1SC2590 – Performance and hybridization of a vehicle by functional modeling

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Department: DOMINANTE - CONSTRUCTION VILLE TRANSPORTS
Language of instruction: ANGLAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 40
On-site hours (HPE): 27,00

Description

During this challenge week, an automotive powertrain will be pre-dimensioned in order to adapt it optimally to a specific vehicle category taking into account performance, consumption, pollutant and price criteria.

Quarter number
ST2

Prerequisites (in terms of CS courses)
No prerequisite

Syllabus
After an introduction presenting the different elements making up a powertrain, students will have to model and optimize a vehicle according to different constraints.
A benchmark will be made to position itself according to the performance of the competition.
The study will first focus on the performance of the vehicle and then the homologation cycles from the point of view of consumption.
Students have a budget to buy different technologies to achieve the objectives required by their segment (performance, economy, low emissions ...).

Class components (lecture, labs, etc.)
Students will work in groups, each responsible for a segment of a general automaker's lineup. The speakers offer support and challenge the students in relation to their technological choices.

Grading
The evaluation has two components :

- continuous observation of the general behavior of the group during the course of the teaching and the answers during discussions
- short final defense presenting the final result and justifying the selected choices

Resources

All sizing will be done using an Excel spreadsheet (or equivalent). Useful data and features will be provided by stakeholders. The use of a spreadsheet will allow us to obtain quickly representative results without the problem of handling more specialized software.

Learning outcomes covered on the course

- Knowing the components of a hybrid automotive powertrain.
- Knowing what impacts different technological choices have on pollutant emissions and performance.
- Pre-dimensioning a powertrain under constraints.

ST2 – 26 – EARTH OBSERVATION FOR OUR ENVIRONMENT AND SAFETY

Dominante : PNT (Physics and Nanotechnology)
Langue d'enseignement : French
Campus où le cours est proposé : Paris-Saclay

Engineering problem

Earth observation by means of measuring instruments embarked on drones, airplanes or satellites is a fairly recent discipline but one that is experiencing exceptional development because of its role in major environmental and security issues. The recent satellites launched by the European, American, Canadian and Chinese space agencies ... all have the following objectives

- land security (border observation, troop movements, nuclear activities ...) and sea security (piracy, smuggling ...),

- a better understanding of the phenomena that affect the environment (deforestation, ice melting, desertification, monitoring of wetlands ...),

- the protection of populations against natural or man-made disasters (earthquakes, floods, fires, pollution...),

- studying the impact of our activities, for example by monitoring the growth of metropolises.

The growing share of private players (Airbus DS, Thales Alenia Space, MDA ...) in this field also reflects the commercial issues related to this theme. Whether for insurance companies, civil security actors, or urban planning, the processing and analysis of this data opens the way to numerous applications and new activities.

The number of sensors is increasing and data is abundant. The challenge is first to correctly interpret the images acquired by these different sensors, and then to develop tools that can be applied automatically. Modeling the interactions between waves (radar, optical, hyperspectral, ...) and the environment is a key step for the analysis of these images.

Whatever the type of sensor, the key point is to identify the useful information in the image. To do this, the very first step is to model the object of interest. Using the physical knowledge of the scene, we will identify the relevant model or develop a new model. Then, detection / classification tools will be used. They can be based on "traditional" or machine learning methods.

The specific course will first address some elements of wave physics in order to understand the interactions between waves and objects. Then, the commonly used models and the analysis techniques corresponding to these models will be covered. Throughout the course, great importance will be given to the manipulation of images by the students.

Adviced prerequisites

None

Context and issue modules Earth observation is a major challenge for the European Commission, which has financed the Copernicus project (series of satellites with various sensors). The ambition of the Commission is to allow the development of new economic activities. This topic will be discussed at the beginning of these modules.

The European Space Agency has the mission to implement the Paris agreements. Representatives of French and European agencies will present in more detail the actions underway.

Companies are also strongly involved in this field, representatives will discuss technical and commercial issues.

Finally, an overview of new scientific developments will be given.

Specific course (40 HEE): Physical models for radar and optical image analysis

- Brief description: This course will provide a first understanding of the physical phenomena in wave-object interactions, give basic modeling techniques and explain how to use them to process data. The main topics covered are propagation and remote sensing, radar sensors, other types of sensors (optical, hyperspectral...), classification, change detection

Challenge week #1: biomass and deforestation

- In partnership with : ESA & CNES & Environment Canada

- Location: Paris-Saclay campus

- Brief description Forests are an important ecosystem from an environmental and climatic point of view. Their protection but also the control of their contribution in terms of CO2 regulation are fundamental. Protection involves both detecting and monitoring sources of deforestation (clear-cutting to sell wood, conversion into agricultural land, etc.) and assessing their health (e.g. infestation of pine trees by butterfly larvae in Canada). The CO2 absorption capacity is a function of the biomass. In 2022, ESA will launch a BIOMASS mission whose objective is to allow the inventory of the world biomass.

- Students will be able to choose to work on one of these aspects, either to estimate the biomass of forests, to detect deforested areas or to follow the evolution of an area infested by insects.

Challenge week #2: Classification of agricultural areas

- In partnership with: CS-SI

- Location: Paris-Saclay campus

- Brief description: Detailed and accurate knowledge of land cover is crucial for many scientific and operational applications, and as such, it has been identified as an essential climate variable. Iota2 is the processing chain that allows the fully automatic production of land cover maps at the country scale using time series of high resolution optical images that are based on supervised classification and use existing databases as reference data for model learning and validation. This chain is triggered once a year in the CNES computing center to produce the land cover maps.

Challenge week #3: Glacier monitoring

- In partnership with: ONERA

- Location: Paris-Saclay campus

- Brief description: Mapping glaciers and studying their change on a global scale is very useful for predicting sea level changes, water resources in certain regions, mountain developments and for studying climate change and associated natural hazards. In this project, we propose to observe the dynamics of glaciers, through the observation of surface state changes, and the calculation of their displacement speed, by flow calculation and interferometry techniques.

Challenge week #4: Automatic land cover classification

- In partnership with: Preligens (formerly EarthCube)

- Location: Paris-Saclay campus

- Short description: This project is an opportunity to use machine learning while getting familiar with satellite imagery. Gohar and her team will first introduce the relevant machine learning and remote sensing concepts, as well as the tools needed to get started with the project. You will then apply the algorithm of your choice to analyze the type of land cover on images from the Sentinel 2 mission. On each image, you will have to decide on the nature of each pixel: is it an artificial area, cultivated, grassy, aquatic, or forested?