Embedded systems

ECTS credits
8 credits

Semester
Spring

Presentation

Learning objectives

A new generation of massively distributed, sensor-rich systems is emerging that will have a very significant economic and environmental impact. There are many relevant applications, including autonomous cars, aerial and underwater drones, factory automation systems, smart environments, sensor networks, space probes, etc. Most of these applications require reconfigurable embedded systems that will operate autonomously for years in harsh and uncertain environments, achieving unprecedented levels of competence and robustness. The design and realization of these intelligent embedded systems requires a software revolution that brings together a diverse set of computational methods from artificial intelligence, software engineering, operations research, and control.

This module covers the principles of embedded systems and the methods of designing, prototyping and realizing such systems. In addition to the physical aspects, the module provides students with a set of design tools that are essential for the prototyping and realization of embedded systems in a wide range of applications.

OPPORTUNITIES AND JOB PROSPECTS:

The considerable and constant progress of electronics in terms of performance, flexibility, programmability and cost reduction, creates important opportunities for innovation in this field. At the same time, the industry has difficulties in finding skills in this field and faces major challenges in integrating software and hardware aspects.

Employers are in particular companies that develop electronic components and embedded systems in various fields.

Description of the programme

Principles of intelligent embedded systems:
CPU, power, memory, I/O and cost constraints
Sensors and data acquisition
Security of embedded systems, attack strategies targeting software and hardware parts
Connectivity of embedded systems

Design and implementation :
Modular design and abstraction
C language
Parallel digital computing systems (CPU, GPU)
VHDL programming and FPGA prototyping
Prototyping with microcontrollers, Raspberry, Arduino, ...
Interfacing and electronic buses, transmission standards
Data acquisition and design with Labview / Matlab

PRACTICAL WORK:
TPs programming in C
VHDL programming with associated CAD tools (ModelSim, Quartus, etc.); FPGA configuration with Altera/Xilinx design-kits
Python programming and robot control with Raspberry Pi
Arduino and Node MCU programming lab
Nodejs programming lab

Mini-projects
Concrete examples of applications and configuration of Arduino, Raspberry, ...

Speakers / external speakers :
IFREMER, YELLOWSCAN, OSEAN, OLEDCOMM,...

Bibliography

[1] J. K. Peckol, *Embedded Systems: A Contemporary Design Tool*, Wiley, 2019.

[2] M. Wolf, *Embedded System Interfacing: Design for the Internet-of-Things and Cyber-Physical Systems*, Elsevier, 2019.

[3] E. Grolleau et al., *Introduction aux Systèmes Embarqués Temps Réel : Conception et Mise en Œuvre,* Dunod, 2018.

[4] D. Paret, H. Rebaine, *Réseaux de Communication pour Systèmes Embarqués*, Dunod, 2014.

Teaching team

Nicolas Bertaux

Ali Khalighi

Fabien Lemarchand

Julien Marot

Michel Moulin, «intervenants industriels »

Total des heures		**110h**
CM	Master class	40h
TP	Practical work	40h
TD	Directed work	20h
AA		10h

Useful info

Name responsible for EU

Lead Instructor

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