



2SC6090 – Building inspection by a semi-autonomous drone (quadricopter)

Instructors: Jeremy Fix, Herve Frezza-Buet

Department: DOMINANTE - MATHÉMATIQUES, DATA SCIENCES

Language of instruction: ANGLAIS

Campus: CAMPUS DE METZ

Workload (HEE): 40

On-site hours (HPE): 27,00

Description

The students will work on issues related to the technical inspection of indoor environments by UAVs (visual and thermal diagnosis). They will thus provide answers to needs in terms of improving energy performance and detecting possible damage, in particular allowing significant savings for the considered sites.

During this week of practicals, the focus is on helping a human operator by automating drone control as much as possible and providing the operator with a high level of logical control. The students will have implemented servoing techniques with the particularity of including a human operator in the control loop. They will also have integrated machine learning and pattern recognition techniques for the interpretation of information flows from the embedded sensors (mainly video). This is a first contact, through the application and experimental side, with the field of machine learning.

Through this experience, they will have acquired a more general competence in the design of robotic systems with ROS.

Warning: One of the major achievement of the sequence is the experimental validation on real quadrotors in the corridors and gymnasium of the school. This requires you to master several tools (ROS, Linux, ...) and skills in Python programming. A lot of work and a real motivation are required from the students; The volume of the ST5 and the availability of the teaching staff are reinforced to help you to achieve these goals.

Quarter number

ST5

Prerequisites (in terms of CS courses)

Students should be comfortable with Linux/Ubuntu, ROS and OpenCV.

These prerequisites will be taught during the thematic sequence with which this practical is associated.

Syllabus

The practical is divided into three main modules. The first module deals with 1) the low level control loop regulating roll/pitch angles and upward and



rotational speeds and 2) some higher level controls (U-turn, translation along an axis). The second module focuses on the management over time of direct behaviors (linear/angular speeds) and logical behaviors (taking the door to the left, moving into the corridor). The third module includes all the image processing functionalities (detection of vanishing lines, calculation of optical flow, etc.). These three modules are further divided with a finer granularity so that the students can parallelize the work.

Class components (lecture, labs, etc.)

- Presentation of case studies by industrial partners
- Designing solutions to proposed problems
- Development of proposed solutions in a real environment
- Implementation on real drones and possible adjustment of solutions
- Presentation/Demonstration of solutions to industrial partners

Grading

Individual and group work will be assessed during the EI period, for competency C6. The oral presentation of each group at the end of the EI on the problem introduced by a company will assess competences C4 and C7.

Resources

Instructor : Hervé Frezza-Buet, Jérémy Fix

Student groups: 5 students

Softwares : Only open source softwares (Linux, Python, ROS, Gazebo-Sphinx)

Hardware: Each group of students will have one bebop2 (lent by Parrot), a joystick, and a laptop

Lab works : The computers in the labs will have all the softwares pre-installed

Learning outcomes covered on the course

- Be able to carry out an ambitious project from start to finish
- Working as a team
- Split the work of a project into subtasks
- Experiment with real robotics platform
- Carry out a software project combining robotics, signal processing and computer science

Description of the skills acquired at the end of the course

C4. Have a sense of value creation for his company and his customers

C6. Be operational, responsible, and innovative in the digital world

C7. Know how to convince