *“Strategic decisions for green electricity marketing in Spain: learning from past experiences”*. Chapter in the book *“Web-based green products life cycle management systems: Reverse supply chain utilization”*. pp. 250-256. Editorial IGI Publishing. ISBN: 978-1605661148. September 2008.
- José Ignacio Pérez Arriaga, H. Rudnick, Michel Rivier Abbad, *“Electric energy systems: An overview”*. Chapter in the book *“Electric Energy Systems: Analysis and Operation”*. pp. 1-50. Editorial CRC Press. Ed. A. Gomez-Exposito, A. J. Conejo, C. Cañizares. ISBN: 9780849373657. July 2008.
- Pedro Linares Llamas, Francisco Javier Santos Pérez, *“The joint impact of carbon emissions trading and tradable green certificates on the evolution of liberalized electricity markets: The Spanish case”*. Chapter in the book *“Markets for carbon and power pricing in Europe”*. Theoretical issues and empirical analyses”. pp. 213-233. Edward Elgar Publishing. ISBN: 978-1-84720-809-5. May 2008.
- Pedro Linares Llamas, Carlos Romero López, *“Economía y medio ambiente: Herramientas de valoración ambiental”*. Chapter in the book *“Tratado de tributación medioambiental”*. pp. 1189-1225. Editorial Thomson-Aranzadi. ISBN: 978-84-8355-272-8. April 2008.
- José Ignacio Pérez Arriaga, Carlos Batlle López, Michel Rivier Abbad, *“Expansión de la oferta e infraestructura eléctrica en Iberoamérica: generación, transmisión y distribución”*. Chapter in the book *“Energía y regulación en*

Iberoamérica". pp. 153-175. Editorial Aranzadi. ISBN: 978-84-470-2970-9. January 2008.

- Aurelio García Cerrada, Chapter in the book "Problemas de electrónica de potencia". Editorial Pearson/Prentice-Hall. Ed. Andrés Barrado Bautista y Antonio Lázaro Blanco. ISBN: 978-84-205-4652-0. October 2007.
- Jesús María Latorre Canteli, Santiago Cerisola López de Haro, Andrés Ramos Galán, Rafael Bellido, Alejandro Perea, "Creation of hydroelectric system scheduling by simulation". Chapter in the book "Complex decision making: Theory and practice". pp. 83-96. Editorial Springer. ISBN: 3540736646. October 2007.

### **4.3.3 Publications in international journals**

- N. Mosquera, J. Reneses, E.F. Sánchez-Úbeda, "Medium-term risk analysis in electricity markets: A decision-tree approach", International Journal of Energy Sector Management, vol. 2, No. 3, pp. 318-339, ISSN: 1750-6220. September 2008.
- C. Sicre, A.P. Cucala, A. Fernández-Cardador, L. Cano, "A computer tool for automatic braking distance calculation", WIT Transactions on The Built Environment, vol. 103, pp. 807-816, ISSN: 1743-3509. September 2008.
- M. Domínguez, A. Fernández-Cardador, A.P. Cucala, L. Pérez-Cayuela, "Computer-aided design of ATO speed commands according to energy consumption criteria", WIT Transactions on The Built Environment, vol. 103, pp. 183-192, ISSN: 1743-3509. September 2008.
- J.R. Jiménez-Octavio, E. Pilo, "Optimal design of power supply systems using genetic algorithms", WIT Transactions on The Built Environment, vol. 103, pp. 391-400, ISSN: 1743-3509. September 2008.
- R. Santodomingo, E. Pilo, J.A. Rodríguez-Mondéjar, M.A. García-Vaquero, "Adapting the CIM model to describe electrified railway systems", WIT Transactions on The Built Environment, vol. 103, pp. 381-390, ISSN: 1743-3509. September 2008.

- Y. González, J.A. Rodríguez-Mondéjar, G. Latorre-Lario, "Software RAMS: the opportunity", WIT Transactions on The Built Environment, vol. 103, pp. 133-142, ISSN: 1743-3509. September 2008.
- F.A. Campos, J. Villar, J. Barquín, J. Reneses, "Variational inequalities for solving possibilistic risk-averse electricity market equilibrium", IET Proceedings-Generation Transmission and Distribution, vol. 2, No. 5, pp. 632-645, ISSN: 1350-2360. September 2008.
- P. Frías, T. Gómez, D. Soler, "A reactive power capacity market using annual auctions", IEEE Transactions on Power Systems, vol. 23, No. 3, pp. 1458-1468, ISSN: 0885-8950. August 2008.
- P. Linares, F.J. Santos, M. Ventosa, "Coordination of carbon reduction and renewable energy support policies", Climate Policy, vol. 8, No. 4, pp. 377-394, ISSN: 1469-3062. August 2008.
- M. Nicoli, M. Castro, R. Cuerno, "Unified moving-boundary model with fluctuations for unstable diffusive growth", Physical Review E, vol. 78, No. 2, pp. 0-0, ISSN: 1539-3755. August 2008.
- J. Reneses, E. Centeno, "Impact of the Kyoto Protocol on the Iberian electricity market: A scenario analysis", Energy Policy, vol. 36, No. 7, pp. 2376-2384, ISSN: 0301-4215. July 2008.
- O. López-García, A. Carnicero, V. Torres, J.R. Jiménez-Octavio, "The influence of cable slackening on the stiffness computation of railway overheads", International Journal of Mechanical Sciences, vol. 50, No. 7, pp. 1213-1223, ISSN: 0020-7403. July 2008.
- B. Tellini, R. Giannetti, S. Lizón-Martínez, "Sensorless measurement technique for characterization of magnetic material under nonperiodic conditions", IEEE Transactions on Instrumentation and Measurement, vol. 57, No. 7, pp. 1465-1469, ISSN: 0018-9456. July 2008.
- P. Linares, F.J. Santos, M. Ventosa, L. Lapiedra, "Incorporating oligopoly, CO2 emissions trading and green certificates into a power generation expansion model", Automatica, vol. 44, No. 6, pp. 1608-1620, ISSN: 0005-1098. June 2008.

- K. Quizhpe, Á. Baíllo, M. Ventosa, "Valoración de contratos a plazo en mercados eléctricos. Aplicación al mercado ecuatoriano", *Revista IEEE América Latina*, vol. 6, No. 2, pp. 184-193, ISSN: 1548-0992. June 2008.
- M. Rodríguez, I.J. Pérez-Arriaga, J. Rivier, J. Peco, "Distribution network tariffs: A closed question?", *Energy Policy*, vol. 36, No. 5, pp. 1712-1725, ISSN: 0301-4215. May 2008.
- A.L. Arranz, A. Cruz, M.A. Sanz-Bobi, P.R. Castelló, J. Coutiño, "DADICC: Intelligent system for anomaly detection in a combined cycle gas turbine plant", *Expert Systems with Applications*, vol. 34, No. 4, pp. 2267-2277, ISSN: 0957-4174. May 2008.
- J. Barquín, M. Vázquez, "Cournot equilibrium calculation in power networks: An optimization approach with price response computation", *IEEE Transactions on Power Systems*, vol. 23, No. 2, pp. 317-326, ISSN: 0885-8950. May 2008.
- J. García-González, R. Moraga, L. Matres-Santos, A. Mateo, "Stochastic joint optimization of wind generation and pumped-storage units in an electricity market", *IEEE Transactions on Power Systems*, vol. 23, No. 2, pp. 460-468, ISSN: 0885-8950. May 2008.
- F.A. Campos, J. Villar, J. Barquín, J. Ruipérez, "Robust mixed strategies in fuzzy non-cooperative Nash games", *Engineering Optimization*, vol. 40, No. 5, pp. 459-474, ISSN: 0305-215X. May 2008.
- E. Lobato, I. Egido, L. Rouco, G. López-Camino, "An overview of ancillary services in Spain", *Electric Power Systems Research*, vol. 78, No. 3, pp. 515-523, ISSN: 0378-7796. March 2008.
- C. Batlle, C. Solé, M. Rivier, "A new security of supply mechanism for the Iberian Market", *The Electricity Journal*, vol. 21, No. 2, pp. 63-73, ISSN: 1040-6190. March 2008.
- C. Mateo, F.M. De Espinosa, Y. Gómez-Ullate, J.A. Talavera, "Experimental validation of ultrasonic guided modes in electrical cables by optical interferometry", *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control*, vol. 55, No. 3, pp. 629-636, ISSN: 0885-3010. March 2008.

- B. Tellini, R. Giannetti, S. Lizón-Martínez, M. Marracci, "Accommodation study via a sensorless measurement technique", *Physica B - Condensed Matter*, vol. 403, No. 2-3, pp. 482-485, ISSN: 0921-4526. February 2008.
- J.R. Jiménez-Octavio, O. López-García, E. Pilo, A. Carnicero, "Coupled electromechanical optimization of power transmission lines", *CMES: Computer Modeling in Engineering & Sciences*, vol. 25, No. 2, pp. 81-97, ISSN: 1526-1492. February 2008.
- M. Castro, G. Lythe, "Numerical experiments on noisy chains: From collective transitions to nucleation-diffusion", *SIAM Journal on Applied Dynamical Systems*, vol. 7, No. 1, pp. 207-219, ISSN: 1536-0040 . January 2008.
- C. Ibáñez, E. Meléndez, F. Nieto, "Variable ordering schemes to apply to the binary decision diagram methodology for event tree sequences assessment", *Proceedings of the Institution of Mechanical Engineers, Part O: Journal of Risk and Reliability*, vol. 222, No. 1, pp. 7-16, ISSN: 1748-006X (Print) 1748-00. January 2008.
- P. Southwell, E. Lobato, WG C1.2 Members, "Maintenance of acceptable reliability in an uncertain environment", *Electra*, No. 235, pp. 72-86, ISSN: 1286-1146. December 2007.
- L. Olmos, I.J. Pérez-Arriaga, "An assessment of inter-TSO compensation algorithms in the Internal Electricity Market of the European Union", *International Journal of Electrical Power & Energy Systems*, vol. 29, No. 10, pp. 699-712, ISSN: 0142-0615. December 2007.
- R. Gallego, M. Castro, J.M. López, "Pseudospectral versus finite-difference schemes in the numerical integration of stochastic models of surface growth", *Physical Review E*, vol. 76, No. 5, pp. 0-0, ISSN: 1539-3755. November 2007.
- J. Barquín, "Convergencia gas-electricidad y cierre de mercado", *Revista Economía Industrial*, No. 365, pp. 49-54, ISSN: 0422-2784. November 2007.
- P. Linares, L. Muñoz-Moro, A. Ramos, J. Montes, "Internalización de externalidades medioambientales en sistemas eléctricos: Una aplicación para España", *Revista Economía Industrial*, No. 365, pp. 149-162, ISSN: 0422-2784. November 2007.

- J. García-González, A. Muñoz, F.A. Campos, J. Villar, "Connecting the intraday energy and reserve markets by an optimal redispatch", IEEE Transactions on Power Systems, vol. 22, No. 4, pp. 2220-2231, ISSN: 0885-8950. November 2007.
- L. Olmos, I.J. Pérez-Arriaga, "Evaluation of three methods proposed for the computation of inter-TSO payments in the Internal Electricity Market of the European Union", IEEE Transactions on Power Systems, vol. 22, No. 4, pp. 1507-1522, ISSN: 0885-8950. October 2007.
- I.J. Pérez-Arriaga, P. Linares, C. Batlle, J. Barquín, "The major elements for a global climate strategy beyond 2012", IAEE Newsletter, No. Fall, pp. 21-25, ISSN: 1093-4243. October 2007.
- A.P. Cucala, A. Fernández-Cardador, F. de Cuadra, E. Pilo, "An optimisation-based traffic regulator for metro lines", WIT Transactions on The Built Environment, vol. 96, pp. 439-448, ISSN: 1743-3509. September 2007.
- I. Martínez, B. Vitoriano, A. Fernández-Cardador, A.P. Cucala, "Statistical dwell time model for metro lines", WIT Transactions on The Built Environment, No. 96, pp. 223-232, ISSN: 1743-3509. September 2007.
- C. Batlle, C. Vázquez, M. Rivier, I.J. Pérez-Arriaga, "Enhancing power supply adequacy in Spain: Migrating from capacity payments to reliability options", Energy Policy, vol. 35, No. 9, pp. 4545-4554, ISSN: 0301-4215. September 2007.
- P.L. Roncero-Sánchez, A. García-Cerrada, V. Feliú, "Rotor-resistance estimation for induction machines with indirect field orientation", Control Engineering Practice, vol. 15, No. 9, pp. 1119-1133, ISSN: 0967-0661. September 2007.
- J. García-González, E. Parrilla, A. Mateo, "Risk-averse profit-based optimal scheduling of a hydro-chain in the day-ahead electricity market", European Journal of Operational Research, vol. 181, No. 3, pp. 1354-1369, ISSN: 0377-2217. September 2007.
- J.M. Latorre, S. Cerisola, A. Ramos, "Clustering algorithms for scenario tree generation: Application to natural hydro inflows", European Journal of Operational Research, vol. 181, No. 3, pp. 1339-1353, ISSN: 0377-2217. September 2007.

- S. López, P. Sánchez, J. de la Hoz-Ardiz, J. Fernández-Caro, "*Estimating conjectural variations for electricity market models*", *European Journal of Operational Research*, vol. 181, No. 3, pp. 1322-1338, ISSN: 0377-2217. September 2007.
- A. Ramos, I. Adler, "*A further step in decision support models for energy markets*", *European Journal of Operational Research*, vol. 181, No. 3, pp. 1243-1244, ISSN: 0377-2217. September 2007.

#### 4.3.4 Publications in national journals

- I. Egado, F. Fernández-Bernal, L. Rouco, E. Porrás, A. Saiz-Chicharro, "*Reguladores de zona para el control automático de la generación*", *Anales de Mecánica y Electricidad*, vol. LXXXV, No. IV, pp. 38-43, ISSN: 0003-2506. July 2008.
- M. Such, J.R. Jiménez-Octavio, A. Carnicero, O. López-García, "*Modelado de estructuras de cables*", *Anales de Mecánica y Electricidad*, vol. LXXXV, No. IV, pp. 22-27, ISSN: 0003-2506. July 2008.
- J.M. Latorre, A. Ramos, R. Palacios, "*Optimización bajo incertidumbre. Técnicas de descomposición y aplicación en Grid*", *Anales de Mecánica y Electricidad*, vol. LXXXV, No. IV, pp. 28-36, ISSN: 0003-2506. July 2008.
- A. Ramos, M.T. Peña, A. Fernández-Cardador, A.P. Cucala, "*Mathematical programming approach to underground timetabling problem for maximizing time synchronization*", *Revista CEPADE*, No. 35, pp. 88-95, ISSN: 1132-175x. June 2008.
- J.M. Latorre, R. Palacios, A. Ramos, "*Entornos Grid. Sistemas distribuidos para cálculo masivo*", *Anales de Mecánica y Electricidad*, vol. LXXXV, No. III, pp. 32-39, ISSN: 0003-2506. May 2008.
- I. Egado, F. Fernández-Bernal, L. Rouco, E. Porrás, A. Saiz-Chicharro, "*El control automático de la generación en el sistema peninsular español*", *Anales de Mecánica y Electricidad*, vol. LXXXV, No. III, pp. 26-31, ISSN: 0003-2506. May 2008.

### 4.3.5 Invited sessions and Communications in congress

#### 4.3.5.1 Invited sessions

- P. Linares, "*Modelos energéticos sostenibles*". Encuentro "Desarrollo sostenible: Un nuevo recurso económico". Universidad Internacional Menéndez Pelayo. Monforte de Lemos. Lugo, Spain, 15 September 2008.
- P. Sánchez, F.A. Campos, "*Marginalistic bidding for cross border transmission capacity*". XIV Congreso Latino Ibero Americano de Investigación de Operaciones - CLAIO 2008. ISBN: 978 958 825283-4. Cartagena de Indias, Colombia, 9-12 September 2008.
- C.A. Díaz, F.A. Campos, J. Villar, "*Linear supply functions determination in electricity market equilibrium*". XIV Congreso Latino Ibero Americano de Investigación de Operaciones - CLAIO 2008. ISBN: 978 958 825283-4. Asociación Latino-Americana de Investigación de Operaciones. Cartagena de Indias, Colombia, 9-12 September 2008.
- P.L. Roncero-Sánchez, V. Feliú, A. García-Cerrada, "*Aplicación del control repetitivo a un filtro activo paralelo con hilo neutro*". Seminario Anual de Automática, Electrónica Industrial e Instrumentación - SAAEI 2008. ISBN-CD-13: 978-84-96997-04-2. Universidad Politécnica de Cartagena. Murcia, Spain, 8-11 September 2008.
- P.L. Roncero-Sánchez, E. Acha, J.E. Ortega-Calderón, V. Feliú, A. García-Cerrada, "*Repetitive control for a dynamic voltage restorer for power-quality improvement*". Seminario Anual de Automática, Electrónica Industrial e Instrumentación - SAAEI 2008. ISBN-CD-13: 978-84-96997-04-2. Universidad Politécnica de Cartagena. Murcia, Spain, 8-11 September 2008.
- A.P. Cucala, A. Fernández-Cardador, M. Domínguez, L. Pérez-Cayuela, "*EFIREG: Computer-aided design of energy-efficient ATO speed commands*". II Jornadas Estrategias de Ahorro y Eficiencia Energética en el Transporte Ferroviario. Sitges, Barcelona, Spain, 5-6 June 2008.
- P. Linares, "*Implicaciones para el agua de los escenarios energéticos mundiales de la Agencia Internacional de la Energía*". Semana Temática: Agua, Energía y Sostenibilidad. Expo Zaragoza 2008. Zaragoza, Spain, 2 September 2008.

- P. Linares, "*Integrating climate policy and renewables targets*". Conference on Electricity Markets. París, France, 3 July 2008.
- J.D. Muñoz Frías, S. Alexandres, C. Rodríguez-Morcillo, "*Microprocesador RISC sintetizable en FPGA para fines docentes*". VIII Congreso de Tecnologías Aplicadas a la Enseñanza de la Electrónica (TAEE'08). Departamento de Ingeniería, Electrónica y Comunicaciones (Universidad de Zaragoza). Zaragoza, Spain, 2-4 July 2008.
- P. Linares, "*Medio ambiente, energías renovables y garantía de suministro*". Jornada sobre Regulación del Sector Eléctrico: Asuntos Pendientes. Fundación Alternativas. Madrid, Spain, 25 June 2008.
- E. Pilo, "*El proyecto ElecRail*". II Jornadas Estrategias de Ahorro y Eficiencia Energética en el Transporte Ferroviario. Sitges, Barcelona, Spain, 5-6 June 2008.
- A. Fernández-Cardador, A.P. Cucala, M.T. Peña, A. Ramos, C. Rodríguez, "*Sincronización de arranques y paradas en metropolitanos para el uso eficiente del frenado regenerativo*". II Jornadas Estrategias de Ahorro y Eficiencia Energética en el Transporte Ferroviario. Sitges, Spain, 5-6 June 2008.
- T. Gómez, "*Integration of distributed generation on distribution networks. Regulatory issues:an European perspective*". Seminario: A Logical and EDP forum for InovGrid. Lisboa, Portugal, 26 May 2008.
- P. Frías, T. Gómez, R. Cossent, "*Overview of costs and benefits and regulatory improvements needed for more DER integration in EU*". i-SUP 2008 - Innovation for Sustainable Production. Flemish Institute for Technological Research. Brujas, Belgium, 22-25 April 2008.
- P.L. Roncero-Sánchez, V. Feliú, A. García-Cerrada, "*Predictive-integral current controller for active- and reactive-power control of wind generators*". International Conference on Renewable Energies and Power Quality 2008 (ICREPQ'08). ISBN 978-84-611-9290-8. Santander, Spain, 12-14 March 2008.
- T. Gómez, "*Integración de la generación distribuida. Proyecto DG\_GRID: Interacción DSO/DG*". Seminario UCUF: Aula Calidad, Medioambiente e I+D. Madrid, Spain, 24 January 2008.

- E. Pilo, "*The development of the electrification as a dependable fuel solution*". Future Fuels Rail Traction 2008. London, U.K., 22-23 January 2008.
- P. Linares, "*Incorporating oligopoly, CO2 emissions trading and green certificates into a power generation expansion model*". Workshop on Industrial Economics: Capacity investments in liberalized electricity markets. Universidad de Vigo. Vigo, Spain, 3 October 2007.
- A. Ramos, M.T. Peña, A. Fernández-Cardador, A.P. Cucala, "*Mathematical programming approach to underground timetabling problem for maximizing time synchronization*". International Conference on Industrial Engineering (CIO 2007). ISBN 978-84-611-8244-2. pp. 1395-1405. Madrid, Spain, 5-7 September 2007.

### 4.3.5.2 Communications

- C. Ibáñez, A. Rauzy, E. Meléndez, F. Nieto, "*Variable ordering techniques for the application of BDD on PSA linked Fault Tree models*". European Safety & Reliability Association (ESRA) and 17th Society for Risk Analysis Europe (SRA-E) Conferences (ESREL'08). Valencia, Spain, 22-25 September 2008.
- J. Arroyo, C. Maté, "*Forecasting time series of observed distributions with smoothing methods based on the barycentric histogram*". 8th International FLINS Conference on Computational Intelligence in Decision and Control. Madrid, Spain, 21-24 Septiembre 2008.
- Y. González, J.A. Rodríguez-Mondéjar, G. Latorre-Lario, "*Software RAMS: the opportunity*". XI International Conference on COMPRAIL2008 - Computer System Design and Operation in the Railway and Other Transit Systems. Universidad Castilla-La Mancha. ISBN: 9781845641269. Toledo, Spain, 15-17 September 2008.
- C. Sicre, A.P. Cucala, A. Fernández-Cardador, L. Cano, "*A computer tool for automatic braking distance calculation*". XI International Conference on COMPRAIL2008 - Computer System Design and Operation in the Railway and Other Transit Systems. Universidad Castilla-La Mancha. ISBN: 9781845641269. Toledo, Spain, 15-17 Septiembre 2008.
- R. Santodomingo, E. Pilo, J.A. Rodríguez-Mondéjar, M.A. García-Vaquero, "*Adapting the CIM model to describe electrified railway systems*". XI

International Conference on COMPRAIL2008 - Computer System Design and Operation in the Railway and Other Transit Systems. Universidad Castilla-La Mancha. ISBN: 9781845641269. Toledo, Spain, 15-17 September 2008.

- J.R. Jiménez-Octavio, E. Pilo, "*Optimal design of power supply systems using genetic algorithms*". XI International Conference on COMPRAIL2008 - Computer System Design and Operation in the Railway and Other Transit Systems. Universidad Castilla-La Mancha. ISBN: 9781845641269. Toledo, Spain, 15-17 September 2008.
- M. Domínguez, A. Fernández-Cardador, A.P. Cucala, L. Pérez-Cayuela, "*Computer-aided design of ATO speed commands according to energy consumption criteria*". XI International Conference on COMPRAIL2008 - Computer System Design and Operation in the Railway and Other Transit Systems. Universidad Castilla-La Mancha. ISBN: 9781845641269. Toledo, Spain, 15-17 September 2008.
- A. Ramos, "*Some IIT operations research models for electricity markets*". XIV Congreso Latino Ibero Americano de Investigación de Operaciones (CLAIO 2008). ISBN 978-958-825283-4. Asociación Latino-Americana de Investigación de Operaciones. Cartagena de Indias, Colombia, 9-12 September 2008.
- A. Ramos, L. Olmos, J.M. Latorre, I.J. Pérez-Arriaga, "*Modeling medium term hydroelectric system operation with large-scale penetration of intermittent generation*". XIV Congreso Latino Ibero Americano de Investigación de Operaciones (CLAIO 2008). ISBN 978-958-825283-4. Asociación Latino-Americana de Investigación de Operaciones. Cartagena de Indias, Colombia, 9-12 September 2008.
- J.R. Jiménez-Octavio, M. Such, A. Carnicero, O. López-García, "*Validation of simulation approaches for catenary-pantograph dynamics*". Ninth International Conference on Computational Structures Technology. Athens, Greece, 2-5 September 2008.
- F.M. Echavarren, L. Rouco, E. Navarro, J.P. Fernández, A. González, "*Computation of the current rating in underground installations with multiple cables*". CIGRE Session 2008. París, France, 24-29 August 2008.
- J.J. Sánchez, J. Barquín, E. Centeno, A. López-Peña, "*A multidisciplinary approach to model long-term investments in electricity generation: Combining*

*system dynamics, credit risk theory and game theory*". IEEE General Meeting 2008. Pittsburgh (Pennsylvania), USA, 20-24 July 2008.

- J. García-González, "*Hedging strategies for wind renewable generation in electricity markets*". 2008 IEEE Power and Energy Society General Meeting - Conversion and Delivery of Electrical Energy in the 21st Century. pp. 1-6. ISBN: 978-1-4244-1905-0. Pittsburgh (Pennsylvania), USA, 20-24 July 2008.
- J. Barquín, "*Symmetry properties of conjectural price responses*". IEEE General Meeting 2008. Pittsburgh, Pennsylvania, USA, 20-24 July 2008.
- P. Frías, T. Gómez, D. Soler, "*Remuneration and charging procedures for competitive procurement of reactive power capacity*". IEEE PES General Meeting. Pittsburgh (Pennsylvania), USA, 20-24 July 2008.
- M. Castro, "*Ecuaciones genéricas de formación de patrones en interfases*". Congreso NoLineal 2008. Universidad Politécnica de Cataluña. Barcelona, Spain, 16-19 July 2008.
- E. Centeno, J. Barquín, A. López-Peña, J.J. Sánchez, "*Effects of gas-production constraints on generation expansion*". 16th Power Systems Computation Conference - PSCC 08. Glasgow, Scotland, 14-18 July 2008.
- F.M. Echavarren, L. Rouco, E. Lobato, "*Total transfer capability computation and improvement in interconnected electric power systems*". 16th Power Systems Computation Conference - PSCC 08. Glasgow, Scotland, 14-18 July 2008.
- J. García-González, J. Barquín, P. Dueñas, "*A hybrid approach for modeling electricity price series in the medium term*". PSCC 2008, 16th Power Systems Computation Conference. Glasgow, Scotland, 14-18 July 2008.
- P. Frías, T. Gómez, J. Rivier, "*Integration of distributed generation in distribution networks: regulatory challenges*". PSCC 2008, 16th Power Systems Computation Conference. Glasgow, Scotland, 14-18 July 2008.
- L. Olmos, I.J. Pérez-Arriaga, "*Definition of single price areas within a regional electricity system*". 16th Power Systems Computation Conference - PSCC 08. Glasgow, Scotland, 14-18 July 2008.

- A. González, T. Gómez, "*Use of system tariffs for distributed generators*". 16th Power Systems Computation Conference - PSCC 08. Glasgow, Scotland, 14-18 July 2008.
- A. González, F.M. Echavarren, L. Rouco, T. Gómez, "*A tool for reconfigurariion of large-scale distribution networks*". 16th Power Systems Computation Conference - PSCC 08. Glasgow, Scotland, 14-18 July 2008.
- P. Linares, M. Rodríguez, X. Labandeira, "*An integrated approach to simulate the impacts of the EUETS on the Spanish Economy*". 3rd Atlantic Workshop on Energy and Environmental Economics "Climate Change Policies after 2012". Universidad de Vigo. A Toxa, Spain, 4-5 July 2008.
- A. Arenas, R. Palacios, R.R. Pecharromán, F.L. Pagola, "*Full-size prototype on active thermal windows based on thermoelectricity*". ECT2008 - 6th European Conference on Thermoelectrics. pp. O.18.1-O.18.4. L'Ecole Nationale Supérieure de Chimie. París, France, 2-4 July 2008.
- P. Linares, F.J. Santos, I.J. Pérez-Arriaga, "*Scenarios for the evolution of the Spanish electricity sector: Is it on the right path towards sustainability?*". International Energy Workshop 2008 (IEW). International Energy Agency. París, France, 30 June-2 July 2008.
- C. Maté, "*A Nonparametric Bayesian approach to forecast combination*". 28th International Symposium on Forecasting - ISF2008. Nice, France, 22-25 June 2008.
- A. Muñoz, A. Cruz, J. Zamora, R. Espínola, "*Forecasting electricity prices with periodic dynamic regression models*". 28th International Symposium on Forecasting - ISF2008. Nice, France, 22-25 June 2008.
- M.T. Peña, A. Fernández-Cardador, A.P. Cucala, A. Ramos, "*Mathematical programming approach to underground timetabling for maximizing the use of regenerative braking power*". International Workshop on Operational Research (IWOR). Madrid, Spain, 5-7 June 2008.
- A. Ramos, S. Cerisola, J.M. Latorre, "*Non linear hydrothermal stochastic optimization model*". International Workshop on Operational Research (IWOR). Madrid, Spain, 5-7 June 2008.

- J. Barquín, "Energy auctions for regulated demand in the Iberian market: a proposal". 5th International Conference on the European Electricity Market - EEM 08. Lisboa, Portugal, 28-30 May 2008.
- C. Ibáñez, A. Rauzy, "Variable ordering heuristics for BDD based on minimal cutsets". International Probabilistic Safety Assessment and Management Conference (PSAM9). Hong Kong, China, 18-23 May 2008.
- E. Pilo, L. Rouco, A. Fernández-Cardador, "A multi-criteria approach to the analysis of modified 2x25kV bi-voltage systems using higher negative voltages". 8th World Congress on Railway Research. Seoul, Korea, 18-22 May 2008.
- B. Tellini, R. Giannetti, S. Lizón-Martínez, "Measurement of magnetic accomodation through a sensorless technique". International Instrumentation and Measurement Technology Conference, I2MTC'2007. pp. 547-551, ISSN: 1091-5281, ISBN: 1-4244-1541-1. Victoria, Canada, 12-15 May 2008.
- J. Barquín, "Modeling market power in absence of historical information: the conjectural response approach". Third International Conference on Electric Utility Deregulation and Restructuring and Power Technologies - DRPT 2008. Nanjing, China, 6-9 April 2008.
- J. Pascual, M.A. Sanz-Bobi, D. Contreras, "Intelligent system for assisting elderly people at home". 2008 International Conference on Health Informatics (HEALTHINF). ISBN: 978-989-8111-16-6. Madeira, Portugal, 28-31 January 2008.
- P. Linares, F.J. Santos, I.J. Pérez-Arriaga, "Scenarios for the evolution of the Spanish electricity sector: is it on the right path towards sustainability?". III Congreso de la Asociación Española para la Economía Energética (AEEE). Bilbao, Spain, 17-18 January 2008.
- J. Barquín, "Una propuesta para el mecanismo de subastas de distribución en el MIBEL". III Congreso de la Asociación Española para la Economía Energética. Bilbao, Spain, 17-18 January 2008.
- M. Pérez-Plaza, P. Linares, "Strategic decisions for green electricity marketing: learning from past experiences". III Congreso de la Asociación Española para la Economía Energética (AEEE). Bilbao, Spain, 17-18 January 2008.

- R.R. Pecharromán, R. Giannetti, C. Heller, J. Herrero, "*Inside Tech USA Summer Course: A Leadership Program that Offers New Qualifications for Engineers*". Meeting the Growing Demand for Engineers and Their Educators 2010-2020. Munich, Germany, 9-11 November 2007.
- J.J. Sánchez, J. Barquín, E. Centeno, "*Fighting market power by auctioning generation: A system dynamics approach*". INFORMS Annual Meeting 2007. Seattle, USA, 4-7 November 2007.
- A. Ugedo, E. Lobato, "*Generator load profiles estimation using artificial intelligence*". 14th International Conference on Intelligent Systems Applications to Power Systems (ISAP 2007). Kaohsiung, Taiwan, 4-8 November 2007.
- A. Ramos, R. Bellido, S. Cerisola, J.M. Latorre, A. Perea, "*A medium term multireservoir hydrothermal coordination model by stochastic programming*". INFORMS Annual Meeting 2007. Seattle, USA, 3-7 November 2007.
- R. Giannetti, A. Muñoz, J. Rodríguez, R.R. Pecharromán, "*WIP: Design of a New European Higher Education Area Degree in Electronics and Control Engineering*". 37th Annual Frontiers in Education Conference (FIE). ASEE/IEEE. Milwaukee, USA, 10-13 October 2007.
- A. Cruz, A. Muñoz, J. Zamora, R. Espínola, J. Alonso, "*Modelos lineales y no lineales de series temporales para la predicción a corto plazo del precio de la energía en el mercado eléctrico español*". II Simposio de Inteligencia Computacional, SICO'2007 (IEEE Computational Intelligence Society, SC). Zaragoza, Spain, 11-14 September 2007.
- P. Sánchez, A. Ramos, "*Optimal location and management of a biomass inventory facility*". XI Congreso de Ingeniería de Organización. International Conference on Industrial Engineering and Industrial Management (CIO 2007). ISBN 978-84-611-8244-2. pp. 843-852. Madrid, Spain, 5-7 September 2007.
- I. Martínez, B. Vitoriano, A. Fernández-Cardador, A.P. Cucala, "*Statistical dwell time model for metro lines*". Urban Transport International Conference. Coimbra, Portugal, 3-5 September 2007.
- A.P. Cucala, A. Fernández-Cardador, F. de Cuadra, E. Pilo, "*An optimisation-based traffic regulator for metro lines*". Urban Transport International Conference. Coimbra, Portugal, 3-5 September 2007.

#### 4.3.6 IIT working papers

- Luis Olmos Camacho, José Ignacio Pérez Arriaga, *"A comprehensive approach for computation and implementation of efficient electricity transmission network charges"*. IIT Internal Paper. June 2008. (IIT-08-018A)
- Tomás Gómez San Román, Javier Reneses Guillén, Pablo Frías Marín, Carlos Mateo Domingo, *"Impact of active demand response programs on distribution investment deferral"*. IIT Internal Paper. May 2008. (IIT-08-005A)
- Carlos Batlle López, *"A methodology to allocate the cost of national support schemes for renewables"*. IIT Internal Paper. April 2008. (IIT-08-017A)
- Carlos Batlle López, Pablo Rodilla Rodríguez, *"Electricity demand response tools: status quo and outstanding issues"*. IIT Internal Paper. March 2008. (IIT-08-006A)
- Pedro Linares Llamas, José Ignacio Pérez Arriaga, *"Markets vs. regulation: A role for indicative energy planning"*. IIT Internal Paper. Submitted to The Energy Journal. January 2008.
- Pedro Linares Llamas, *"Scenarios for the evolution of the Spanish electricity sector: Is it on the right path towards sustainability?"*. IIT Internal Paper. Accepted to Energy Policy, Forthcoming: 2008.
- Pedro Linares Llamas, Francisco Javier Santos, José Ignacio Pérez Arriaga, *"Are inconsistent decisions better? An experiment with pairwise comparisons"*. IIT Internal Paper. Accepted to European Journal of Operations Research, Forthcoming: 2008.
- José Ignacio Pérez Arriaga, Carlos Batlle López, Michel Rivier Abbad, Tomás Gómez San Román, *"Expansión de la oferta e infraestructura eléctrica en Iberoamérica: generación, transmisión y distribución"*. IIT Internal Paper. Chapter in book: *"Libro sobre la energía y regulación en Iberoamérica"*. Comisión Nacional de Energía, Madrid. First Version: January 2008 (IIT-08-001A)
- Juan José Sánchez Domínguez, Julián Barquín Gil, Efraim Centeno Hernaez, *"Combining system dynamics and game theory to analyse strategic behaviours in electricity markets: A study of the influence of forward markets"*. IIT Internal Paper. Submitted to System Dynamics Review. January 2008 (IIT-08-003A)

- Juan José Sánchez Domínguez, Derek W. Bunn, Efraim Centeno Hernaez, Julián Barquín Gil, *“Dynamics in forward and spot electricity markets”*. IIT Internal Paper. Submitted to IEEE Transaction on Power Systems. January 2008. (IIT-08-002A)
- Santiago Cerisola López de Haro, Jesús Latorre Canteli, Andrés Ramos Galán, *“Stochastic integer programming solution through a convexification method”*. IIT Internal Paper. Submitted to Computational Management Science. December 2007 (IIT-07-031A)
- Juan José Sánchez Domínguez, Julián Barquín Gil, Efraim Centeno Hernández, Alvaro López Peña, *“Generation expansion planning: Forecasting and investment decisions in a system dynamics based model”*. IIT Internal Paper. December 2007 (IIT-07-029A)

#### 4.3.7 IIT Technical Reports

This section presents both reports prepared for entities with which IIT collaborates (typically confidential) and research results that have not been published yet.

- IIT-07-022I. *“Principles and criteria to estimate the contribution of the groups to the power system firmness: the not-so-well-known firm capacity”*. Carlos Batlle López, Miguel Vázquez Martínez, Pablo Rodilla. September 2007.
- IIT-07-023I. *“A new security of supply mechanism for the Iberian Market”*. Carlos Batlle López, Carlos Solé Martín, Michel Rivier Abbad. September 2007.
- IIT-07-024I. *“Design criteria for implementing a capacity mechanism in a liberalized electricity market”*. Carlos Batlle López, José Ignacio Pérez Arriaga. September 2007.

#### 4.4 Research Sufficiency Degree

The following students, involved in the IIT Research Training Program and supervised by a member of IIT research staff, have obtained during the present

academic year the Research Sufficiency Degree, after publicly defending their Research Dissertation.

- Victoria Quinteiro Moreno. October 2007
- David Trebolle Trebolle. October 2007
- Alezeia González García. March 2008
- Manuel Rojas Guerrero. May 2008
- Teresa Sánchez Carazo. May 2008
- Iosu Miren Martínez Martínez. June 2007
- Cristina Puente Águeda. July 2008
- Pablo Rodilla Rodríguez. July 2008
- Miguel Vázquez Martínez. July 2008
- Jorge Carrascal García. September 2008

## **4.5 Doctoral Theses**

The doctoral theses that appear below have been developed at IIT or supervised by IIT permanent staff. In most cases, the theses are directly linked to research projects undertaken by the Institute.

### **4.5.1 Submitted Theses**

- *Resolution distributed stochastic optimization problems.*  
Author: Jesús María Latorre Canteli.  
Supervisors: Andrés Ramos Galán, Rafael Palacios Hielscher  
Date: 15<sup>th</sup> November, 2007.

- *A regulatory model proposal for voltage control in electric power systems.*  
Author: Pablo Frías Marín.  
Supervisors: Tomás Gómez San Román, David Soler Sonería  
Date: 13<sup>th</sup> February, 2008.
- *Method to define an information system for the management of intangible assets, based on the method of borrosificación DELPHI. The art of engineering.*  
Author: Javier Tapia Cuevas  
Supervisors: Ángel Sarabia Viejo, Raquel Caro Carretero  
Date: 8<sup>th</sup> September, 2008.

#### 4.5.2 Ongoing Theses

- *Conflict resolution between agents on distributed artificial intelligence systems applied to the industrial diagnosis.*  
Author: Gustavo Plaza González  
Supervisor: Miguel Angel Sanz Bobi
- *Reliability options for long term guarantee of supply in deregulated power systems.*  
Author: Ernesto Parrilla Pozzy  
Supervisors: Carlos Vázquez Martínez, José Ignacio Pérez Arriaga
- *Study of the thermoelectric phenomena using the boundary element method and experimental techniques.*  
Author: Jorge Vázquez Arias  
Supervisors: José Ignacio Linares Hurtado, Rafael Palacios Hielscher
- *Electric tariff design: Distribution network tariffs.*  
Author: María Pía Rodríguez Ortega  
Supervisors: Juan Rivier Abbad, Jesús Pascual Peco González
- *A methodology for the prediction with data symbolic.*  
Author: Javier Arroyo Gallardo.  
Supervisor: Carlos Maté Jiménez
- *Development of a reference network model for the regulation of distribution.*  
Author: Javier Cimadevila García  
Supervisor: Juan Rivier Abbad

- *A decision-aid methodology for appropriate rural electrification in developing countries.*  
Author: Francisco Javier Santos Pérez  
Supervisor: Pedro Linares Llamas
- *Development of a methodology for the automatic selection and application of automatic learning techniques.*  
Author: Rocío Martínez López  
Supervisor: Miguel Angel Sanz Bobi
- *Optimal design of small batch production in multi-model vehicles assembly chains.*  
Author: Santiago López de Haro  
Supervisors: Pedro Sánchez Martín, Andrés Ramos Galán
- *Strategic analysis of the long term planning of the generation capacity in liberalized electrical markets.*  
Author: Juan José Sánchez Domínguez  
Supervisors: Efraim Centeno Hernaez, Julián Barquín Gil
- *Model of integrated management of the resources generation and elaboration of optimum bids on a sequence of short-term.*  
Author: Alejandro Ugedo Álvarez-Ossorio  
Supervisor: Enrique Lobato Miguélez
- *Paradigm Simulation-based adaptive agents, aimed to support decision making within the telecommunications market.*  
Author: Antonio Puente Sánchez  
Supervisor: Miguel Angel Sanz Bobi
- *Diagnosis of biochemistry and technological process of production of bioethanol through automatic learning.*  
Author: Pablo Ruiz Castelló  
Supervisors: Julio Montes Ponce de León, Miguel Angel Sanz Bobi
- *The energy intensity in Spain: key to understanding its evolution.*  
Author: María Mendiluce Villanueva  
Supervisors: José Ignacio Pérez Arriaga, Carlos Ocaña Pérez de Tudela
- *Analysis of electricity markets is not ideal: interconnections and functions of non-convex costs.*

Author: Félix Fernández Menéndez  
Supervisors: Julián Barquín Gil, Begoña Vitoriano Villanueva

- *Collective intelligence in the Internet: interaction semantics between artificial and human agents.*  
Author: Antonio Arranz Matía  
Supervisor: Miguel Angel Sanz Bobi
- *Liberalization vs. regulation: an assessment of the transition to competition in the electricity sector. Practical application to the Spanish case.*  
Author: Alberto Nuñez Fernández  
Supervisor: José Ignacio Pérez Arriaga
- *Dynamic analysis and optimization for high speed catenaries.*  
Author: Jesús Jiménez Octavio  
Supervisor: Alberto Carnicero López, Eduardo Pilo de la Fuente
- *Implementation of the binary decision diagrams to the integrated analysis of safety.*  
Author: Cristina Ibañez Llano  
Supervisor: Francisco Nieto Fuentes



## 5 Other Activities

### 5.1 International Exchanges

It is an IIT policy to encourage and support, within its means, those IIT members wishing to complete their studies and research abroad.

Several IIT members visited foreign universities or organizations in the capacity of visiting scientists or visiting engineers, collaborating on specific projects and gaining valuable experience on research problems.

- Antonio Muñoz San Roque, invited researcher, Research Center NESC, Universidad Federal do Pará, Belem (Brazil). Program Hispano-Brazilian Cooperation Interuniversity. Funded by the Ministry of Education and Science. August-September 2007.
- Miguel Ángel Sanz Bobi, invited researcher, Research Center NESC, Universidad Federal do Pará, Belem (Brazil). Program Hispano-Brazilian Cooperation Interuniversity. Funded by the Ministry of Education and Science. August-September 2007.
- Carlos Maté Jiménez, invited researcher, Department of Economics, University of California, Riverside, California (USA). September-December 2007.
- Pedro Linares Llamas, invited researcher, MIT Center for Energy and Environmental Policy Research, Cambridge (USA). April 2008.

- Mariano Ventosa Rodríguez, invited researcher, Department of Geography and Environmental Engineering, Johns Hopkins University, Baltimore, Maryland (USA). June-September 2008.
- José Daniel Muñoz Frías, invited researcher, Research Center NESC, Universidad Federal do Pará, Belem (Brazil). Program Hispano-Brazilian Cooperation Interuniversity. Funded by the Ministry of Education and Science. August 2008.
- Sadot Alexandres Fernández, invited researcher, Research Center NESC, Universidad Federal do Pará, Belem (Brazil). Program Hispano-Brazilian Cooperation Interuniversity. Funded by the Ministry of Education and Science. August 2008.
- Carlos Rodríguez-Morcillo García, invited researcher, Haute Ecole d'Ingénierie et de Gestion du Canton de Vaud, Yverdon-les-bains (Switzerland). Funded by the Ministry of Education and Science. September 2008.

## 5.2 Consultancy and Courses

Courses offered to external entities and consultancy activities are usually linked to research projects.

- Mariano Ventosa Rodríguez, Invited conference: "*Modeling Risk Management in Oligopolistic Electricity Markets: A Benders Decomposition Approach*". Atlantic Energy Group (AEG) Meeting #2-2008 at the Federal Energy Regulatory Commission. Washington DC (USA). September 2008.
- Efraim Centeno Hernández, Javier Reneses Guillén, "*UETP Course: Models for electricity generation strategy in the 21st century: new roles and new approaches*". Madrid (Spain). September 2008.
- Eduardo Pilo de la Fuente, "*Alimentação em energia elétrica das redes ferroviárias de alta velocidade*". Ciclo de Formação Avançada na Ferrovia. Módulo Peral". INESC/FEUP. Porto (Portugal). July 2008.
- Carlos Batlle López, "*FSR Summer School on Regulation of Energy Utilities*". Florence School of Regulation. Florence (Italy). June-July 2008.

- Mariano Ventosa Rodríguez, Pedro Linares Llamas, Carlos Batlle López, Tomás Gómez San Román, Pablo García González, Michel Rivier Abbad, Julián Barquín Gil, *“Curso sobre Nuevas tendencias en el Sector Eléctrico”*. EDIMA. On-line course. July-October 2008.
- Luis Rouco Rodríguez, *“Curso sobre estabilidad de pequeña perturbación en sistemas de energía eléctrica”*. Red Eléctrica de España (REE). June 2008.
- Andrés Ramos Galán, *“Modelos de planificación de la explotación de la generación eléctrica”*. Invited session in Máster en Administración de Empresas e Ingeniería de Organización (MBAE). Universidad de Castilla-La Mancha. Ciudad Real (Spain). May 2008.
- Eugenio Francisco Sánchez Úbeda, *“Métodos avanzados en la predicción de series temporales”*. Invited session in Máster en Administración de Empresas e Ingeniería de Organización (MBAE). Universidad de Castilla-La Mancha. Ciudad Real (Spain). May 2008.
- Eugenio Francisco Sánchez Úbeda, *“Predicción de series de consumo energético”*. Invited session in Máster en Administración de Empresas e Ingeniería de Organización (MBAE). Universidad de Castilla-La Mancha. Ciudad Real (Spain). May 2008.
- Antonio Muñoz San Roque, *“Curso de análisis de curvas de oferta con la herramienta IDAT”*. Global 3. May 2008.
- José Villar Collado, *“Representación del Conocimiento mediante Conjuntos Borrosos”*. Invited session in Máster en Administración de Empresas e Ingeniería de Organización (MBAE). Universidad de Castilla-La Mancha. Ciudad Real (Spain). April 2008.
- José Villar Collado, *“Algoritmos Genéticos”*. Invited session in Máster en Administración de Empresas e Ingeniería de Organización (MBAE). Universidad de Castilla-La Mancha. Ciudad Real (Spain). April 2008.
- Carlos Maté Jiménez, *“Introducción a los Métodos y Modelos de Decisión”*. Invited session in Máster en Administración de Empresas e Ingeniería de Organización (MBAE). Universidad de Castilla-La Mancha. Ciudad Real (Spain). April 2008.
- Carlos Batlle López, *“FSR advanced training course on electricity markets”*. Florence School of Regulation. Florence (Italy). April 2008.

- Carlos Batlle López, *"Modelaje matemático de subastas de energía eléc"*. DecisionWare Ltda. Bogota (Colombia). March 2008.
- Antonio Muñoz San Roque, Carlos Maté Jiménez, *"Curso para usuarios de empresa "Introducción a la predicción de series temporales energéticas"*. Madrid (Spain). February 2008.
- Andrés Ramos Galán, Javier García González, *"Seminarios optimización del despacho de generación y compromiso de unidades"*. Comisión Nacional de la Energía. Santo Domingo (Dominican Rep.). February-March 2008.
- Carlos Maté Jiménez, *"Forecasting Methods for Symbolic Data - Some Comments for Bayesian Developments"*. Department of Statistics, University of California, Los Angeles (USA). November-December 2007.
- Ignacio Egido Cortés, Francisco Miguel Echavarren Cerezo, *"Course ESS/UETP: New challenges to ancillary services regulation and operation"*. Madrid (Spain). November 2007
- Tomás Gómez San Román, Carlos Batlle López, Mariano Ventosa Rodríguez, Michel Rivier Abbad, *"FSR e-learning course on Regulation of Energy Utilities (3rd Edition)"*. Florence School of Regulation. Florence (Italy). November 2007 – June 2008
- José Ignacio Pérez Arriaga, Tomás Gómez San Román, Damián Laloux Dallemagne, Mariano Ventosa Rodríguez, Pedro Linares Llamas, Julián Barquín Gil, Carlos Batlle López, Michel Rivier Abbad, *"Curso on-line sobre Regulación del Sector Eléctrico. 5ª Edición"*. Centro de Educación a Distancia para el Desarrollo. October 2007 – March 2008
- Javier García González, Damián Laloux Dallemagne, Michel Rivier Abbad, Tomás Gómez San Román, *"Coordinación de los bloques 12 y 10 en el Master en Cadena de Gas del Instituto Superior de la Energía"*. Fundación Repsol YPF. Madrid (Spain). October 2007 – July 2008
- Carlos Maté Jiménez, *"Forecasting Histogram-Valued Time Series (HTS) in Financial markets. Applications to Stock Indices"*. Department of Economics, University of California, Riverside (USA). October-November 2007.
- Luis Rouco Rodríguez, *"Curso sobre corrientes de cortocircuito e inserción de máquinas eléctricas en redes eléctricas"*. Red Eléctrica de España (REE). September-November 2007

- José Ignacio Pérez Arriaga, Julián Barquín Gil, Carlos Batlle López, Luis Rouco Rodríguez, *“European Energy Institute Training Program on Sustainable Energy Markets”*. European Energy Institute. Madrid (Spain). September-October 2007
- Mariano Ventosa Rodríguez, Damián Laloux Dallemagne, Carlos Batlle López, Tomás Gómez San Román, Pedro Linares Llamas, Julián Barquín Gil, Michel Rivier Abbad, Javier García González, Juan Rivier Abbad, *“Master en Regulación de la Industria Eléctrica”*. FUNGLODE. Santo Domingo (Dominican Rep.). February 2007 – February 2008
- Andrés Ramos Galán, Javier García González, Pedro Sánchez Martín, Santiago Cerisola López de Haro, *“Red temática de Optimización bajo incertidumbre”*. Ministry of Education and Science. Madrid (Spain). January-December 2007

### 5.3 Software Products

- **Model for Electric System Reliability Computation (FLOP)**  
(<http://www.iit.Comillasmillas.es/~aramos/flop.htm>)
- **Bulk Production Model (StarNet)**  
(<http://www.iit.Comillasmillas.es/~aramos/starnet.htm>)
- **AGC Software for the Spanish power system.** AGC software adapted to the Spanish Power System that outperforms other current commercial alternatives. The software can be easily integrated in any complete SCADA system.
- **QuercusLab** is a data analysis tool. It uses decision and regression trees. It has been developed at the IIT and it has been utilized in several research projects.
- **IDAT** is an intelligent information processing tool that includes technologies of processing and visualization of information, as well as advanced analysis and data mining by means of statistical models and Artificial Intelligence techniques. IDAT has been developed at the IIT and is being used as analytical tool for diverse projects.

## 5.4 Other activities

- Eduardo Pilo de la Fuente, Member of the *"International Scientific Advisory Committee of the 11th International Conference on Computer System Design and Operations in the Railway and Other Transit Systems"*. Wessex Institute of Technology. September 2008.
- Julián Barquín Gil, Electronic Source: *"Perspectivas del hidrógeno en la Unión Europea"*. Soitu.es. August 2008.  
([http://www.soitu.es/soitu/2008/08/18/medioambiente/1219060954\\_381620.html](http://www.soitu.es/soitu/2008/08/18/medioambiente/1219060954_381620.html))
- Julián Barquín Gil, José Ignacio Pérez Arriaga, Electronic Source: *"Prospects for a European Hydrogen Economy (CESSA Policy Brief)"*. UE Energy Policy Blog. August 2008.
- Julián Barquín Gil, Conference chairman: *"Modelling Long Term Dynamics"*. IEEE General Meeting 2008. Pittsburgh, Pennsylvania (USA). July 2008.
- Julián Barquín Gil, Electronic Source: *"Radiografía del mercado europeo de carbono"*. Soitu.es. July 2008  
([http://www.soitu.es/soitu/2008/07/16/medioambiente/1216207784\\_382154.html](http://www.soitu.es/soitu/2008/07/16/medioambiente/1216207784_382154.html))
- Tomás Gómez San Román, Vice-chairman of the *"Technical Program Committee Power System Computation Conference"*. Glasgow, Scotland (UK). July 2008.
- Pedro Linares Llamas, Electronic Source: *"Geoingeniería contra el cambio climático"*. Soitu.es. July 2008.  
([http://www.soitu.es/soitu/2008/07/10/medioambiente/1215688349\\_693741.html](http://www.soitu.es/soitu/2008/07/10/medioambiente/1215688349_693741.html))
- Julián Barquín Gil, Electronic Source: *"El coste del CO2 a 25 euros la tonelada"*. Soitu.es. June 2008  
([http://www.soitu.es/soitu/2008/06/13/medioambiente/1213356643\\_791897.html](http://www.soitu.es/soitu/2008/06/13/medioambiente/1213356643_791897.html))

- Pedro Linares Llamas, Electronic Source: "*¿Es ético el comercio de emisiones?*". Soitu.es. June 2008.  
([http://www.soitu.es/soitu/2008/06/02/medioambiente/1212407432\\_566666.html](http://www.soitu.es/soitu/2008/06/02/medioambiente/1212407432_566666.html))
- Pedro Linares Llamas, Electronic Source: "*Demagogia con la tarifa eléctrica*". Soitu.es. May 2008.  
([http://www.soitu.es/soitu/2008/05/16/medioambiente/1210933403\\_476998.html](http://www.soitu.es/soitu/2008/05/16/medioambiente/1210933403_476998.html))
- Julián Barquín Gil, Electronic Source: "*El justo reparto del problema del cambio climático*". Soitu.es. May 2008.  
([http://www.soitu.es/soitu/2008/05/09/medioambiente/1210339635\\_113053.html](http://www.soitu.es/soitu/2008/05/09/medioambiente/1210339635_113053.html))
- Pedro Linares Llamas, Electronic Source: "*Los límites de la tecnología frente al cambio climático*". Soitu.es. April 2008.  
([http://www.soitu.es/soitu/2008/04/30/medioambiente/1209549117\\_491582.html](http://www.soitu.es/soitu/2008/04/30/medioambiente/1209549117_491582.html))
- Julián Barquín Gil, Electronic Source: "*La energía nuclear en Europa*". Soitu.es. April 2008.  
([http://www.soitu.es/soitu/2008/04/02/medioambiente/1207149527\\_467198.html](http://www.soitu.es/soitu/2008/04/02/medioambiente/1207149527_467198.html))
- Pedro Linares Llamas, Electronic Source: "*¿Seguro que compensa el cambio de hora?*". Soitu.es. March 2008.  
([http://www.soitu.es/soitu/2008/03/24/medioambiente/1206377765\\_033244.html](http://www.soitu.es/soitu/2008/03/24/medioambiente/1206377765_033244.html))
- Julián Barquín Gil, Electronic Source: "*La factura de la energía eólica*". Soitu.es. February 2008.  
([http://www.soitu.es/soitu/2008/02/29/medioambiente/1204298007\\_487016.html](http://www.soitu.es/soitu/2008/02/29/medioambiente/1204298007_487016.html))
- Pedro Linares Llamas, Electronic Source: "*Las cuentas de la energía nuclear*". Soitu.es. February 2008.  
([http://www.soitu.es/soitu/2008/02/18/medioambiente/1203358229\\_923689.html](http://www.soitu.es/soitu/2008/02/18/medioambiente/1203358229_923689.html))

- Carlos Maté Jiménez, Reviewer of the international journal "*Interfaces*". February-March 2008.
- Julián Barquín Gil, Electronic Source: "*La conexión eléctrica con Francia*". Soitu.es. January 2008.  
([http://www.soitu.es/soitu/2008/01/29/medioambiente/1201604741\\_028270.html](http://www.soitu.es/soitu/2008/01/29/medioambiente/1201604741_028270.html))
- Pedro Linares Llamas, Electronic Source: "*Cuando el que controla la luz es el consumidor*". Soitu.es. January 2008.  
([http://www.soitu.es/soitu/2008/01/25/medioambiente/1201260349\\_808791.html](http://www.soitu.es/soitu/2008/01/25/medioambiente/1201260349_808791.html))
- Julián Barquín Gil, Chairman in session "*Seguridad y sostenibilidad energéticas*". III Congreso de la Asociación Española para la Economía Energética, Bilbao (Spain). January 2008.
- Julián Barquín Gil, Electronic Source: "*El año que tomamos conciencia del cambio climático*". Soitu.es. January 2008.  
([http://www.soitu.es/soitu/2008/01/03/medioambiente/1199364630\\_488103.html](http://www.soitu.es/soitu/2008/01/03/medioambiente/1199364630_488103.html))
- Pedro Linares Llamas, Electronic Source: "*La tarifa eléctrica y el cambio climático*". Soitu.es. December 2007.  
([http://www.soitu.es/soitu/2007/12/20/medioambiente/1198155362\\_175172.html](http://www.soitu.es/soitu/2007/12/20/medioambiente/1198155362_175172.html))
- Julián Barquín Gil, Conference chairman "*Modelling long-term market dynamics*". Seattle, Washington (USA). November 2007.
- Eugenio Francisco Sánchez Úbeda, Reviewer of the international journal "*IET Generation, Transmission and Distribution*". October 2007 – July 2008.
- Eduardo Pilo de la Fuente, Working Group member "*Política planificación, economía y energía y sostenibilidad of the Plataforma Tecnológica Ferroviaria Española*". October 2007 – September 2008.
- Sadot Alexandres Fernández, Reviewer of the international journals "*IET Electronics Letters and IEEE Transactions on Industrial Electronics*". October 2007 – July 2008.

- Carlos Maté Jiménez, Reviewer of the journal *“Cuadernos de Economía de la Universidad Nacional de Colombia”*. October 2007 – January 2008.
- Julián Barquín Gil, Electronic Source: *“Windy Changes in Spain” in UE Energy Policy Blog*. September 2007.
- José Antonio Rodríguez-Mondéjar, Yolanda González-Arechavala, Eduardo Pilo de la Fuente, Roberto López de la Cruz, Miguel Angel García Vaquero. Patent *“Procedure for transfer of command between Centers for Control”*. September 2007 – June 2008.
- Sadot Alexandres Fernández, Member of the *“Management Committee of the CAM Research Group of the Program: PRO-TVD Proyecto integral de investigación en Televisión Digital, related with R+D activities between research groups of the Comunidad de Madrid. Number S-0505/TIC/039”*. Consejería de Educación y Cultura de la Comunidad de Madrid. January 2006 – December 2009.
- Asunción Paloma Cucala García. Referee of the National Agency for Research Projects Evaluation (Ministry of Science and Innovation) for evaluation research proposals. 2008



## 6 Relations with other institutions

### 6.1 European institutions

#### 6.1.1 EES–UETP (Electric Energy Systems - University Enterprise Training Partnership)

Web page: <http://power.inescn.pt/EES-UETP/>

The Electric Energy System University Enterprise Training Partnership (EES-UETP) is a consortium of 4 enterprises and 19 universities in 12 European countries. The Partnership began its activities in 1992 within the framework of the COMETT Program (COMmunity program for Education and Training in Technology).

The EES-UETP's main objective is to provide an advanced technical and economic basis for the interconnected European Electric Energy System. This aim is pursued by means of the organization of advanced courses on electrical engineering and through the interchange of students and researchers.

The IIT currently coordinates the EES–UETP, with Begoña Pérez de Lema as the EES-UETP Coordinator.

The Partnership is funded by contributions from the industrial partners.

### 6.1.1.1 EES–UETP Partners

Current partners of the EES–UETP are listed in the following table, listed by countries:

<b>Belgium</b>	Université de Liège Katholieke Universiteit Leuven
<b>Croatia</b>	Energy Institute Hrvoje Požar
<b>Denmark</b>	Danmarks Tekniske Universitet
<b>France</b>	Electricité de France Gestionnaire du Réseau de Transport d'Electricité (RTE) École Supérieure d'Electricité (SUPELEC)
<b>Germany</b>	Technische Universität Dortmund
<b>Greece</b>	National Technical University of Athens
<b>Italy</b>	CESI Ricerca Università degli Studi di Bologna Università di Cagliari Università di Genova
<b>Netherlands</b>	Technische Universiteit Eindhoven
<b>Portugal</b>	INESC Porto
<b>Spain</b>	Iberdrola Universidad de Sevilla Universidad Politécnica Valencia Universidad Pontificia Comillas de Madrid Universidad Carlos III de Madrid
<b>Switzerland</b>	École Polytechnique Fédérale de Lausanne (EPFL) ETH Zürich
<b>United Kingdom</b>	University of Manchester

Besides being an active member of the network, the Universidad Pontificia Comillas fills the following positions for the EES-UETP:

- Chairman of the board: D. Tomás Gómez San Román
- Coordinator Secretariat: D<sup>a</sup>. Begoña Pérez de Lema

### 6.1.1.2 Taught courses

- *“Electricity networks of the future: Theoretical and practical issues to design the new distribution system”*, Italy, 24-26 September 2007.
- *“Simulation and analysis of power system transients”*, Italy, 24-26 October 2007.
- *“Probabilistic planning and operation of power transmission systems in a competitive market”*, Greece, 12-14 November 2007.
- *“New challenges to ancillary services regulation and operation”*, Spain, 14-16 November 2007.
- *“Integration of wind generation”*, Germany, 21-25 April 2008.
- *“Developing microgeneration and microgrids”*, Portugal, 19-21 May 2008.
- *“Models for electricity generation strategy in the 21st Century: New roles and new approaches”*, Spain, 10-12 September 2008.

## 6.2 ICAI Engineers’ Association

The IIT maintains a close relationship with the ICAI Engineers' Association, in several aspects. On the one hand, the Association funds part of a doctoral thesis developed at the IIT. During this course, the thesis funded was *“Dynamic analysis and optimization for high speed catenaries”*, developed by Jesús Jiménez Octavio and supervised by Alberto Carnicero López and Eduardo Pilo de la Fuente.

On the other hand, the IIT has agreed to publish part of its research findings in the Associations' official journal, *“Anales de Mecánica y Electricidad”*.



## 7 Economic Results

The IIT is financed through the research projects it carries out. The main economic results are presented in the table below.

	2002–2003	2003–2004	2004–2005	2005–2006	2006–2007	2007–2008
Revenues	3.676	3.771	3.821	3.629	3.766	4.393

Data in thousands of Euros