**CS & TELECOM PROJECTS**

**Project Title: Machine learning methods applied in diagnosis of hydropower plants**

**Objective**: The objective of this project is to review published methods in the area of machine learning in order to detect anomalies in the behaviour of components or systems in hydraulic power plants. This review will be used for focusing on the most effective methods found in order to be applied in some real case in Scandinavian plants.

**Deliverables**: Report about the study developed.

**Supervisor:** Dr.Miguel A. Sanz-Bobi (masanz@comillas.edu) School of Engineering, Comillas Pontifical University, Madrid, Spain

**Previous knowledge**: MATLAB at user level. Knowledge and/or interest in machine learning techniques.

**Number of students**: The project can be developed by one or two students.

**Period**: Second term.

**Workload**: 4 or 8 ECTS.

**Project Title: Development of health condition indicators of wind turbines using machine learning techniques.**

**Objective**: The objective of this project is the characterisation of the normal behaviour of some key components in a wind turbine in order to propose health condition indicators for rescheduling the applied maintenance. The normal behaviour model will be based in machine learning techniques such as support vectors or ANFIS models.

**Deliverables**: Report about the study developed.

**Supervisor:** Dr.Miguel A. Sanz-Bobi (masanz@comillas.edu) School of Engineering, Comillas Pontifical University, Madrid, Spain

**Previous knowledge**: MATLAB at user level. Knowledge and/or interest in machine learning techniques.

**Number of students**: The project can be developed by one or two students.

**Period**: Indifferent.

**Workload**: Indifferent.

**Project Title: IoT gateway in communications sensor-to-cloud**

**Objective**: The objective of this project is to develop a software for a Raspberry Pi, which sends the information about many BLE sensors to an IoT-Cloud platform. The student will work with many kinds of sensors (temperature, humidity, air quality, etc.).

**Deliverables**: Software and report about the solution developed.

**Supervisor**: Dr. David Contreras (davidcb@comillas.edu) School of Engineering, Comillas Pontifical University, Madrid, Spain

**Previous knowledge**: Computer programming languages.

**Number of students**: The project can be developed by one or two students.

**Period**: Second term.

**Project Title: Experimental analysis of wireless communications (Bluetooth Low Energy).**

**Objective**: The objective of this project is to study and analyse the Bluetooth Low Energy protocol through several experimental scenarios and configurations of sensors and actuators. The student will work with many kinds of sensors (temperature, humidity, air quality, etc.)

**Deliverables**: Software and report about the solution developed.

**Supervisor**: Dr. David Contreras (davidcb@comillas.edu) School of Engineering, Comillas Pontifical University, Madrid, Spain

**Previous knowledge**: Computer programming languages.

**Number of students**: The project can be developed by one or two students.

**Period**: Second term.

**ELECTRICAL PROJECTS**

**Title: Development of electric vehicles business models in US**

**Summary:** The deployment of plug-in electric vehicles (PEVs) has been highlighted as a transportation alternative with lower carbon emissions and as a flexible resource that can provide services to the electricity system. At the same time, battery technologies are becoming more competitive and therefore PEVs costs are decreasing. PEVs sector is developing differently around the world and the US is becoming a leader as companies such as Tesla Motors are becoming a major player in this market. The objective of this project is to describe main business models for PEVs interacting with the electricity sector in US which may include PEV aggregation, charging strategies, and development of charging infrastructure. The project will make a literature survey on ongoing initiatives and developments.

**Previous knowledge:** not required. Knowledge of electric power sector is an advantage.

**Supervisors:** Tomás Gómez San Román & José Pablo Chaves Ávila

**Schedule:** Intensive

**Work load:** 80h or 160h

**Number of students**: 1 or 2

**Title: Impact of electric vehicles on the US electricity sector**

**Summary:** The deployment of plug-in electric vehicles (PEVs) has different challenges and implications for the electricity sector. The US is expected to face an increasing penetration of PEVs in the coming years and decades. The objective of this project consists in describing the state of the art of the main impacts and expected challenges of PEVs penetration in the electricity sector in the main US markets at wholesale level, distribution level, market design and regulation.

**Previous knowledge:** not required. Knowledge of electric power sector is an advantage.

**Supervisors:** Tomás Gómez San Román & José Pablo Chaves Ávila

**Schedule:** Intensive

**Work load:** 80h or 160h

**Number of students:** 1 or 2

**ELECTRONIC PROJECTS**

**Title: Digital Signal Processing with RaspberryPi**

**Abstract:**  Thanks to the evolution of digital electronics, signal processing has moved in the last decades from the analog to the digital world. In addition to this, in recent years this trend has incremented dramatically, in part, thanks to the development of small and inexpensive computers such as the RaspberryPi.

In the present research project, the student is encourage to assess the possibilities of using a RaspberryPi as a small development board for digital signal processing. In order to facilitate the task, additional sampling hardware could become useful, such as a bitscope board (<http://www.bitscope.com/>)

To facilitate the evaluation of the task, the final objective would be to implement a digital filter using Store and Overlap FFT method.

**Previous knowledge:** Electronics and some basics on Digital Signal Processing.

**Supervisor:** Javier Matanza Domingo

**Workload:** Semestral.

**Workload per student:** 80 h

**Period:** Summer

**Number of students:**  1 or 2

**Title: RFID (Radio Frequency Identification)**

**Abstract:** The goal of the project is to study the use of a radio frequency identification system (RFID) for factory automation. The student must study the response of the RFID systems of the laboratory with different tags (Siemens tags and ISO tags). Then, the student must integrate the RFID systems with the PLC (Programmable Logic Controller) installed in the laboratory. Finally, he must control a belt conveyor using the PLC and the RFID.

**Prerequisites:** Foundations of digital/logic system and programming.

**Supervisor:**  José Antonio Rodríguez Mondéjar

**Dedication:** Any of them. The goal of the project can be tuned. Preferences: summer intensive.

**Load:** 80h or 160h. Preferences: 160h

**Student number:**  1 or 2. Preferences: 1

**Title: Robot for mounting a system**

**Abstract:**  The aim of the project is the programming of a robot for mounting a system with pieces provided by a conveyor belt system. First, the student must study the programming language of the robot ABB IRB 120 installed in the laboratory. Second, he must develop the robot programs to mount the system with pieces provided by the conveyor system (for example: lego pieces). Third (optionally), he can improve the system using a camera to solve the problem of random position of the pieces.

**Prerequisites:** Foundations of digital/logic system and programming.

**Supervisor:**  José Antonio Rodríguez Mondéjar

**Dedication:** Any of them. The goal of the project can be tuned. Preferences: summer intensive.

**Load:** 80h or 160h. Preferences: 160h

**Student number:** 1 or 2. Preferences: 1

**Title: Inspection system**

**Abstract:**  The aim of the project is the programming of an inspection system based on a COGNEX camera for classifying pieces provided by a conveyor belt system. First, the student must study the programming language of the COGNEX camera installed in the laboratory. Second, he must develop the camera programs to inspect the pieces provided by the conveyor system (for example: lego pieces). Third (optionally), he can improve the system using a robot to solve the problem of pieces position.

**Prerequisites:** Foundations of digital/logic system and programming.

**Supervisor:**  José Antonio Rodríguez Mondéjar

**Dedication:** Any of them. The goal of the project can be tuned. Preferences: summer intensive.

**Load:**   80h or 160h. Preferences: 160h

**Student number:** 1 or 2. Preferences: 1

**Title: Modelling magnetic materials in circuit simulators.**

**Abstract:** There are several applications where non-linear magnetic materials (especially ferrites) are commonly used. Taking into account first-order characteristics of these materials (like saturation, variable differential permeability, etc.) is quite easy. It is quite more difficult to take into account more detailed behaviors; there are several approach in the technical literature and various models that try to approximate the real behavior of these materials, like for example [1].

In order characterize magnetic materials and find the parameters of the advanced models, accurate measurements are needed. Tradition approaches call for quite expensive instrumentation systems; lately a simplified method has been proposed [2] that reduce the cost and the complexity of the system at the expense of a quite more convoluted analysis of the results.

These methods are quite sensible to the details of the conditioning system and on the parasitics of the devices used; these method will benefit greatly from the availability of circuital models that can be integrated into circuit simulators programs. Proprietary models for proprietary programs do exist, but they are closed source and so they are difficult to modify when the simulation is not satisfactory.

[1] E. Cardelli, R. Giannetti, B. Tellini, "Numerical Characterization of Dynamic Hysteresis Loops and Losses in Soft Magnetic Materials", in IEEE Transaction on Magnetics, vol. 41(5), p. 1540--1543, May 2005

[2] B. Tellini, R. Giannetti, S. Lizón-Martínez, "Sensorless Measurement Technique for Characterization of Magnetic Materials Under Nonperiodic Conditions", in IEEE Transaction on Instrumentation and Measurement, vol. 57(7), p. 1465--1469, Jul 2008, ISSN 0018-9456.

**Prerequisite:** The student(s) is/are expected to learn how to use one of the available open source circuit simulator systems [3] and to try to develop a macro-model of the magnetic materials that take into account the detailed behavior of the material. They must know basic calculus, basic electronics device and circuits, fundamentals of magnetic fields and transformer, and be at ease with using and programming computers and using electric simulators. It greatly helps if he or she has good computer programming skills (any programming language).

[3] http://ngspice.sourceforge.net/, <http://qucs.sourceforge.net/>

**Supervisor:** Prof. Dr. Romano Giannetti

**Format:** better extensive, acceptable intensive.

**Workload:** 80 h x 2 students

**Students:** 2 (but can be assigned to one student, if he or she has sufficient prerrequisites, with a reduction in goals).

**MATERIALS PROJECTS**

**Influence of graphene nanoplatelets on mechanical properties of epoxy adhesive joints**

2 students for 2 months

**Mechanical characterization of CFRP composites reinforced with graphene nanoplatelets**

2 students for 2 months

**Mechanical characterization of epoxy resins reinforced with graphene nanoplatelets**

1 student for 2 months

**RIF HPLC**

Study of elution of rifampicin-loaded acrylic bone cement by high performance liquid chromatography

1 student for 2 months

**Mechanical Study of Hybrid joints. Structural and PSA Adhesive Joints**

2 students for 2 months

**MATH PROJECTS**

**Title: PROJECT TITLE: IMPLEMENTATION OF ALGORITHMS FOR THE ALLOCATION OF SEATS IN THE SPANISH ELECTIONS**

**Summary:** The proposed project has as main goal the implementation of an algorithm to distribute the parliament seats in a proportional way. The implemented algorithm will be checked with the data obtained of the last Spanish elections.

**Recommended previous knowledge:** Manage of some programming language, as C, Visual Basic or Mathematica

**Supervisor:** Javier Rodrigo

**Format:** Intensive

**Number of hours per student:** 4 ECTS

**Maximum number of students:** 2

**Summer project**

**PROJECT TITLE: BASIC GUIDE OF THE MATLAB TOOLBOX “PARTIAL DIFFERENTIAL EQUATIONS TOOLBOX”, FOR STUDENTS OF ENGINEERING**

**Summary:** The proposed project will be focussed to investigate the different utilities of the *Partial Differential Equations Toolbox* of the software Matlab, and in making an elementary guide of such a toolbox thought for students of a grade in engineering, in order to solve initial value problems and boundary value problems in the framework of ordinary differential equations and partial differential equations.

**Recommended previous knowledge:** knowledge of the Matlab software and elementary knowledge in ordinary and partial differential equations.

**Supervisor:** Santiago Cano Casanova

**Format:** summer (starting in may-june)

**Number of hours per student**: 4 ECTS (100 hours)

**Maximum number of students**: 1

**PROJECT TITLE: SPECTRAL AND PSEUDO-SPECTRAL METHODS WITH MATLAB TO SOLVE BOUNDARY VALUE PROBLEMS.**

**Summary:** The proposed project will be focussed to implement with the software Matlab some of the basic spectral or pseudo-spectral methods, used to approximate solutions of nonlinear boundary value problems in the framework of ordinary differential equations.

**Recommended previous knowledge:** knowledge of the Matlab software and elementary knowledge in ordinary differential equations

**Supervisor:** Santiago Cano Casanova

**Format:** summer (starting in may-june)

**Number of hours per student:** 4 ECTS (100 hours)

**Maximum number of students:** 1