2SC5390 – Design of a "last mile" urban delivery system using autonomous and connected vehicles

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Language of instruction: FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 40
On-site hours (HPE): 27,00

Description
The challenges of autonomous and connected vehicles do not only concern the automotive sector. The integration teaching offered here allows you to understand on the one hand the approach of designing a complex and critical system, and on the other hand the plurality of problems of the autonomous and connected vehicle, through an industrial scenario in an adapted context.

The chosen scenario is that of a so-called “last mile” delivery. The cost and delivery time of a parcel by carrier is strongly impacted by the last mile, especially in urban areas. Due to traffic jams and parking, delivery trucks could advantageously be picked up at the entrance to major cities by lighter means of transport adapted to the urban environment. Using bikes is too expensive; the carriers consider in the short term a fully automated delivery on the last mile. The solution consists in managing a fleet of autonomous and connected robots carrying out deliveries, based on arrival times, delivery addresses and characteristics of the robots.

You work in a team in charge of designing such a delivery system. In this context, you follow a model-oriented system engineering process to specify the functionality of the system. You adopt a modeling methodology to develop the necessary algorithms (control / command, sensor fusion, data fusion, decision making and telecommunications) to meet the specifications. A reduced-scale test platform allows you to assess the quality of the delivery system obtained and improve the algorithms.

Quarter number
ST5

Prerequisites (in terms of CS courses)
1st-year SPI module "Electronic systems"
1st-year SPI module "Network security"
Specific teaching module "Architecture and technologies for smart and connected vehicules"

Syllabus

The following technical aspects are implemented in this integration teaching:

- functional needs analysis, system specifications
- system modeling
- state machines
- control law
- telecommunications
- communications protocol
- image processing
- sensor fusion
- embedded and real-time processing
- mixed hardware-software computation

Class components (lecture, labs, etc.)

The objective is to complete a technical proof of concept on a reduced-scale platform made up of robots rolling on an adapted support schematically representing the urban environment. Teams of 5 or 6 students are formed beforehand so as to present a broad spectrum of skills. After an initial functional analysis of the system based on brainstorming, the teams decide on their internal organization in order to deal with the various aspects in parallel and with consistency: hardware, modeling, embedded intelligence, connectivity. Each team is given a robot and can access the test rooms to validate the behavior of the system in a physical environment and refine its functionality. The last day of the week is devoted to the preparation of the evaluation and to the evaluation itself.

Grading

The grading is done through regular progress reports with the supervision team during the week (once per half-day), as well as with a final evaluation at the end of the week, comprising an oral presentation describing the design choices and the innovations of the system, and a demonstration of its performances on the test platform, in front of a panel of teachers and industrial experts.

Resources

Human resources: a team of teachers specializing in the various engineering fields concerned (electronics, telecommunications, modeling, signal processing) present 100% of the time; automotive (Renault) and modeling

(Mathworks) industrial experts visiting during the week and present for the evaluation.
Logistical resources: working rooms for student teams, large rooms for test and evaluation platforms, a teachers' HQ.
Material resources: rolling robots (including 4 driving wheels, an Arduino board, a Raspberry Pi nanocomputer, a camera and several other on-board sensors, batteries).
Software resources: Matlab / Simulink, Linux, Python, C ++, OpenCV, ...

Description of the skills acquired at the end of the course

The following skills will be evaluated during this learning activity: C2, C4 and C7. The skills assessment will be based on the regular progress reports with the supervision team (once per half-day), on the demonstrated performances of the system, and on the final oral presentation.

ST5 – 54 – THE ECO-NEIGHBORHOOD, A COMPLEX SYSTEM. SUSTAINABLE DEVELOPMENT & COMPLEX PROJECT MANAGEMENT

Dominante : CVT (Construction, City, Transportation) and GSI (Large Interacting Systems)
Langue d'enseignement : French
Campus où le cours est proposé : Paris-Saclay

Engineering problem

The eco-neighborhood is an interesting case of a complex system. It requires a multidisciplinary approach combining real estate and construction, mobility (flows and infrastructures), urban networks and the problems of consumption of natural resources (water, energy, waste) but also geography, sociology and the history of places and people. It involves implementation at various scales, from the political decisions required for its emergence and implementation, to the geographical location of the catchment area and the various catchment areas for major facilities, to the choice of heating and lighting methods for each home.

The development market is undergoing a major transformation, with public developers ceding ground to private developers who are emerging among the various real estate developers.

The engineering problematic of this thematic sequence is therefore the following: how to approach all the studies necessary to the creation of an eco-neighborhood in order to make a coherent set of decisions?

The different pedagogical activities will allow students to acquire different technical and managerial skills:

- Knowing how to design or transform the complex systems that are eco-neighborhoods by integrating the many stakeholders with different, even divergent, roles and interests,

- Take into account sustainable development parameters to ensure that the concept of eco-neighborhood is achieved

- Know how to design and plan large complex projects, which can be considered as multiple interdependent projects

Adviced prerequisites

Sufficient level of French to be able to read and understand texts / articles in French

Context and issue modules: This part involves major players in the field who will share their vision and their roadmaps. It includes a presentation of the Plateau de Saclay development project by the EPAPS, a visit to a development project that has been or is being carried out in the Ile de France region (and if possible in Paris), and a presentation of international projects by various players.

Specific course (60 HEE) : *Sustainable urban planning and development*

Brief description: The specific course allows to approach the main disciplines which constitute the urban project, and to prepare the realization during the IE of the main deliverables produced during the design phase.

Disciplines: Initiation to the game of actors and the real estate value chain, smart city and sustainable city, urban and peri-urban agriculture, circular economy, energy issues, the Grand Paris Express and mobility, urban planning and eco-district reference.

Deliverables: Diagnosis, modeling and exploration of alternatives, economic balance sheet, convergence of multiple coordinated decisions, schematization / representation, scenario of use situations, macro-plan.

Challenge Week : Design project for an eco-neighborhood - the case of Corbeville

Associated partner: -

- Location: Paris-Saclay campus - site visit required

- Brief description: How to build the city? The city is made up of different structures: streets and public spaces, urban networks and energy in particular, public and individual transport, buildings and equipment... Complex project management tools are applied here to dissect the interplay of actors that allows the transformation of the city and to address all the disciplines and scales of territories to achieve these major projects.

The situation corresponds to one or several major (imaginary) modifying scenario(s): a 20-year delay of the metro line 18 or replacement of the metro by a tramway or any other scenario... . An urban design competition is launched to take into account this fundamental change.

The pedagogical objectives are the following:

- To handle on a concrete case the main concepts, methods and tools related to a complex project in the field of sustainable development and construction. The generic character and reusability to other contexts will also be important.

- Acquire a first set of knowledge related to the sectoral fields of urban planning, real estate development, smart grids and other urban networks, mobility (intermodality, and infrastructure) in particular.

At the end of the IE, students will have experienced the decision-making systems specific to urban development projects by having analyzed the key stages of specification, design and planning of such projects.