VIBOT – International programme in Vision & Robotics

Bachelor in Computer Vision & Robotics – Last year of Bachelor cycle
"Licence Science pour l'Ingénieur"

Université de Bourgogne, Centre Universitaire Condorcet, Le Creusot - France.

Courses description Updated March 2019

SEMESTER I	SEMESTER II

Applied Physics (50 hours, 6 ECTS)
This module covers the fundamental principles in Physics. Students learn key concepts and applications within:
• Sensors and sensor instrumentation
• Optics and basics of image sensors
• Mechanics
 	
Signal Processing (60 hours, 6 ECTS)
Syllabus of this module is in Analog Signal Processing:
• Mathematical tools.
• Temporal representation of signals and systems.
• Spectral representation of deterministic signals.
• Random signals.
• Physical aspect and characterization of the background noise.
• Analog filtering.
And in Digital Signal Processing:
• Sampling and digitalizing signals.
• Definition of digital signals and Z-transform.
• The Discrete Fourier Transform (DFT).
• The Fast Fourier Transform (FFT).
• The FIR and IIR digital filters.
 	
Robotic Engineering 1 (60 hours, 6 ECTS)
The aim of this course is:
• Introduction to Control Systems with application in Robotics.
• Theory of univariate and multivariate systems.
• Mathematics for control systems.
• Study of source of noise.
• Filtering and correction mechanisms (PID).
	Computer Science (50 hours, 6 ECTS)
	• Programming Languages and IDE.
	• Basics: Data types, variables, constants and operators.
	• Control structures.
	• Functions, arrays and pointers.
	• Input & Output streams.
	• Fundamentals of Oriented Object Programming.
	• Introduction to the standard Template Library.
	• Image and 3D Processing Algorithms (OpenGL, OpenCV).
	• Graphical User Interface.
	
	Electronic Engineering (50 hours, 6 ECTS)
	This module is structured in two parts (lectures: 14 hours, labs: 36 hours).
	1. Sequential system architecture and micro-programming.
	  • General concepts on sequential system.
	  • Micro-controller PIC structure and embedded programming.
	2. FPGA architecture and hardware language description (VHDL).
	  • Digital electronics basics.
	  • FPGA: principles and component's architecture.
	  • VHDL basics.
	  • Basic filtering implementation based on FPGA's component.
	  • Basic design description & simulation.
	  • Implementation on FPGA evaluation boards.

Numerical Analysis (CAD1, 50 hours, 6 ECTS)

This module is divided into two main courses, which aim is to develop knowledge for solving mathematic problems with Matlab and Maxima.

1. Introduction to Matlab
    - Linear Algebra.
    - Functions.
    - Image Processing.
2. Introduction to Maxima.
    - Formal resolution.
    - Function simplification.
    - Differential calculus.

Introduction to Programming (CAD2, 50 hours, 6 ECTS)

This module is divided into three main courses:

1. Algorithms.
    - Methodology to perform an algorithm.
    - Role of the algorithms in computing.
    - Functions, variables, loops.
    - Sorting algorithms.
    - Data structures.
    - Binary search trees.
    - Computational geometry.
2. Introduction to C/C++ language.
    - Implementation of the algorithms in C/C++.
    - Structure of a program.
    - Variables, data types, operators, functions, pointers, classes.
3. Introduction to Python language.
    - Implementation of the algorithms in Python.
    - Structure of a program.
    - Variables, data types, operators, functions, pointers, classes.

Image Processing (50 hours, 6 ECTS)

Introduction to image acquisition:

- CCD/CMOS sensors, linear camera, colour camera.
- Camera lighting.
- Image format.

Image transformation:

- Image histogram, colour histogram, equalization, matching.
- Linear and non-linear filtering.
- Mathematical morphology.
- Application to contour detection, denoising, feature detection.

Segmentation:

- Contour based methods.
- Region based methods.

Robotics Engineering 2 (50 hours, 6 ECTS)

During this module students handle development of a mobile robotics project using a ground mobile robot and Robot Operating System (ROS).

Tasks:

- Motion control.
- Localization.
- Navigation.
- Obstacle Avoidance.
- Map.

Local Culture / French (30 hours, 6 ECTS)