
MASTER OF SCIENCE, TECHNOLOGY AND HEALTH

2021-2022

YEAR 1

CONTROL AND ROBOTICS EMBEDDED REAL TIME SYSTEMS

PROGRAMME SUPERVISOR(S):

Guy LEBRET



YEAR 1 - Autumn Semester

CORE COURSES

Course code	Title	ECTS Credits
ARPRO	Advanced and Robot Programming	4
ARTIN	Artificial Intelligence	4
CLACO	Classical Linear Control	5
EMBEL	Embedded Electronics	4
MICRO	Embedded Computing	4
SIPRO	Signal Processing	5

LANGUAGE COURSES

Course code	Title	ECTS Credits
CCE1	Cultural and Communication English	4
ESP1	Spanish Language	4
FLE1	French Language	4

YEAR 1 - Spring Semester

CORE COURSES

Course code	Title	ECTS Credits
COVIS	Computer Vision	4
MOBRO	Mobile Robots	4
OPTEC	Optimization Techniques	4
PRETS	Programming Real Time Systems	4
PROJECT	Group Project	6
SOFAR	Software Architecture for Robotics	4

LANGUAGE COURSES

Course code	Title	ECTS Credits
CCE2	Cultural and Communication English	4
ESP2	Spanish Language	4
FLE2	French Language	4

Master Programme - Control and Robotics - Embedded Real Time Systems

YEAR 1 - Autumn Semester

Advanced and Robot Programming [ARPRO]

LEAD PROFESSOR(S): Gaëtan GARCIA / Olivier KERMORGANT

Objectives

To provide students with the fundamentals of modern programming (with C++) and industrial robot manipulator programming with specialized robot languages.

After completing the course, students will be able to:

- Write a C++ program from scratch or expand an existing project, using external libraries
- Create their own classes and know how to understand a class interface documentation
- Use tools such as Cmake, Qt Creator, a debugger and a profiler
- Use the STL when needed

In robot programming, the students will be able to:

- Analyze moderately complex robot tasks
- Implement the corresponding robot programs
- Handle robotic tasks involving software interrupts and multiple programs.

Course contents

C++

- Basic types, STL useful classes (string, vector, pair, map), struct
- Control blocks: if/then/else, for, while, switch
- Functions: argument passing, overloading
- Classes: attributes and methods, inheritance
- Templates, lambda-functions and STL algorithms
- Code organization
- Compilation with Cmake, using external libraries
- Debugger and profiler

Industrial manipulator programming

- The different levels of programming,
- Tools for teaching locations,
- Robots, sensors and flexibility,
- Synchronous vs asynchronous motions, guarded motions,
- Tool-level programming,
- Real-time aspects of robot programming,
- The V+ language, including its real-time aspects and sensor-handling capabilities.

Practical Work: C++ labs are essentially oriented towards developing small to large games and problem-solvers. A number of the exercises will not be covered during the labs but solutions will be given.

As for industrial robot programming, the students will be able to practice with a setup of two Stäubli industrial robots, a Puma 560 and a RX 90 programmable in V+. The robots are equipped with a belt conveyor, and a number of sensors.

Course material

- C. Blume, W. Jakob, Programming Languages for Industrial Robots, Springer Verlag.
- Stäubli: RX Robots Technical Documentation, 2001.
- Bruce Eckel, Thinking in C++, volumes 1 and 2, 2007.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	8 hrs	0 hrs	24 hrs	0 hrs	2 hrs

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YEAR 1 - Autumn Semester

Artificial Intelligence [ARTIN]

LEAD PROFESSOR(S): Diana MATEUS LAMUS

Objectives

This course introduces the key notions of artificial intelligence and machine learning, essential today in dealing with the ubiquitous collection of increasing amounts of data. Starting from general theoretical concepts, we will review the most influential methods for unsupervised and supervised learning, and link them to applications. The sessions will alternate between lectures and practical exercises in Python. Although the techniques will be presented from a broad and general perspective, the applications will focus on image and signal processing

Course contents

- General concepts
- Unsupervised methods for clustering and dimensionality reduction
- From linear classification to Support Vector Machines (SVM)
- Decision trees and ensemble methods
- Neural networks and introduction to deep learning
- Evaluation measurements

Course material

- [1] Bishop C. : Pattern Recognition and Machine Learning. Springer, 2006.
 [2] Kevin Patrick Murphy. Probabilistic Machine Learning: An Introduction. 2022

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	16 hrs	4 hrs	12 hrs	0 hrs	2 hrs

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Classical Linear Control [CLACO]

LEAD PROFESSOR(S): Guy LEBRET

Objectives

Review the fundamentals of classical control for linear systems and provide a control methodology starting from the open loop analysis of the system to be controlled to the synthesis of a closed loop using classical PID type controllers (one degree of freedom controllers) which can be combined with a feedforward part (two degrees of freedom controllers).

Course contents

- Description of SISO linear systems through the transfer function
- Analysis of behaviour (poles/zeros, first/second/more general systems, time domain/frequency domain responses etc)
- Definition the Control objectives (stability/performance, tracking/regulation)
- Nominal/robust stability (Routh, Nyquist criteria, stability margins).
- Nominal/robust performance and the unavoidable trades off between stability and performance.
- Synthesis of PID type controllers, using frequency approach tunings, in a classical closed loop (one degree of freedom controller strategy).
- Possibility of introducing a feedforward contribution which tries to "invert" the first closed loop obtained (two degrees of freedom controllers).

After completing this course, the students will be able to:

- Analysis of the dynamic behaviour of a SISO linear system
- Design a PID type controller as an example of a feedback controller
- Design a feedforward controller to increase tracking performance

Course material

Recommended texts: course notes will be provided by the lecturer.

Further reading:

- "Modern Control Systems", R.C. Dorf and R.H. Bishop, Prentice Hall, 2011.
- "Control Systems Engineering", N. S. Nise, John Wiley & Sons, 2011.
- "Control system design", G.C. Goodwin, S.F. Graebe and M.E. Salgado, Prentice Hall, 2001.
- "Multivariable Feedback Control Analysis and Design", D.S. Skogestad and I. Postlethwaite, Wiley, 2005.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	22 hrs	6 hrs	4 hrs	0 hrs	2 hrs

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YEAR 1 - Autumn Semester

Embedded Electronics [EMBEL]

LEAD PROFESSOR(S): Rémi PARROT

Objectives

At the end of the course the students will be able to:

- understand different synchronous or asynchronous architectures of embedded systems;
- write and simplify boolean expressions to design logic circuits;
- implement logic circuits in VHDL, on Field Programmable Gate Arrays (FPGA).

Course contents

The first part of the course deals with designing logic circuit:

- Boolean algebra;
- Truth tables and Karnaugh maps;
- Design logic circuits from specifications.

The second part of the course introduces to the VHDL Language:

- VHDL syntax and semantics;
- Concurrent code vs. Sequential code;
- implement logic circuits in VHDL using Xilinx Vivado;
- test VHDL code on Vivado using simulation;
- configure Xilinx Basys 3 Artix-7 (FPGA) board with Vivado;

Course material

Volnei A. Pedroni, Circuit Design and Simulation with VHDL, PH, 2011

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	10 hrs	2 hrs	20 hrs	0 hrs	2 hrs

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YEAR 1 - Autumn Semester

Embedded Computing [MICRO]

LEAD PROFESSOR(S): Mikael BRIDAY

Objectives

At the end of the course the students will be able to:

- understand the architecture of a microcontroller;
- design a low-level driver to access a peripheral of a microcontroller and deal with microcontroller interrupts;
- design a bare metal application, i.e. without any real time operating system.

Course contents

The first part of the course deals with the software environment for deeply embedded systems:

- data representation
- cross compiler: bit operations, memory model, common C design rules, low level C and assembly specific attributes
- debugging with a JTAG probe (breakpoints, memory watch, etc)

The second part introduces some basic hardware peripherals of a microcontroller to interact with the environment:

- standard GPIO
- timers and PWM
- interrupts
- serial communication peripherals

The third part of the module focuses on the design of both bare metal applications and driver, including concurrent execution of both software and hardware parts.

Course material

- Philip Koopman, Better Embedded Software Systems, Drumnadrochit Education LLC, 2010
- D. Patterson & J. Hennessy, Computer Organization and Design – ARM Edition, Morgan Kaufmann, 2017

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	12 hrs	4 hrs	16 hrs	0 hrs	2 hrs

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YEAR 1 - Autumn Semester

Signal Processing [SIPRO]

LEAD PROFESSOR(S): *Eric LE CARPENTIER*

Objectives

- To interpret the spectral representations of signals
- To understand the time sampling of signals (sample rate, anti-aliasing filter etc.)
- To model a system using the transfer functions language
- To model a system using the state space language
- To switch from one representation to the other
- To link the physical phenomena to the parameters of these representations (stability, response velocity etc.)
- To simulate these mathematical representations with adapted scientific software tools (Matlab, Simulink)

Course contents

- Analysis of continuous-time and discrete-time signals
 - o Fourier, Laplace and z transforms
 - o Sample, hold, quantization, Shannon theorem
- Modelling of continuous-time and discrete-time linear time invariant (LTI) systems
 - o Transfer function, state space representation
 - o Poles, zeros, stability
 - o Time response, frequency response
 - o Sampling
 - o Simulation (Matlab Simulink)
 - o First-order and second-order systems
- Design of an actual digital control implementation
 - o Analog to Digital Converter, Digital to Analog converter
 - o Sample and hold
 - o Link with the previous mathematical representations
- Lab work
 - o A simple encoder
 - o Spacecraft control simulation

Course material

- Modern Signals and Systems, H. Kwakernaak, R. Sivan, Prentice Hall.
- Signals and Systems, R. Baraniuk, <http://www.eng.ucy.ac.cy/cpitris/courses/ece623/notes/SignalsAndSystems.pdf>
- Signal processing. Introduction to signals and systems theory, E. Le Carpentier, <https://hippocampus.ec-nantes.fr/mod/resource/view.php?id=9179>

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	16 hrs	0 hrs	16 hrs	0 hrs	2 hrs

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YEAR 1 - Autumn Semester

Cultural and Communication English [CCE1]

LEAD PROFESSOR(S): Spencer HAWKRIDGE

Objectives

Introduction to Cultural and Communicational English:

- Understand the general concepts of communication English (different levels of language, etc.)
- Build a communicational project
- Develop strategies for enhanced interaction
- Organize, lead and participate in discussions, interviews and meetings
- Behavioral skills in an inter-cultural environment:
- Strengthen engagement and level of conviction
- Develop a capacity to explain and argue
- Acquire notions of corporate culture and values
- Enhance team work

Course contents

Cultural and Communicational English: exercises to explore in practice the areas of culture and communication
 Inter-cultural project (for example, documentary project, publishing project: construct a work of fiction or of educational value and experience the complete publishing process)
 VEC (Virtual Environmental Challenge) Challenge - international competition to design an Eco-campus with participants from French and foreign universities.

Course material

Written and televised press, information and digital tools, general documents, business environment and company strategies.
 Internet conferences (Ted Talks, etc.), our own educational materials on Hippocampus (Moodle).
 Our own eZoomBook template for the Intercultural project.
 VEC padlet and PMooc ('The stories we live by' - Professor Arran Stibbe lecturing on Ecolinguistics)

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	0 hrs	64 hrs	0 hrs	0 hrs	0 hrs

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YEAR 1 - Autumn Semester

Spanish Language [ESP1]

LEAD PROFESSOR(S): Marta HERRERA

Objectives

For beginners:

Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction)

Acquisition of vocabulary and linguistic structures

Be able to talk about yourself and those around you

Be able to express oneself during daily activities

Know how to give your opinion

For advanced students:

Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction)

Acquisition of specialised vocabulary

Be able to understand the essential content of concrete or abstract subjects including a technical discussion

Be able to communicate spontaneously and fluently

Be able to express oneself in a clear and detailed manner, to express an opinion on a topical subject

Course contents

For beginners:

Personal environment (introduce yourself, express yourself, your tastes, your character, your hobbies, etc.), your surroundings (friends, family, location, climate), your interests (sports, leisure)

Present tense (regular and irregular)

Language patterns to express habit, obligation, "gustar" and its equivalents,

Possessive adjectives

Differences between "es", "está", "hay"

Use of "por" and "para"

Adverbs and frequency patterns

Numeral adjectives

For advanced students:

Knowledge of the Hispanic world (economic, technical, cultural and social environment)

Present tense (regular and irregular)

Imperative

Past tenses

Direct / indirect style

Future tense

Conditional tense

Present and past subjunctive moods

Course material

Preparation manuals, our own tailor-made documents, written and internet press, general civilization documents, digital tools

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	0 hrs	64 hrs	0 hrs	0 hrs	0 hrs

Master Programme - Control and Robotics - Embedded Real Time Systems

YEAR 1 - Autumn Semester

French Language [FLE1]

LEAD PROFESSOR(S): *Silvia ERTL*

Objectives

The objective is to familiarize the learner with the French language and French culture through an entertaining task-based communicative language teaching, focused on speaking combined with:

- Phonetics
- Self-correcting exercises on our learning platform
- Learning Lab activities
- Project work
- Tutoring

Course objectives include the acquisition and reinforcement of vocabulary, syntax, and pronunciation by both traditional means and through the use of digital resources.

Students will learn general French, develop language skills of oral and written comprehension and expression.

After completing this course (32 hours + personal work), the students will be able to communicate in spoken and written French, in a simple, but clear manner, on familiar topics in the context of study, hobbies etc. Another important goal of this course is to introduce the student to French culture. At the end of the course (2 semesters), complete beginners can achieve an A1 level and some aspects of the A2 of The Common European Framework of Reference for Languages. More advanced students may aim for B1/B2 levels.

Course contents

Full range of practical communication language exercises: reading comprehension, listening comprehension, written expression, oral expression.

Learners will be able to use the foreign language in a simple way for the following purposes:

1. Giving and obtaining factual information:

- personal information (e.g. name, address, place of origin, date of birth, education, occupation)
- non-personal information (e.g. about places and how to get there, time of day, various facilities and services, rules and regulations, opening hours, where and what to eat, etc.)

2. Establishing and maintaining social and professional contacts, particularly:

- meeting people and making acquaintances
- extending invitations and reacting to being invited
- proposing/arranging a course of action
- exchanging information, views, feelings, wishes, concerning matters of common interest, particularly those relating to personal life and circumstances, living conditions and environment, educational/occupational activities and interests, leisure activities and social life

3. Carrying out certain transactions:

- making arrangements (planning, tickets, reservations, etc.) for travel, accommodation, appointments, leisure activities
- making purchases
- ordering food and drink

Course material

Preparation manuals, our own tailor-made documents, written and televised press, internet, general civilization documents, digital tools, our own educational materials on Hippocampus (Moodle).

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	0 hrs	64 hrs	0 hrs	0 hrs	0 hrs

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YEAR 1 - Spring Semester

Computer Vision [COVIS]

LEAD PROFESSOR(S): Vincent FREMONT

Objectives

- To acquire knowledge and skills in computer vision and image processing to understand and to master methods for artificial perception and scene understanding.
- To learn to implement current visual odometry pipelines used in mobile robots and to understand and how to tune Deep Learning algorithms for semantic segmentation.

Course contents

- Introduction
- Image Formation 1: perspective projection and camera models
- Image Formation 2: camera calibration algorithms
- Filtering and Edge detection
- Feature Point Detection
- Multiple-view Geometry and Robust Estimation
- Optical Flow and Feature Tracking
- Visual SLAM Frameworks
- Deep Learning and Semantic Segmentation

Practical Work: Sessions on camera calibration, template tracking and object detection will be proposed.

Course material

Recommended textbooks:

- Digital Image Processing, by Rafael C. Gonzalez and Richard E. Woods, 2018
- Computer Vision: Algorithms and Applications, by Richard Szeliski, 2009.
- Multiple view Geometry, by R. Hartley and A. Zisserman, 2003.
- An Invitation to 3D Vision, by Y. Ma, S. Soatto, J. Kosecka, S.S. Sastry, 2004.
- Robotics, Vision and Control: Fundamental Algorithms, by Peter Corke, 2011.

Online courses:

- Course by Davide Scaramuzza: <http://rpg.ifi.uzh.ch/teaching.html>
- Course by James Hays at Brown University: <https://www.cc.gatech.edu/~hays/>
- Course by Andrea Vedaldi: <http://www.robots.ox.ac.uk/~vedaldi/teach.html>

Further reading: will be provided by lecturer

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	20 hrs	0 hrs	12 hrs	0 hrs	2 hrs

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YEAR 1 - Spring Semester

Mobile Robots [MOBRO]

LEAD PROFESSOR(S): Gaëtan GARCIA

Objectives

The objective of the course is to provide students with the necessary tools to model, localize and control conventional wheeled mobile robots, along with tools to plan their path..

Course contents

The following subjects will be addressed:

- Modelling of wheeled Robots: Constraint equations, Classification of robots using degrees of mobility and steerability, Posture kinematic model, Configuration kinematic model, Motorisation of wheels.
- Localization: Relative localization using odometry, Absolute localisation, Localization sensors, Localization using extended Kalman filtering. Observability analysis of localization problems.
- Control: Controllability and stabilization, static and dynamic feedback linearization, non-linear control based on Lyapunov functions.

Practical Work: The students will study various control laws in simulation. They will also implement a Kalman filter-based localization algorithm using data recorded with a real robot.

Course material

- "Theory of robot control", Carlos Canudas de Wit, Bruno Siciliano, Georges Bastin, Springer Science & Business Media, 2012 - 392 pages.
- "Wheeled Mobile Robots—Kinematic Modelling", G. Garcia, Class material in book form.
- "Mobile robots—Localization", G. Garcia, Class material in book form.
- "Principles of robot motion", H. Choset et. al., Bradford books, MIT Pres.

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	20 hrs	0 hrs	12 hrs	0 hrs	2 hrs

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YEAR 1 - Spring Semester

Optimization Techniques [OPTEC]

LEAD PROFESSOR(S): Fouad BENNIS

Objectives

The lecture presents different theoretical and computational aspects of a wide range of optimization methods for solving a variety of problems in mechanical engineering. The main objective of this course is to give the students the ability to formalise, select the appropriate method, implement the optimisation problem and then analyse the results in order to take the best decision regarding the objectives, variables and constraints.

Course contents

- Basic concepts of optimization,
- Gradient based methods,
- Evolutionary algorithms,
- Multi objective optimization methods,
- Robust optimization methods,
- Multidisciplinary optimization problems,
- Programming aspects,
- Use of optimization toolbox.

Practical Work: exercises and a project on the design optimisation of a mechanical product, manufacturing process or system.

The students will be able to understand different theoretical and computational aspects of a wide range of optimization methods.

Course material

R. Fletcher, Practical Methods of Optimization, Wiley, 2000.
 Mitchell Melanie: An Introduction to Genetic Algorithms, MIT Press 1996

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	16 hrs	0 hrs	16 hrs	0 hrs	2 hrs

Master Programme - Control and Robotics - Embedded Real Time Systems

YEAR 1 - Spring Semester

Programming Real Time Systems [PRETS]

LEAD PROFESSOR(S): Sébastien FAUCOU

Objectives

At the end of the course the students will be able to:

- Design a software architecture for a real-time system
- Build deterministic programmes with a multitasking RTOS
- Handle time and recurring events in a real-time software system
- Understand and solve resource sharing issues in concurrent real-time software

Course contents

- Introduction to real time systems: what is a real time system, classes of timing constraints, basic model and results on real time scheduling
- Trampoline RTOS: what is a RTOS, when is it useful, architecture of Trampoline, build process, task management and scheduling, synchronisation, handling of recurring events, shared resources
- Design of real time applications: case studies and design patterns

Course material

- Alan Burns, Andy Wellings, Analysable Real-Time Systems: Programmed in Ada, CreateSpace Independent Publishing Platform, 2016
- Giorgio C. Buttazzo, Hard Real-Time Computing Systems: Predictable Scheduling Algorithms and Applications, Springer, 2011
- Philip Koopman, Better Embedded Software Systems, Drumnadrochit Education LLC, 2010

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	12 hrs	4 hrs	16 hrs	0 hrs	2 hrs

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YEAR 1 - Spring Semester

Group Project [PROJECT]

LEAD PROFESSOR(S): Gaëtan GARCIA

Objectives

To contribute to solving a scientific, technological or theoretical problem proposed by any of the instructors of the master (professors, assistant professors, researchers etc.) or industrial partners.

Course contents

The students (individually or often as a group of two) organize the project. Depending on the subject, a bibliography may be necessary, an original methodology or solution can be proposed or it can involve purely the application of techniques learned throughout the courses.

32 hours are set aside for the project in the timetable, but additional personal work will be required. Project assessment is based on a written report and an oral presentation.

Course material

To be provided by the supervisor(s) if necessary.

Assessment

Collective assessment: EVC 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	6	0 hrs	0 hrs	0 hrs	32 hrs	0 hrs

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YEAR 1 - Spring Semester

Software Architecture for Robotics [SOFAR]

LEAD PROFESSOR(S): Gaëtan GARCIA

Objectives

The main objective of Software Architecture for Robotics is to provide students with methodological tools and practical information about how to design and develop complex software architecture for intelligent robots. Nowadays, robots can be considered as complex systems made up of modules and components whose behavior is complex in its own right. Given a specific scenario where a robot must operate autonomously and effectively, the problem of defining software architecture requires one to:

- define which sensory information is needed and how it must be processed;
- couple sensory information and internal representation structures, which must be appropriate in terms of efficiency, computational load and usability;
- design and develop algorithms to operate on such representation structures;
- embed those algorithms in software modules and components, which must be concurrently executed on (typically realtime) operating systems.

The course provides a principled treatment of current stateoftheart design approaches, development frameworks, modelling tools and advanced research trends in this field, as well as a comprehensive discussion about typical scenarios, solutions and use cases. In terms of development framework, the objective is to obtain sufficient command of ROS (Robot Operating System – web: <http://www.ros.org/>) to implement moderately complex applications.

Course contents

The course covers the following aspects:

- Design patterns for robot software development,
- Component-based software engineering aspects,
- Typologies of software architecture for robots, and their use in real-world scenarios,
- Biologically-inspired approaches to robot software design,
- Real-time and non-real-time software components,
- Integration of robot perception, knowledge representation, reasoning, and action.
- Practical introduction to ROS in the labs.

Course material

Relevant material will be provided by the instructors during the course

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	12 hrs	0 hrs	20 hrs	0 hrs	2 hrs

Master Programme - Control and Robotics - Embedded Real Time Systems

YEAR 1 - Spring Semester

Cultural and Communication English [CCE2]

LEAD PROFESSOR(S): Spencer HAWKRIDGE

Objectives

Interview techniques and communicational English:

- Understand the general concepts of interactive communication
- Build a media project
- Acquire interview techniques
- Understand the process of sourcing and checking facts and figures
- Understand issues related to plagiarism
- Create a bibliography
- Behavioral skills in an inter-cultural environment:
- Strengthen self-confidence and capacity for interaction
- Develop active listening and reformulation skills
- Develop networking skills

Course contents

Cultural and Communicational English: exercises to explore in practice the areas of culture and communication.

Media project (for example: prepare, conduct and promote interviews for a radio programme: L'Heure Centralienne (<http://www.euradionantes.eu/emission/l-heure-centralienne>), with the contribution of professors, PhD students, industrial partners, industry players at fairs, etc.

Course material

Written and televised press, information and digital tools, general documents business environment and company strategies. Internet conferences (Ted Talks, etc.), our own educational materials on Hippocampus (Moodle). Our own eZoomBook template for the Intercultural project.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

Master Programme - Control and Robotics - Embedded Real Time Systems

YEAR 1 - Spring Semester

Spanish Language [ESP2]

LEAD PROFESSOR(S): Marta HERRERA

Objectives

For beginners:

Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction)

Acquisition of vocabulary and linguistic structures

Be able to talk about yourself and those around you

Be able to express oneself during daily activities

Know how to give your opinion

For advanced students:

Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction)

Acquisition of specialised vocabulary

Be able to understand the essential content of concrete or abstract subjects including a technical discussion

Be able to communicate spontaneously and fluently

Be able to express oneself in a clear and detailed manner, to express an opinion on a topical subject

Course contents

For beginners:

Personal environment (introduce yourself, express yourself, your tastes, your character, your hobbies, etc.), your surroundings (friends, family, location, climate), your interests (sports, leisure)

Present tense (regular and irregular)

Language patterns to express habit, obligation, "gustar" and its equivalents,

Possessive adjectives

Differences between "es", "está", "hay"

Use of "por" and "para"

Adverbs and frequency patterns

Numeral adjectives

For advanced students:

Knowledge of the Hispanic world (economic, technical, cultural and social environment)

Present tense (regular and irregular)

Imperative

Past tenses

Direct / indirect style

Future tense

Conditional tense

Present and past subjunctive moods

Course material

Preparation manuals, our own tailor-made documents, written and internet press, general civilization documents, digital tools

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

Master Programme - Control and Robotics - Embedded Real Time Systems

YEAR 1 - Spring Semester

French Language [FLE2]

LEAD PROFESSOR(S): *Silvia ERTL*

Objectives

The objective is to familiarize the learner with the French language and French culture through an entertaining task-based communicative language teaching, focused on speaking combined with:

- Phonetics
- Self-correcting exercises on our learning platform
- Learning Lab activities
- Project work
- Tutoring

Course objectives include the acquisition and reinforcement of vocabulary, syntax, and pronunciation by both traditional means and through the use of digital resources.

Students will learn general French, develop language skills of oral and written comprehension and expression.

After completing this course (32 hours + personal work), the students will be able to communicate in spoken and written French, in a simple, but clear manner, on familiar topics in the context of study, hobbies etc. Another important goal of this course is to introduce the student to French culture. At the end of the course (2 semesters), complete beginners can achieve an A1 level and some aspects of the A2 of The Common European Framework of Reference for Languages. More advanced students may aim for B1/B2 levels.

Course contents

Full range of practical communication language exercises: reading comprehension, listening comprehension, written expression, oral expression.

Learners will be able to use the foreign language in a simple way for the following purposes:

1. Giving and obtaining factual information:

- personal information (e.g. name, address, place of origin, date of birth, education, occupation)
- non-personal information (e.g. about places and how to get there, time of day, various facilities and services, rules and regulations, opening hours, where and what to eat, etc.)

2. Establishing and maintaining social and professional contacts, particularly:

- meeting people and making acquaintances
- extending invitations and reacting to being invited
- proposing/arranging a course of action
- exchanging information, views, feelings, wishes, concerning matters of common interest, particularly those relating to personal life and circumstances, living conditions and environment, educational/occupational activities and interests, leisure activities and social life

3. Carrying out certain transactions:

- making arrangements (planning, tickets, reservations, etc.) for travel, accommodation, appointments, leisure activities
- making purchases
- ordering food and drink

Course material

Preparation manuals, our own tailor-made documents, written and televised press, internet, general civilization documents, digital tools, our own educational materials on Hippocampus (Moodle).

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs