PhD SCHOLARSHIP APPLICATION DATA

Business Division Business Area or Platform	DEMA Digital Energy
Scholarship location Province/Building	700 Department of Electrical Engineering UPV-EHU

SCHOLARSHIP DESCRIPTION

Scholarship Title:

New Hybrid Models of Energy Assets for O&M

(New Hybrid Models of Energy Assets for the error cause analysis of faults, generation of synthetic normality and error data, and Data Flow Mining (*temporary series*) for their Efficient Operation and Maintenance).

Brief Description of Scholarship:

The purpose of the scholarship is to broaden knowledge on energy asset modelling in OPEN MODELICA and DYMOLA environments to generate functional models, learn about their error causes and effects, and generate synthetic error data and temporary series emulated from operation and error data. Based on this data and its calibration and hybridisation with real data collected from operation SCADAS, new data-based knowledge will be extracted and exploited. Essentially, the thesis will focus on the domain known as Digital Energy or Energy Digitalisation process, for which data analytics plays a major role for various specific applications, such as the monitoring, identification of the condition, modelling of the ageing and predictive maintenance of machines, and optimisation of the operation with energy infrastructure efficiency criteria. To do so, research will be carried out in the fields of data analytics, such as soft sensing, synthetic data generation based on digital twins, prediction of the emergence of faults based on data driven or hybrid models or energy efficiency in intensive energy consuming infrastructures, among others. In particular, the thesis will revolve around the design and implementation of new models that identify cause-effect relations based on indirect or virtual sensor measures, new models of predictive maintenance and efficient operation of energy assets based on descriptive and predictive techniques that learn from real measured data, synthetic data generated via digital models.

Scholarship description:

This PhD scholarship falls within the set of techniques under the framework of Digital Twin energy assets towards Big Data, a concept referring to the set of techniques, methods, models and architectures oriented to obtain knowledge from large data volumes and interpret their value.

On one hand, the multi-technology modelling techniques (electrical-thermal or electrical-vibrations is an area of knowledge with its value contribution and specialised research. On the other hand, the data analytics models may help the precision of the digital twin model and

generate a set of synthetic mix and real mix data that can be used to infer data knowledge, either to discover patterns and existing relations between its variables, forecast future values of one or several of these variables, or prescribe which actions should be implemented according to the values recorded by those variables during a specific period. For an engineer, data analytics is a field where creativity and technical challenge meet. This is currently generating a 'research fever' around the creation of new descriptive, predictive and prescriptive models, with proposals combining bio-inspired algorithms, machine learning and distributed computing.

Recently, data analysis in Big Data systems has become known and started to be successfully applied to several sectors such as: Telecommunications (fraud detection; digital platform offer pairing; or resource optimisation in networks); Banking (portfolio optimisation); or Health (prediction of illnesses). However, this technology is practically incipient in the energy domain, which is undergoing a severe digitalisation process. This fact is leading to a sharp increase in the demand for models and functionalities based on Big Data. In spite of its inherent value, energy consumption and generation data collected at industrial plants, wind farms and other infrastructures has unique characteristics, generated in real time, subject to unforeseeable (but detectable) changes, which may be vital for security, and the way of accessing and handling is usually very restricted. The volume of data in this environment will continue to grow exponentially as a result of the progressive instrumentation and digitalisation of intensive energy consumption and generation infrastructures.

In this context, the doctoral thesis will address various lines of research related to energy efficiency in large infrastructures, with particular emphasis on the following aspects:

- Real time multi-parametric monitoring of energy infrastructures and their modelling for the generation of normality and failure data. For this, the thesis will contemplate the design of multi-technological models through tools such as OOPEN MODELICA or DYMOLA.

- Generation of data sets throughout the useful life of the energy asset. This data will be generated based on SCADA operation data and on analysis techniques and fault and effect models. The fault distribution probabilities in energy asset components will also be studied.

- Data analytics with incremental learning and diversity mechanisms for learning problems with demanding requirements in terms of computing and eventual times derived in the data pattern (e.g.: detection of data flow anomalies).

- Fault diagnosis through unsupervised models, fault prediction through supervised models with generated and labelled data.

- Prediction of faults through Deep Learning models, as well as task planning algorithms for renewable energy integration in the plant energy mix.

- Automatic construction of in-depth neural computing models for soft sensing of equipment or energy infrastructures, and the creation of hybrid models (simulative/predictive) for the design of more reliable digital twins.

In any case, the candidate shall be given sufficient flexibility to propose research lines of his/her own interest which are in line with the *leit motiv* of the thesis (energy efficiency and operation & maintenance of energy infrastructures).

The candidate will be backed by high level TECNALIA teams, such as the Digital Energy Transversal Platform (Energy and ICT Divisions) and the Operation and Maintenance TRT (Technologically Relevant Team) (Industry Division).

Degree and specialisation required:

The PhD candidate shall meet the following requirements:

- Degree and specialisation: Electrical Engineering, Physics, Mathematics, Telecommunications Engineering.
- Languages: (Level): English (medium-high level), Spanish.
- IT skills (please specify programmes and level of use): Python, R, MATLAB, Latex.
- Proactivity, critical analysis skills and teamwork. Ability to generate result-oriented applied science.

The following will be a plus: candidates with previous training in the thesis topics (at Master's or similar level), and particularly in electric modelling and in machine learning models and neural computing models.

Further information and applications: http://bit.ly/2qEd2qt