UCLouvain

lelec2103

2021

Project in Electrical Engineering: Optimization of wireless embedded sensing systems

5.00 credits	22.5 h + 22.5 h	Q2

Teacher(s)	Bol David (coordinator) ;Jacques Laurent ;Louveaux Jérôme ;Standaert François-Xavier ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	In information and communication technologies (ICTs), embedded systems are computing systems that interact with the physical world with a dedicated function. They fill up our industrial world: from cash machines to consumer connected objects and IoT devices to automotive regulation systems to production-line control systems to medical equipment. This integrated project deals with wireless embedded sensing systems and their core technologies from both the disciplines of the Master degree in electrical engineering (electronic circuits and systems, communication systems, information and signal processing, cryptography, electronic materials and devices, and energy) and from embedded software programming. We will specifically practice the multi-objective optimization of these embedded systems with respect to sensing performance, communication range, robustness, power consumption and resource usage. Within the social-ecological transition, an important point is to use technologies like ICTs for meaningful applications with positive societal and/or environmental outcomes. In this project, we will focus on an audio monitoring system for natural ecosystem preservation.
Learning outcomes	**At the end of this learning unit, the student is able to :** . Contribution of the activity to the learning outcomes of the program In view of the LO reference framework of the "Master in Electrical Engineering", this course contributes to the development, acquisition and evaluation of the following learning outcomes: • LO1.1, 1.2 and 1.3 • LO2.1, 2.2, 2.3, 2.4 and 2.5 • LO4.1, 4.2, 4.3 and 4.4 • LO5.1, 5.4, 5.5 and 5.6 • LO6.1, 6.2 and 6.3 b. Learning outcomes **After this course, the students in electrical engineering should be able to:** • Identify the limiting factors (bottlenecks) on performance in a wireless embedded sensing system: sensing performance, communication performance, security, resource usage. • Propose, implement and characterize a multi-objective optimization in a wireless embedded sensing system with respect to sensing performance, communication performance, hardware resource usage, security. • Evaluate experimentally the robustness of a wireless embedded sensing system against various environmental conditions and link them to its internal technical characteristics.
Evaluation methods	In this course, the students are evaluated through: • a demonstration of the group project at the end of the semester, which enables 1 or 2 bonus points out of 20 points for the final grade if a first or a second threshold of technical performance are reached, these threshold being defined in advanced by the teaching team; • a certificative written group evaluation, based on a project report at the end of the semester, which accounts for 50% of the final grade; • a certificative oral group evaluation during the exam session, which accounts for 50% of the final grade. The grade is individualized as a function of the implication of the student in the group during the semester (presence at the compulsory activities, active participation to the work, ...).
Teaching methods	Most of the work consists in the project realization in groups of students, with regular meetings with the teaching team. It also includes a few lectures to introduce related advanced techniques.
Content	This project builds on the technologies and concepts already learned in the course LELEC2102 Integration of Wireless Embedded Sensing Systems (embedded systems, wireless communications, digital electronic systems,

	audio signal processing and data security), and may also feature the following technologies that the student can choose to study and practice in function of their personal interest. • Analog electronics for acoustic sensor interface and audio signal conditioning, • Photovoltaic energy harvesting and battery management.
Inline resources	https://moodle.uclouvain.be/course/view.php?id=4829
Faculty or entity in charge	ELEC

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Electrical Engineering	ELEC2M	5		
Master [120] in Electro-mechanical Engineering [Version 2020]	ELME2M	5		