2SC7890 – Insular carbon-free micro grid

Instructors: Nabil Sadou
Department: DOMINANTE - ENERGIE, DOMINANTE - GRANDS SYSTÈMES EN INTERACTION
Language of instruction: ANGLAIS
Campus: CAMPUS DE RENNES
Workload (HEE): 80
On-site hours (HPE): 48,00

Description
Nearly 800 million people are still without access to electricity (IEA 2021). These populations are often found in isolated regions in rural or insular areas. Thus, for 3/4 of them, it is not economically efficient to bring them electricity by expanding the existing large electricity networks. Electrification must therefore be done at the local level, through microgrids.

The generation of electricity in a microgrid can be done using fossil fuels (diesel generators) or renewable energies (solar panels...). Thanks to technological advances, the latter are generally cheaper. However, their intermittency pushes to supplement them with more expensive but controllable means (diesel, battery storage...). The size of each of the components of a microgrid (called its "sizing") must therefore be optimized according to different criteria: the economic cost of course, but also the quality of service, energy independence or greenhouse gas emissions. The management of energy flows (e.g.: arbitrage between diesel and battery) also needs to be optimized. This project proposes to address these different optimization challenges in the real case of an isolated island site.

Quarter number
ST7

Prerequisites (in terms of CS courses)
Optimization course.

Syllabus

Problem definition :

Input data:

- collection of production and consumption data
- data analysis and normalization

Modeling and formalization:

- definition of optimization criteria
- formalization of the optimization problem

Resolution:

- choice of resolution method
- sensitivity analysis

Class components (lecture, labs, etc.)

Project 80h

Grading

project reports and presentations (intermediate and final)

Resources

project in groups

Learning outcomes covered on the course

By the end of this course students will be able :

- Understand the economic, ecological and societal context and challenges of microgrids.
- Formalize an optimization problem
- Select the appropriate resolution method.
- Trade-off analysis
- Work in groups and results present

Description of the skills acquired at the end of the course

- Understand the economic, ecological and societal context and challenges of microgrids. C1.1, C.4.2
- economical et technical microgrid modelling C2.1, C6.2
- Formalize an optimization problem. C1.2, C1.3, C2.1
- Select the appropriate resolution method. C2.1, C2.3, C6.1, C6.2
- presentation of the results. C7.1
- Work in groups. C8.1, C8.4

ST7 – 79 – DIGITAL TECHNOLOGY AT THE SERVICE OF THE HUMAN FACTOR

Dominante : Info&Num (Computer Science & Digital), MDS (Mathematics, Data Sciences), VSE (Living-Health, Environment)
Langue d'enseignement : English
Campus où le cours est proposé : Rennes

Engineering problem

The massive recourse to computer automation of numerous processes, to AI-type decision-making agents, and to the analysis of ever larger data sets, question the relationship between humans and information technologies.

In fact, the current speed of development of these technologies, and the wealth of tools that are emerging, allow us to get even closer to the human being. Analysis of expressions and emotions by extraction of multi-sensor data (webcam, kinect, micro, EEG, sweating), modeling of human behavior in critical contexts (crisis, health problems, depression) and advanced analysis of interactions between different agents, are all possibilities offered by digital tools.

For research in the humanities and medicine, these new methods represent an opportunity to refine our understanding of subjects, patients and their relationship to the world or to others (autistic behavior, collaborative contexts).

The CentraleSupélec engineer will be able to understand how to put digital technology at the service of the human factor, what its possibilities and limits are, and which technologies are appropriate for building the computer science of tomorrow.

Advised prerequisites

Courses in Algorithms and Complexity, Statistics and Learning, Signal Processing

Context and issue modules: These modules include an introductory lecture on the theme, presentations on the technological and scientific challenges, and a presentation of the associated projects. The whole will allow to highlight a common problem (the analysis of non-verbal behavior) with very

varied application fields, and will give an introduction to social psychology, on the aspects of verbal and non-verbal language.

Specific course (60 HEE) : *2D-3D Image and Sound Analysis*

Brief description: the course will cover three important parts necessary for project completion:

Image analysis: Filtering, segmentation, feature detection
Sound analysis : time-frequency representation, speech modeling, spatial audio

Project: *What you say without meaning to: deciphering and automatic analysis of non-verbal behavior*

- Associated partner :

- Location: Rennes

- Brief description: Every year, the audio, video and machine learning communities gather around international research challenges on the automatic analysis of human behaviors: emotions, depression, mood, motion detection, etc. (e.g. http://sspnet.eu/avec2017/). The project consists in the participation to one of these challenges. It is about, from a large corpus of data representing subjects in action, to automatically determine information about their behavior and emotions.

Each project team will focus on a particular study (e.g. voice, face, etc.), knowing that all the teams will participate in the same international challenge.

It will therefore be necessary to choose and apply certain methods seen in the course of image and 3D sound analysis. The classification and regression tools will lead to the implementation of optimization algorithms (neural network regression, fuzzy logic, SVM,...).