ST5 – 60 – SEMI-AUTONOMOUS NAVIGATION OF DRONES

Dominante : MDS (Mathematics and Data Sciences)
Langue d'enseignement : English
Campus où le cours est proposé : Metz

Engineering problem

Data collection by a human is sometimes extremely difficult, e.g. for exploration/monitoring of abandoned mines or disused buildings, crop monitoring, environmental monitoring. What makes it difficult for a human to explore these areas may depend on the congestion of these areas (e.g. riprap in mines), the accessibility of these areas (e.g. monitoring the state of dykes, river banks ...), the size of the territory to be covered (e.g. monitoring agricultural crops, rivers). In this respect, the recent development of drones offers many opportunities but also raises several problems. To date, the piloting of a drone still requires a certain level of expertise since its control is quite low level. We can then consider a piloting assistance where some aspects of the drone control are managed automatically, due to a processing of the sensors' information flows by machine learning techniques. This semi-autonomous control requires in this case to build from the information of the sensors more integrated representations from which the human, as well as the automatic controller which assists him, can ensure in concert a robust navigation of the UAV.

Advised prerequisites

The specific course and the integration teaching require a mastery of several tools (ROS, Linux,...) to which the students will be trained. However, this training to these new tools requires a real motivation and implication of the students. It is also necessary to have skills in Python programming.

Context and issue modules:

This part is structured in conferences and round tables allowing to understand the problems, technologies and stakes related to the use of UAVs in several target areas of the sequence (interventions to be confirmed from Parrot, Safran...)

Specific course n°1 (10 HEE) : *Introductory practical work*

Brief description : These practical works aim at training students to use Linux (Ubuntu), OpenCV under Python. The knowledge acquired will be used in the other activities of the sequence.

Specific course n°2 (60 HEE) : *Autonomous Robotics*

Short description : This course will present the field of autonomous robotics (vehicle driving, exploration and inspection robots, ...) by showing how this problematic integrates very diverse technologies (localization (SLAM), point clouds, planning, pattern recognition) and how this integration is achieved at the system level (illustrations with ROS). The laboratory work associated with the course will be carried out on the Turtlebots mobile robots available in the smartroom of the Metz campus. This work will be an opportunity to integrate different machine learning and signal processing techniques on robots moving in their environment by progressively building a system allowing manual control but also autonomous mapping and navigation in an unknown environment.

Challenge Week : *Building inspection by a semi-autonomous drone (quadricopter)*

Associated partner: Parrot

- Location : Metz campus

- Short description : Students will work on issues related to technical inspection by drones (visual and thermal diagnosis) of hard-to-reach areas of industrial sites, on case studies provided by the industrial partners. They will thus provide answers to their needs in terms of improving energy performance and detecting possible degradations, allowing in particular significant savings at the level of the sites considered.

The students will have implemented servo-control techniques with the particularity of including a human operator in the control loop. They will also have integrated machine learning techniques (vector quantization, supervised learning) on an industrial case, for the interpretation of information flows from sensors (mainly video). This is a first contact with the field of machine learning through the application and experimental side. They will have acquired, through this experience, a more general competence on the design of robotic systems with ROS.