Syllabus UPSSITECH

Systèmes Robotiques et Interactifs

Robotic and Interactive Systems

2020-2024

Content Table

1. General Program Overview

SEMESTER 5		ECTS	C	TD	TP	H
UE1 UESHSL 1	Foreign Languages	9		36		36
	Economics and Business Management		18	18		36
	Physical Education and Sports			16		16
	Human and Social Sciences*		8	10		18
	30 hours of mathematics support **		14	16		30
UE2 UEOSI1	Algorithmic basics and programming*	9	8	10	16	34
	Physics		12	22		34
	Mathematical tools for engineers		18	18		36
UE3 UEST1	System modeling and control I	12	14	14	8	36
	System Dependability		12	12	12	36
	Computer modelling tools *		14	16	6	36
	Object Programming		12	12	12	36
* Shared between SRI and STRI / ** support hours are not taken into account in the global hour volume (H) .		**30**	**116**	**184**	**54**	**354**

SEMESTRE 6		ECTS	C	TD	TP	H
UE4 UESHS L2	Foreign Languages	9		36		36
	Project Management		10	26		36
	Physical Education and Sports			16		16
	Human and Social Sciences		8	10		18
	2-month internship					
UE5 UEOSI2	Industrial Computing *	9	10	10	15	35
	System Communication		12	12	12	36
	Signal Processing		12	12	12	36
UE6 UEST2	System modeling and control II	12	12	10	15	36
	Object Oriented Design		12	12	12	38
	Introduction to Robotic and Interactive Systems		20	22	28	70
* shared between STRI/SRI		**30**	**96**	**166**	**94**	**356**

SEMESTRE 7		ECTS	C	TD	TP	H
UE7 UESHSL3	Foreign Languages	12		36		36
	Business Management		18	16		34
	Physical Education and Sports			16		16
	Human and Social Sciences		8	10		18
	Initiation: How to conduct a scientific study and research work		6	24		30
UE8 UEST3	Estimation and Optimization for Robotics	9	14	10	12	36
	Models for paralellism		12	10	12	34
	Advanced Programming		10	10	16	36

UE9 UEST4	Industrial and Mobile Robotics	9	26	18	26	70
	Control and Optimization for Robotics		12	9	15	36
		30	**106**	**159**	**81**	**346**

SEMESTRE 8		ECTS	C	TD	TP	H
UE10 UESHSL4	Foreign Languages	6		36		36
	Physical Education and Sports			16		16
	Quality Management		8	14		22
	3-month internship (mandatory)	6				
UE11 UEST5	Multi-task programming and real-time systems	9	12	14	18	44
	AI and solving problem methods		12	10	24	46
	AI – Machine learning and Deep Learning		16	12	16	44
UE12 UEST6	Robot Motion and Navigation	9	18	12	16	46
	Speech Processing and Synthesis		16	8	20	44
	Image Processing and synthesis		16	10	18	44
		30	**98**	**132**	**112**	**342**

SEMESTRE 9		ECTS	C	TD	TP	H
UE13 UESHSL5	Foreign languages	6		36		36
	Innovation and law		10	20		30
UE14 UEST7	Robotic systems	9	30	18	44	92
	Design and implementation of Robotic Systems		10	10	8	28
UE15 UEST8	Advanced Robotics / Advanced Interaction	6	16	8	26	50
	Project Management and coaching		4	4	16	24
UE16 UEST9	Interactive Systems	9	22	16	48	86
	Design and implementation of Interactive Systems		10	6	8	24
		30	**102**	**118**	**150**	**370**

SEMESTRE 10		ECTS	C	TD	TP	H
UEPR	Professionalization and Qualification (professional project)	**6**	-	-	-	-
	5-month internship (mandatory)	**24**	-	-	-	-
		30	**-**	**-**	**-**	**-**

1. 1st Year – Semester 5

UE	UESHSL1	9ECTS	Semester 5
Discipline	**Foreign Language : English (FL1)** Spanish/German/Japanese (FL2)	Organization	24 h TD English 12h TD Others

Learning outcomes and skills

Master the English language with a view to written socio-professional communication in a specialised language: writing abstracts. Oral reports and reports following the acquisition of written and oral data.

Pedagogical methodology and specific aspects of teaching

These skills are applied through professionalizing projects, thus making students aware of the soft skills that will be expected in a company.
Reversed pedagogy: The student prepares different Disciplines then passes them on to others, thus placing themselves as expert.
Case studies and role-playing games, with a priority to creativity and initiative, in which the students working in competing teams are the driving force behind proposals from both a technological and a communication point of view, including notions of diplomacy and intercultural communication.

Summary description of the lessons

Work on various themes proposed and chosen by the students.
The topics are always relevant to their field of expertise and are proposed and chosen by the students.

Prerequisites

This type of approach allows a good management of the linguistic heterogeneity.

Bibliographical references

Students who have to find documents to carry out their projects must refer to relevant references in order to respond to critics.
Authentic documents such as scientific or press articles.

UE	UESHSL1	9 ECTS	Semester 5
Discipline	**Economics and Business Management - Management**	Organization	4 h C, 10 h TD

Learning outcomes and skills

The objective of the course is to provide students with the skills required to read and analyze key accounting documents (income statement, balance sheet, cash flow statements). The aim is to give students a methodology and tools to help them learn how to read and construct accounting and financial information.

Summary description of the lessons

The course covers the 3 main cycles encountered in a company: the operating cycle, the investment cycle and the financing cycle. These three cycles provide an understanding of how to construct and read financial statements, particularly the balance sheet and income statement.

Prerequisites

beginner / beginner level, no prerequisites

Keywords

Revenue, income, cash, balance sheet, income statement, Cash Flow…

UE	UESHSL1	9 ECTS	Semester 5
Discipline	**Economics and Business Management - Economy**	Organization	8 h C

Learning outcomes and skills

- Identify the main economic agents and their function in the national context based on the economic circuit.
- To be able to describe the economic situation by using the main economic indicators and the main issues on sustainable development.
- Know the different markets and macroeconomic imbalances, and the main economic policies to address them by mobilizing the law of supply and demand.
- Describe the principles of international trade and the characteristics of French foreign trade, supported by the doctrines of free trade and protectionism.
- Understand the role of money and the banking sector and financial markets in the economy by mobilizing monetary policy in a context of financial globalization.

Summary description of the lessons

Session 1.: Introduction to be able to identify the main economic agents and their function
Theme 1. Economic Indicators, Growth and Sustainable Development
To be able to define: the main economic indicators, the rate of growth and the challenges of sustainable development.
Session 2.: Market Economy, Imbalances and Economic Policies
To be able to: make the link between demand, supply and price in a market; know the different types of market and their imbalances; understand inflation, unemployment and the deficit of the external balance; know how to explain the difference between cyclical and structural policies.
Session 3. : International exchanges
Being able to: understand the principles of international trade, know the main characteristics of French foreign trade.
Session 4. : Financing the economy, the currency and the financial markets
Being able to: understand the role of money and the banking sector, make the differences between the financial markets.

Prerequisites

beginner / beginner level, no prerequisites

Bibliographical references

- *Dictionnaire d'économie et de sciences sociales*, (2003)sous la direction de Echaudemaison, C.D., 6ème édition, Nathan
- Gendron, B; Saker, A. (2009), *Economie*, Gualino
- Le Guirriec-milner, G. (2013), *L'essentiel des mécanismes de l'économie*, 3ème édition, Gualino (Disponible scholarvox)
- Monier, P. (2013), *L'économie générale: acteurs et marchés économiques*, 7ème édition, Gualino (Disponible sur Scholarvox)
- Tacheix, T. (2012), *L'essentiel de la macro-économie, 6ème édition, Gualino*

Keywords

economic agents, markets, cyclical / structural imbalances, economic policies

UE	UESHSL1	9 ECTS	Semester 5
Discipline	**Economics and Business Management - Law**	Organization	6 h C, 8 h TD

Learning outcomes and skills

- Identify legal risks in a confidentiality agreement in a given context, with access to the internet
- Identify the intellectual property titles adapted to the element to be protected and the context, with access to the internet
- Find and retrieve legal information on a given theme, with access to the internet and / or access to a specialized library
- Master the basics of law useful to the engineer

Pedagogical methodology and specific aspects of teaching

Sort of inverted class: paired presentations on a subject or a text related to a legal theme.

Summary description of the lessons

Introduction to Law
Trade Law
Corporate law
Contract law
Intellectual Property Law
Labor law
Right of personal data

Prerequisites

None

Bibliographical references

Azéma, J., Galloux, J.-C. (2012). Droit de la propriété industrielle (7e éd.). Dalloz, Précis.
Cozian, M., Viandier, A., Deboissy, F. (2013). Droit des sociétés (26e éd.). LexisNexis, Manuel.
Gautier, P.-Y. (2016). Propriété littéraire et artistique (10e éd.). PUF, Droit fondamental.
Malinvaud, P., Fenouillet, D. (2012). Droit des obligations (12e éd.). LexiNexis, Manuel.
Pellegrini, F., Canevet, S. (2013). Droit des logiciels, logiciels privatifs et logiciels libres. PUF.
Peskine, E., Wolmark, C. (2018). Droit du travail 2019. Dalloz, HyperCours.
Vivant, M. (dir.) (2015). Les grands arrêts de la propriété intellectuelle (2e éd.). Dalloz, Grands Arrêts.
Pellegrini, F., Canevet, S. (2013). Droit des logiciels, logiciels privatifs et logiciels libres. PUF.

Keywords

Law, contract, intellectual property, social law, court system, RGPD, company creation, legal risk

UE	UESHSL1	9 ECTS	1er semestre
Disciplines	**Physical Education and Sports Preparation Sliding Sport, Golf, Climbing, Muscular Strengthening, Volleyball**	Organization	16h TD

Learning outcomes and skills

- Know and follow the regulation of activities and the different stages of warming-up in order to practice safely.
- Know the different resources required by the activity in order to start acquiring a specific motricity.
- Engage in training situations by relying on rehearsal and regulation in order to strengthen motor skills.

UE	UESHSL1	9 ECTS	Semester 5
Discipline	**Human and Social Sciences – Written and Oral Communication**	Organization	8h C - 10h TD

Learning outcomes and skills

- Organize and produce a written report or an oral presentation.
- Be aware of persuasion, federation and influence techniques in a group.
- Organize a working meeting by analyzing and identifying good professional practices.

Pedagogical methodology and specific aspects of teaching

The teaching will be:
- active and participatory, students will work independently and in teams. They will pass on their results to their colleagues and to the teacher.
- differentiated (personalized) and reversed (permutations between instructing and listening students),
- by project. Pedagogy per project will be used in the context of a technical and scientific project (ELUTR5B1- "informatique du projet"), thus decompartmentalising engineering sciences and techniques (STI) and Humanities.

Summary description of the lessons

- learn to know each other better (weaknesses and strengths) in order to better communicate,
- optimize the functioning of a group, how to gain leadership, how to analyze the group dynamics, enhance their know-how-to-be, with continuous improvement in mind,
- analyze and synthesize effectively so as to better communicate orally and in writing,
- organize a working meeting,
- re-use the knowledge and know-how about "Written and Oral communication" in the technical and scientific project (ELUTR5B1-informatique du projet).

Prerequisites

Good knowledge of the French language. For this purpose, French courses for non-francophone students are offered at Paul Sabatier University.

Bibliographical references

- 12 Méthodes de Communication écrite et orale, M. FAYET, J.D. COMMEIGNES Dunod (4eme édition) 2013
- Comment le web change le monde F. PISANI, D. PIOLET, Ed. Pearson 2011.
- Progresser en communication, M. L. FOUGIER, M. ROCCA, G. SEBASTIEN, Ed. PUG 2007.

Keywords

company, written and oral communication, self-awareness, professional relationships, leadership, continuous improvement.

UE	-	-	Semester 5
Discipline	**Mathematics support**	Organization	14 h C, 16 h TD

Learning outcomes and skills

- Compute a partial fraction decomposition in the context of integration
- Compute an integral using one of the following methods: classical form recognition, integration by parts, change of variable
- Give a basis and compute the dimension of a linear subspace
- Solve a linear system using the Gauss elimination method
- Determine the kernel, the image and the matrix associated to a linear map between two linear spaces
- Solve a linear first or second order ordinary differential equation with constant coefficients

Pedagogical methodology and specific aspects of teaching

A homework on the mathematical bases of each topic is given before each small class in order to give the students the opportunity to study efficiently the course before the practical exercises.

Summary description of the lessons

- Complex, polynoms and rational fractions
- Integration
- Linear systems, vector spaces, basis, linear application
- Ordinary Differential Equations
- Introduction to series

UE	UEOSI1	9 ECTS	Semester 5
Discipline	**Algorithmic basics and programming**	Organisation	8 h C, 10 h TD, 16 h TP, 12 h projet

Learning outcomes and skills

- Acquire the fundamental notions of algorithmics using the method of successive refinements
- Transforming an algorithm into a computer program
- Acquire a structured and effective programming methodology
- The student will be able to:
- Analyze a simple problem and propose an IT solution to solve it
- Design an algorithm based on a defined set of specifications
- Analyze the behaviour of programs in order to modify them
- Use a programming language for the development of small applicatins
- Identify test situations to validate your program

Pedagogical methodology and specific aspects of teaching

Case studies

Summary description of the lessons

- Problem formulation and algorithm research
- Methodology of imperative programming
- Basic data structures
- Compound data structures
- Expressions and Operators
- Control structures
- Sub-programs
- Memory management
- Input/output functions
- Situation tables
- Use of development environments

Bibliographical references

[1] J. Courtin, I. Kowarski. Initiation à l'algorithmique et aux structures de données, Tome I : programmation structurée et structures de données élémentaires. Editions Dunod

Keywords

Problem Analysis - Algorithmics - Successive refining - Functional decomposition - Programming - Testing

UE	UEOSI1	9 ECTS	Semester 5
Discipline	**Physics** **Digital Electronics -**	Organisation	6 h C, 12 h TD

Learning outcomes and skills

- Synthesize simple combinatorial logical functions
- Identify and understand how the different scales work
- Analyze and describe the operation of simple sequential systems (counter, register)

Summary description of the lessons

Acquire the necessary bases to:

- number manipulation in computer science, digital electronics and automation,
- synthesis of a simple combinatorial logical function.
- sequential system analysis (counter, register)

Content :

- Numeration: study of bases 2, 10 and 16, change of base.
- Representation of integers: pure binary, complement to 2.
- Boolean Algebra: theorems and axioms, algebraic simplifications. Karnaugh's paintings.
- Representation of combinatorial logical functions: truth table, algebraic form, logigram, chronogram
- Introduction to sequential logic
- RS, JK and D scales
- Asynchronous and synchronous systems
- Counters, Registers

Bibliographical references

- Claude Brie (2002), Logique combinatoire et séquentielle, éditions Ellipses, 320 pages, ISBN-13 : 978-2729814250
- Jacques Jorda & Abdelaziz M'zoughi (2012), Mini-manuel d'architecture de l'ordinateur, éditions Dunod, ISBN-13 : 978-2-10-057411-7

Keywords

Binary, Hexadecimal, Coding, Boolean Algebra, Karnaugh Tables, Combinatorial logic, Sequential logic, Toggle, Counter, Register, Logic Function, Digital Electronics

UE	UEOSI1	9 ECTS	Semester 5
Discipline	**Physics -** **Mechanics**	Organisation	6 h C, 10 h TD

Learning outcomes and skills

- Understand the structure of metals and polymers and the relationships between the microscopic structure of a solid and its properties
- Understand the basics of the mechanics of solid continuous media

Summary description of the lessons

- Structure of the material
- Mechanics of Continuous Media

UE	UEOSI1	9 ECTS	Semester 5
Discipline	**Mathematical tools for engineers**	Organisation	18 h C, 18 h TD

Learning outcomes and skills

Master the basic mathematical tools essential to any engineer and enable him to understand more specific concepts

Summary description of the lessons

- Laplace and Fourier Transforms
- Vector spaces
- Matrix calculation
- Differential calculus
- Probabilities

UE	UEST1	12ECTS	Semester 5
Discipline	**System modeling and control I**	Organization	14 h C, 14 h TD, 8 h TP

Learning outcomes and skills

Represent continuous time dynamic systems by models such as state representations and transfer functions
Analyze continuous time dynamical systems to extract their properties by using mathematical tools adapted to the type of considered model
Develop finite state machine models, tabular and algebraic representations of discrete event systems.

Pedagogical methodology and specific aspects of teaching

Classical pedagogy: courses, TD and TP

Summary description of the lessons

- General information about dynamic systems.
- **Discrete Event Systems:** Modeling by techniques of Discrete Event Automation
  - Boolean algebra
  - Combinatorial logic functions
  - Sequential logic
  - Representation of sequential systems by finite state machine and algebraic description
- **Control theory:** Modeling and Analysis using continuous control techniques:
  - state representations and input-output models (differential equation and transfer function)
  - time domain responses
  - dynamics (poles, zeros) and gain
  - structural analysis (stability, controllability, observability,...)
  - Frequency response

Prerequisites

Rational polynomials and fractions. Matrix algebra. Laplace transform. Boolean algebra. Combinatorial logic functions.

Bibliographical references

[1] B. Pradin, G. Garcia. Modélisation, analyse et commande des systèmes linéaires. Presses Universitaires du Mirail, 2010.
[2] G.F. Franklin, J.D. Powell, A. Emani-Naeini. Feedback control of dynamic systems. Prentice Hall, 2009.
[3] C. Brie. Logique combinatoire et séquentielle : méthodes, outils et réalisations. Ellipses, 2002.
[4] Cassandras, C.G. et Lafortune, S., Introduction to Discrete Event Systems, Springer, 2008
[5] R. Airiau, J.-M. Bergé, V. Olive, J. Rouillard. VHDL, langage, modélisation, synthèse - Presses Polytechniques et Universitaires Romandes - 1998

Keywords

Control theory, modelling and analysis of continuous time systems, state space representations, transfer functions, time and frequency responses, sequential logic, finite state machine

UE	UEST1	12ECTS	Semester 5
Discipline	**System Dependability**	Organization	12 h C, 12 h TD, 12 h TP

Learning outcomes and skills

Perceive the necessity, importance and transversality of dependability for software and material systems, by apprehending basics concepts and terminology (attributes, hindrances, means)
Perform risk analysis on software/hardware for robotic systems, using methods such as FMECA or FTA.
Design and develop critical software with the lowest possible risk of malfunctions based on the standards in force in sector of activity concerned.

Pedagogical methodology and specific aspects of teaching

Classical pedagogy: courses, TD and TP

Summary description of the lessons

Introduction to systems dependability and system engineering: "Dependability of a system is the property (of this system) that allows its users to place justified confidence in the service provided by this system".

- Basic concepts, methods and vocabulary of dependability: 1) causes of dysfunctions (threats); 2) properties (attributes) sought (e.g.: reliability, safety); 3) means to evaluate and/or achieve a given level of attributes (e.g.: tests, fault tolerance, etc.).
- Focus on risk analysis and assessment methods: FTA (Fault trees) and FMECA (Failure Mode Effects and Criticality Analysis).
- System engineering: Basic concepts, processes, methodology.

Practical implementation work: use of the GRIF graphic platform to determine fundamental indicators of dependability

Prerequisites

Basic knowledge of UML. and probability calculations.

Bibliographical references

[1] J.C. Laprie et al. Guide de la sûreté de fonctionnement (2ème édition). Cépaduès-Éditions, Toulouse, 1996.
[2] Collectif AFIS, S. Fiorèse, JP. Meinadier. Découvrir et Comprendre l'Ingénierie Système. Cépaduès-Éditions, 2012.
[3] Handbook of Software Reliability Engineering, Ed. M.R. Lyu, Mc Graw Hill, N°ISBN 0-07-039400-8, 1996

Keywords

Dependability (reliability, safety, etc.), risk analysis and assessment, tests, system engineering

UE	UEST1	12ECTS	Semester 5
Discipline	**Computer modelling tools**	Organization	14 h C, 16 h TD, 6 h TP

Learning outcomes and skills

Acquire fundamental notions concerning graphs, understand classical problems and master the algorithms to solve them:
- Define and illustrate the fundamental concepts of graph theory (vertices, arcs, edges, connexity, trees, coloring, directed and undirected paths, flows)
- Recognize and Represent a Problem in terms of graph theory
- Execute an appropriate algorithm for computing the connected components, minimum weight tree, shorter path in a graph, or for finding a solution for scheduling or maximum flow problems.

Acquire the notion of object and handle UML diagrams:
- Read a class diagram
- Describe a business context by class diagrams.
- Identify inputs/outputs by system sequence diagrams for a previously identified case (described by a text).
- Describe a case, previously specified by a system sequence diagram, by constructing the detailed sequence diagram and associated participating class diagram.

Pedagogical methodology and specific aspects of teaching

Quizz (during Graph and UML lessons), role games (during UML tutorials)

Summary description of the lessons

Informally, graph theory makes it possible to reason on schemas in which vertices and arcs appear. Operational research proposes rational methods for making better decisions in organizational problems. The topics covered in this course are at the confluence of graph theory and combinatorial optimization:

- connexity, coloring;
- trees;
- shortest paths; task scheduling.
- flow problems;

In a second part this course deals with UML modeling:

- the "object" concept;
- UML diagrams.

Prerequisites

None

Bibliographical references

[1] C. Berge. **Graphes et Hypergraphes.** Edition Dunod, Paris, 1969.
[2] M. Gondran, M. Minoux. **Graphes et Algorithmes.** Edition Eyrolles, 1985.
[3] P. Lacomme, C. Prins, M. Servaux. **Algorithmes de graphes.** Edition Eyrolles, 2003.
[4] P.-A. Muller, N. Gaertner. **Modélisation objet avec UML.** Edition Eyrolles, 2003.

Keywords

- graphs, vertices, arcs, directed and undirected path, coloring, trees, connected component, flows, scheduling,
- object, classes, UML diagrams

UE	UEST1	12 ECTS	Semester 5
Discipline	**Object Programming**	Organization	12 h C, 12 h TD, 12 h TP

Learning outcomes and skills

Know the main paradigms of object programming and of an object language in order to design and develop software modules using UML formalism and Java language.
Design, with some help, small softwares dedicated to various application domains using paradigms of object programming and UML formalism.
Develop software functionalities in order to apply them to various application domains using paradigms of object programming and Java Language.

Pedagogical methodology and specific aspects of teaching

Classical pedagogy: courses, TD and TP– Transversal project to develop POO skills

Summary description of the lessons

- Introduction to "object" concepts from systems given as examples (objects, methods, attributes, classes, associations, inheritance, polymorphism - constrained or not -, etc.).
- Presentation of the basics of object-oriented programming with the Java object language.
- Illustration of concepts by studying and programming simple examples (lists, trees, geometric figures, etc.).
- Initiation to object-oriented design by studying a small software system, in which classes, relationships between classes, objects, links between these objects are identified; then coding this system in Java.

Prerequisites

None

Bibliographical references - Références bibliographiques

[1] J B. Eckel. Thinking in Java (3rd Edition). Editions Prentice Hall PTR.

Keywords

objects, methods, attributes, classes, associations, inheritance, polymorphism – oriented object programming, java

2. 1st Year – Semester 6

UE	UESHSL2	9 ECTS	Semester 6
Discipline	**Foreign Languages – English (FL1)** Spanish/German/Japanese (FL2)	Organization	24 h TD English 12h TD Others

Learning outcomes and skills

Master the English language with a view to written socio-professional communication in a specialised language: Document analysis for critical thinking analysis writing.
Development of critical analysis and perspective contextualization in order to develop autonomy and self-confidence.

Pedagogical methodology and specific aspects of teaching

These skills are applied through professionalizing projects, thus making students aware of the soft skills that will be expected in a company.
Reversed pedagogy: The student prepares different subjects then passes them on to others, thus placing themselves as expert.
Case studies and role-playing games, with a priority to creativity and initiative, in which the students working in competing teams are the driving force behind proposals from both a technological and a communication point of view, including notions of diplomacy and intercultural communication.

Summary description of the lessons

Reverse pedagogy: The student chooses and analyses press articles on a same subject. They must be able to demonstrate whether or not the various newspapers comply with their editorial line. To see how they target their readership (language level, registers and types of communication) from a social and cultural point of view...
The student will submit these same articles to their class mates' analysis and criticism, thus placing himself as an expert.

Prerequisites

This type of approach allows a good management of the linguistic heterogeneity.

Bibliographical references

Students who have to find documents to carry out their projects must refer to relevant references in order to respond to critics.
Authentic documents such as scientific or press articles.

UE	UESHSL2	9 ECTS	Semester 6
Discipline	**Project Management**	Organization	10h C ; 26h TD

Learning outcomes and skills

Acquire the basic concepts of project management
Identify the characteristics of a project
Manage a project using the appropriate methods and tools
Manage a project team

Pedagogical methodology and specific aspects of teaching

None

Summary description of the lessons

Fundamentals of project management: definition, actors, organization, triangle "quality - cost delay" ...
Project methodology: Scope, Structuring (PBS, WBS ...), introduction to risk analysis
Planning and follow-up of deadlines
Appraisal of the profitability of a project according to different methods (NPV, IRR, IP)
Financing plan (interpretation and design)
Team Management and Conflict Management

Prerequisites

beginner / beginner level, no prerequisites

Bibliographical references

T. Hougron, JJ Cousty (2015), "Conducting Projects", Dunod / L'Usine Nouvelle, 2015, 3rd Edition, 448 pages
E. Larson, C.F. Gray (2014), "Project Management", Dunod, 2nd Edition, 592 pages

Keywords

Project, scope, structuring, WBS, PERT, Gantt, financing plan

UE	UESHSL2	9 ECTS	Semester 6
Disciplines	**Physical Education and Sports Preparation Sliding Sport, Golf, Climbing, Muscular Strengthening, Volleyball**	Organization	16 h TD

Learning outcomes and skills

- Know and follow the regulation of activities and the different stages of warming-up in order to practice safely.
- Know the different resources required by the activity in order to start acquiring a specific motricity.
- Engage in training situations by relying on rehearsal and regulation in order to strengthen motor skills.

UE	UESHSL2	9 ECTS	Semester 6
Discipline	**SHS - Skills development - Finding a job or a traineeship**	Organization	8 h C, 10hTD

Learning outcomes and skills

- Recognize and make use of core and transversal competencies.
- Adapt applications to business requests.
- Build and follow a Personal Professional Project until graduation and first employment.

Pedagogical methodology and specific aspects of teaching

The teaching will be:
- differentiated (suited to student's demand) and reversed (the student will present his/her own Professional Project to the other students),
- decompartmentalised: engineering sciences and techniques (STI) and Humanities.
- active and participatory: meeting people in the industry during speed-net working and recruitment forums
- by project: each student builds and presents his/her own Professional Project

Summary description of the lessons

- enhance the skills, this work is carried out in partnership with the department responsible for the guidance and vocational integration of students S.C.U.I.O.-I.P. (1)
- write a CV and a cover letter adapted to the company's request,
- use social networks dynamically,
- convince during a recruitment interview, during the negotiation for the internship agreement, for the employment contract and for the salary,
- integrate recruitment strategies, understand business demand,
- direct oneself towards the demands of companies.

Prerequisites

Good knowledge of the French language. For this purpose, French courses for non-francophone students are offered at Paul Sabatier University.

Bibliographical references

- Méthodes de recrutement, Frédéric BONTE, Yann BUSTOS, Vuibert 2014
- Comment le web change le monde F. PISANI, D. PIOLET, Ed. Pearson 2011
- Le guide du Cv &de la lettre de motivation, I. WACKENHEIM, Prat éditions 2010

Keywords

professional and personal skills, recruitment, social networks, professional project, CV, motivation letter, job interview, employment contract and salary negotiation

1-S.C.U.I.O.-I.P, Service Commun Universitaire d'Information d'Orientation et d'Insertion Professionnelle de l'Université Paul Sabatier

UE	UEOSI2	9 ECTS	6th semester
Discipline	**Industrial Computing**	Organization	10 h C, 10 h TD, 15 h TP

Learning outcomes and skills

Programming microprocessor or microcontroller in low-level language.
Implement an acquisition chain to perform processing using an acquisition card.
Develop a simple control system using an electronic board equipped with a microcontroller.

Pedagogical methodology and specific aspects of teaching

Classical pedagogy: courses, TD and TP.

Summary description of the lessons

Mastering the use of a microcontroller for its implementation in a system requires a good understanding of:

- the general architecture of a computer;
- techniques for encoding information in a computer;
- operations of an arithmetic and logical unit;
- operating principles of a processor (analysis of information transfers and instruction execution);
- its general architecture (processor, memory, interfaces with the outside world);
- its functionalities: digital inputs/outputs, analog/digital converter, serial communication, time management (signal generation, time interval measurement), event management (external interruption);
- its programming.

Practical implementation including data acquisition, processing and process control.

Prerequisites

Basics of computer programming.Basics of combinatorial and sequential logic.

Bibliographical references

[1] Tanenbaum, J.A. Hernandez, R. Joly. Architecture de l'ordinateur : Cours et exercices. Edition Dunod, 4ème édition, 2001.

Keywords

Microcontroller, CPU, input/output peripherals.

UE	UEOSI2	9 ECTS	6th semester
Discipline	**System Communication**	Organization	12 h C, 12 h TD, 12 h TP

Learning outcomes and skills

Understanding the need and importance of a multilayered generic model (OSI) of communication systems by apprehending basic concepts and terminology (layers, protocols, services)
Choose a communication system for a distributed robotic system
Configure an Internet communication stack
Program a communication protocol adapted to real-time distributed control

Pedagogical methodology and specific aspects of

Classical pedagogy: courses, TD and TP.

Summary description of the lessons - Description synthétique des enseignements

- Fundamental notions necessary for any network user: vocabulary and concepts (including in particular multilayer architecture).
- Functionalities of the lower layers of a network, essential to allow communications between a limited number of subscribers (local network).
- Impact of the network on the time constraints of the system using it.
- Upper layers required to extend the network in terms of distance and/or of number of subscribers
- Internet architecture and illustration of additional layers: network and transport level protocols, concepts of service quality.
- Specificities of embedded networks, example of the CAN network.

Practical implementation work:

- Configuration and manipulation of Internet protocols
- Control (of an electric motor) distributed through a CAN network.

Prerequisites

Operating system (Unix), microcontroller (seen in S5 and S6) -Programming in C language (seen in S5).

Bibliographical references

[1] G. Pujolle. **Initiation aux réseaux (cours et exercices)**. Edition Eyrolles. ISBN-10: 2212091559
[2] Tanenbaum. **Réseaux**. Edition Dunod. ISBN-10: 2744070017
[3] R. Orfali, D. Harkey, J. Edwards. **Clients/Serveurs : guide de survie**. 3ème édition, édition Vuibert 1999.

Keywords

Principles, vocabulary and basic network technologies - OSI model - Protocols (Ethernet, CAN, IP).

UE	UEOSI2	9 ECTS	6th semester
Discipline	**Signal processing**	Organization	12 h C, 12 h TD, 12 h TP

Learning outcomes and skills

Know the time and frequency representation tools for analog and digital signals
Analyze the input-output relationship of linear systems such as filters and amplitude modulation.
Analyze a digital signal with FFT using the properties of windowing and zero-padding
Design an analog or digital filter that meets a given specification

Pedagogical methodology and specific aspects of teaching

Classical pedagogy: courses, TD and TP

Summary description of the lessons - Description synthétique des enseignements

- Reminder on the frequency representations of time-continuous signals and systems.
- Signal digitization (sampling, Shannon theorem, quantification). Frequency representations of discrete time signals and systems (Z-Transform, Discrete Time Fourier Transform, Discrete Fourier Transform-DFT, FFT).
- Analog filtering (analysis and synthesis of an analog filter) and analog modulations.
- Digital filtering: filter characterization, synthesis of FIR digital filters, synthesis of IIR digital filters by digitizinganalog filters.
- Spectral analysis by DFT: truncation effect and notion of resolution; effect of DFT calculation and frequency accuracy; windowing and zero padding effects; introduction to time-frequency analysis.

Example of practical sessions (with Matlab): signal digitization, detection of the direction of arrival of a sound and denoising by synthesis and implementation of IIR digital filters, demodulation of a stereo signal by synthesis and implementation of FIR digital filters, spectral analysis and time-frequency analysis of signals by FFT.

Prerequisites

UE Mathematical tools for engineers.

Bibliographical references

[1] *F. Auger. Introduction à la théorie du signal et de l'information, Cours et exercices. Editions Technip, 1999.*
[2] M. Kunt. Traitement numérique des signaux. Presses Polytechniques et Universitaires Romandes, 1996.
[3] G. Blanchet, Charbit. Signaux et Images sous Matlab - Méthodes, Applications et Exercices Corrigés. Edition *Hermès Science Publications, 2001.*

Keywords

Digital signal processing, Fourier analysis, Filtering, Matlab

UE	UEST2	12 ECTS	6th semester
Discipline	**System modeling and control II**	Organization	12 h C, 10 h TD, 15 h TP

Learning outcomes and skills

Model a discrete event system (DES) using state machines and switch from one representation to the other.
Be able to provide stability specifications from an Evans locus for a proportional control law or a state feedback control law.
Design theoretically and validate in simulation (Matlab / Simulink) a state feedback control law or a proportional control law.
Perform a software or PLD implementation of a state machine.
Build an asynchronous control of a system using logic gates.

Pedagogical methodology and specific aspects of teaching

Classical pedagogy: courses, TD and TP.

Summary description of the lessons - Description synthétique des enseignements

Discrete event systems (DES):

- DES control modeling
- DES implementation.

Continuous automation:

- overview of ordering methods in complete and incomplete information.
- state feedback control.
- analysis of control systems by frequential methods
- elementary methods of synthesis of control systems by frequential methods.

Prerequisites

UE System modeling and control I

Bibliographical references

[1] B. Pradin, G. Garcia. Modélisation, analyse et commande des systèmes linéaires. Presses Universitaires du Mirail, 2010.
[2] G.F. Franklin, J.D. Powell, A. Emani-Naeini. Feedback control of dynamic systems. Prentice Hall, 2009.
[3] C. Brie. Logique combinatoire et séquentielle : méthodes, outils et réalisations. Ellipses, 2002.
[4] Nketsa. Informatique Industrielle. Circuits logiques programmables. Mémoires, PLD, CPLD et FPGA. Ellipses, 1998.
[5] R. Airiau, J.-M. Bergé, V. Olive, J. Rouillard. VHDL, langage, modélisation, synthèse - Presses Polytechniques et Universitaires Romandes – 1998.

Keywords

State machine, discret event system, control law, frequential methods

UE	UEST2	12 ECTS	6th semester
Discipline	**Object Oriented Design**	Organization	12 h C, 12 h TD, 12 h TP

Learning outcomes and skills

Develop java applications using standard data structures (array, collection and map) as well as advanced concepts (Exception, internal classes and threads).
Consolidate applications to deliver quality developments using tools (checkstyle, sonarQube) and tests (unit testing, functional testing and acceptance testing).
Know how to use a framework to simplify software design and software maintenance (MVC, Singleton, factory).
Understand and implement an existing modeling from UML diagrams (case diagram, sequence diagram and class diagram).

Pedagogical methodology and specific aspects of teaching

Interactive pedagogy : quizz (clickers)

Summary description of the lessons

- "Object" concepts and their implementation in Java (inheritance, event programming).
- Object-oriented design with UML in support language.
- Object application development methodology and associated tools (development environment, design-pattern, CVS, makefile...).

Application to the design and development of a major project in conjunction with the other "Science and Technology" modules.

Prerequisites

Knowledge of UML (UE Scientific tools for engineers & Computer modelling tools (S5). Knowledge of "object" concepts and object programming (UE "Science and technology - Object oriented Programming (S5).

Bibliographical references

[1] M. Lai. Penser objet avec UML et Java. Editions Dunod.
[2] P. Sestoft. Java Precisely (2nd Edition). Editions MIT Press.
[3] P. Roques. UML par la pratique (2nd Edition), cours et exercices Java et C++. Editions Eyrolles.

Keywords

Object programming, Inheritance, event programming, design patterns, UML

UE	UEST2	12 ECTS	6th semester
Discipline	**Introduction to SRI**	Organization	20 h C, 22 h TD, 28 h TP

Learning outcomes and skills

Master the main principles related to industrial vision systems as well as the concepts of industrial image processing
Master the User-Centered Design methods and concepts
Master the main principles of sound acquisition and acoustic parametrization
Model an industrial robot to express its end-effector pose using dedicated mathematical tools
Express the end-effector pose of a manipulator arm using the most classical coordinates systems
Program industrial robots to perform a simple manipulation task using dedicated languages

Pedagogical methodology and specific aspects of teaching

Classical pedagogy: courses, TD and TP.

Summary description of the lessons

Robotics:

- Problems and Basic Tools
- Basics of robot modeling and control
- Sensor, Actuator and integration into a robotic chain
- CAD and robotics

Image and sound analysis:

- Presentation of sound: frequency, intensity, etc.
- Speech production and auditory perception.
- Sound digitization process: transition from analog audio to digital audio
- Description of sound units: phonemes (speech), notes (music), etc.
- Image formation and implementation of industrial vision systems. Application to industrial image processing

Human-machine interaction:

- Interaction foundations and areas of application
- Definition of the HMI, issues and Human Factors
- Interaction styles and techniques, introduction to gestural and tangible interaction
- The triptych: design-evaluate-realize
- HMI methods and tools
- Rapid prototyping tools

TPs (software and hardware) specific to the three parts, illustrating their complementarity forRobotics and Interaction.

Prerequisites

None

Bibliographical references

[1] Donald A. Norman. The Design of Everyday Things. MIT Press, 2001
[2] Saul Greenberg and al. User Experiences: The Workbook. Sketching, Morgan Kaufmann, 2012
[3] J.P. Haton, J.P., C. Cerisara, D. Fohr, et al. Reconnaissance automatique de la parole: Du Signal à son Interprétation. Dunod, 2006.
[4] C. Demant, B.Streicher-Abel, P.Waszkewitz. Industrial image processing. Edition Springer, 1999
[5] W. Khalil, E. Dombre. Modélisation, identification et commande des robots. Edition Hermès, 1999.

Keywords

Industrial image processing, audio processing, rapid prototyping, HMI applications, robot modelling and control.

3. 2nd Year – Semester 7

UE	UESHSL4	6 ECTS	Semester 7
Discipline	**Foreign Languages – English (FL1)** **Job Interview**	Organization	16 h TD First module

Learning outcomes and skills

Job Interview Module: present and promote your professional skills for a job interview in English. Understand the issues at stake for both the recruit and the recruiter.

Pedagogical methodology and specific aspects of teaching

Address any technical questions in order to promote your technical and cross-functional potential.
Work in teams of 3 to 5 students.
At a turn, each team play the role of recruiter and applicant.
They design and write a case study to highlight the skills expected on a job description as well as evaluation criteria corresponding to the skills expected in the job description and those that the case study should help to reveal.
Team A submits their case study to Team B and vice versa.
After a period of preparation, the students of the B team are in competition as applicants and are interviewed in turn by team A, which plays the role of recruiters and who will choose the best one.
Thus, students who have been in a recruiter position better understand the expectations they will have to face in a real situation.

Prerequisites

This type of approach allows a good management of the linguistic heterogeneity.

UE	UESHSL4	6 ECTS	Semester 7
Discipline	**Foreign Languages – English (FL1)** **Scientific Communication**	Organisation	16 h TD Second module

Learning outcomes and skills .

English for Science and Engineering- English for Academic Purpose
Developing strategies and vocabulary for reading and understanding academic texts. Finding, understanding, describing and evaluating information for academic purposes. Gathering a range of information, using the skills learned, to integrate into your written report.

Pedagogical methodology and specific aspects of teaching
Workshop on the various elements of academic rhetoric for science and engineering.

Summary description of the lessons

- -Complete research using primary and secondary sources. - Share results through documented research papers and presentations.
  - Synthesize information from a variety of sources.
  - Read to determine thesis, tone and purpose, and evaluate the accuracy/reliability of an author's arguments and supporting evidence.
- -Initiate and sustain classroom discussions and debates on academic topics in engineering.
- -Utilize analytical and critical thinking skills in aural/oral contexts.
- -Cultivate independent learning habits and practice strategies for academic and professional success.
- -Summarize and respond to oral presentations (Powerpoint), academic lectures, and written texts of a variety of rhetorical patterns.

UE	UESHSL3	12 ECTS	Semester 7
Discipline	**Business management: Strategy, Marketing, Finance**	Organization	18h CM + 16 h TD

Learning outcomes and skills

To sensitize the students to the creation of company. The business plan to reflect and then present his project integrates 3 dimensions: strategic, marketing, financial

Strategy:The objective of this course is to acquire the fundamental concepts of strategic management. At the end of this course, students must be able to take ownership of the overall approach of the strategy, as well as the main models and tools for decision support.

It details in particular:

- issues and tools related to strategic diagnosis,
- the main strategic choices facing organizations,
- the implementation of the strategy and its interactions with the structure.

Marketing: Put students in a position to analyze the market and define the strategic marketing of a product or service in their area of specialty

Finance: Being able to use financial tools in the financial part of a business plan: calculating break-even point, establishing a financing plan, making cash forecasts

Summary description of the lessons

Strategy :

Lesson Plan

1 - The strategic diagnosis

2- Strategic Choices

3- Strategic Deployment

Marketing :

Students, by group, analyze the market and launch a product or service in their area of specialty. Given the low hourly volume, students take a product or service that already exists on the market, but they are free in their strategic choices. It is impossible, in this volume of time, that it is a product or service that they would have developed.

Finance :

Construction of a financing plan based on a fictitious or real project.

Prerequisites

Strategy :None

Marketing :None

Finance :Knowledge of basic financial documents (balance sheet, income statement)

Bibliographical references

Stratégique, Johnson, Scholes, Whittington & Fréry. 9e édition. Pearson.
Safari en pays stratégie, Mintzberg, Ahlstrand & Lampel. 2e édition. Pearson.
Management stratégique, Ulrike Mayrhofer, Bréal.
Management stratégique, Gérard Koenig, 2e édition. Dunod.

Keywords

Strategic management, strategic diagnosis, structure, decision support tools
PESTEL model, PORTER model, segmentation, positioning, 5P,
Break-even point, Financing plan, Cash Flow

UE	UELSHSL3	12 ECTS	Semester 7
Disciplines	**Physical Education and Sports Preparation Sliding Sport, Golf, Climbing, Muscular Strengthening, Volleyball**	Organization	16 h TD

Learning outcomes and skills

- Design and propose a warming-up sequence based on general and specific knowledge of the activity in order to gain some autonomy.
- Define the objectives of an individual or collective project based on the student knowledge, resources and experience in the activity.
- Mobilize and develop all the student resources required to raise his/her level of training (repetition, intensity, ...) in order to enrich his/her specific motricity.

UE	UESHSL3	12 ECTS	Semester 7
Discipline	**Human and Social Sciences - Finance**	Organization	8 h C, 10 h TD

Learning outcomes and skills

application of the notions of courses on practical cases related to the field of activity

Summary description of the lessons

case studies applied to the code of the public order (ordinance n ° 2018-1074 of November 26th 2018: legislative part and decree n ° 2018-1075 of December 3rd, 2018: regulatory part), whenever possible

Keywords

break-even point, BFRE, budgets, advance, holdback, direct payment, factoring

UE	UESHSL3	9 ECTS	Semester 7
Discipline	**Initiation: How to conduct a scientific study and research work**	Organization	14 h C, 10 h TD, 12 h TP

Learning outcomes and skills

Apply bibliographical research methods related to a given topic.
Carry out a bibliographic study as part of a R&D project: searching for relevant documents and producing a synthesis of the scientific information collected. Citing and referencing related work, avoiding plagiarism.
Answer academic or industrial specifications, identify the underlying problem, carry-out in-advance studies for the choice of equipment, tools and algorithms leading to innovative solutions.
Organize and work as a team to design and develop an R&D application.
Communicate with the project client and identify his/her expectations and requirements. Be able to report on group work in written (report) and oral form (presentation and demonstration)

Pedagogical methodology and specific aspects of teaching

Pedagogy by project: Develop or acquire new skills through transversal projects, in an academic or industrial context.

Summary description of the lessons

Bibliographical research

- Objectives of a state of the art
- Methods and tools to search for scientific information into scientific databases
- Synthesis of existing work

Implementation of the TER

- Analysis of a specification
- Positioning of the work in relation to a state of the art
- Choice of hardware and software for the realization of a prototype or a POC
- Testing and evaluation of the performances of the application and/or device developed

Prerequisites

Project management (S5 & S6) ; Programming skills (S5, S6 & S7) – Introduction to SRI (S6) ; Communication (S5 & S6)

Keywords

Project Management, State of the art, Proof of concept, Prototype, Validation and evaluation tests

UE	UEST3	9 ECTS	Semester 7
Discipline	**Estimation and Optimization for Robotics**	Organization	14 h C, 10 h TD, 12 h TP

Learning outcomes and skills

Be able to model and apply linear optimization techniques on robotic engineering problems
Analyze and synthesize a stochastic estimation scheme, classical or Bayesian, of constant parameters for various applications (robotics, perception, phoneme recognition, etc.)

Pedagogical methodology and specific aspects of teaching

Classical pedagogy : courses, TD and TP

Summary description of the lessons

Estimation

- Fundamental concepts of stochastic estimation.
- Estimator analysis: bias, covariance, mean-square error, Cramér-Rao lower bound, etc.
- Synthesis of classical and Bayes estimators (maximum likelihood, minimum mean-square error, maximum a posteriori) with a focus on the linear Gaussian case.
- Identification of parametric models.

Optimization introduction

- Fundamental concepts.
- Modeling.
- One-dimensional optimization.
- Linear programming (simplex method).

Robotics Applications

Prerequisites

UE "Mathematical tools for the engineer": matrix computations, probabilities, , differential calculus…(S5)

Bibliographical references

[1] E. Walter et L. Pronzato. Identification de Modèles Paramétriques à Partir de Données Expérimentales. Masson, 1994.
[2] M. Bierlaire. Introduction à l'optimisation différentiable. PPUR presses polytechniques, 2006.
[3] M. Minoux. Programmation mathématique : Théorie et algorithmes. Tec & Doc Lavoisier, 2007.
[4] S. M. Kay. Fundamentals of Statistical Signal Processing: Estimation Theory. Prentice Hall, 1993.

Keywords

Stochastic estimation – Linear and nonlinear mathematical programming.

UE	UEST3	9 ECTS	Semester 7
Discipline	**Models for paralellism**	Organization	12 h C, 10 h TD, 12 h TP

Learning outcomes and skills

Design parallel and distributed control of Discrete Event Systems (DES)
Understand the sub-systems synchronization and resource sharing mechanisms
Be familiar with the formalism of well-known parallel DES models and their implementation

Pedagogical methodology and specific aspects of teaching

Classical pedagogy: courses, TD and TP.

Summary description of the lessons

- Limits of state machine modelling.
- Formalisms modelling sequential systems with parallel evolutions: Statecharts, Grafcet and Petri nets.
- Description of their specificities (synchronization, resource sharing, parallelism) and properties (liveness, boundedness and *reinitialisability*). Illustration with automatic and computer science applications.
- Presentation of some hardware and software implementation techniques for these models.
- Petri net analysis.
- Concerning the practical work, they illustrate the course by the realization of control systems with parallel evolutions (hardware and software implementation).

Prerequisites

Boolean algebra, State machine modelling.

Bibliographical references

[1] D. Drusinsky. Modeling and verification using UML statecharts - a working guide to reactive system design, runtime monitoring and execution-based model checking. Elsevier 2006: I-XII, 1-306.
[2] B. Reeb. Développement des Grafcets, Automatismes. Niveau B, 2ème édition, Technosup, éditions Ellipses, 2011.
[3] David R., Alla H. Du grafcet aux réseaux de Pétri. Edition Hermes.1997.

Keywords

Discrete Event Systems, Statecharts, Grafcet, Petri Nets, analysis of DES control systems

UE	UEST3	9 ECTS	Semester 7
Discipline	**Advanced Programming**	Organization	10 h C, 10 h TD, 16 h TP

Learning outcomes and skills

Deepen programming skills by mastering new high-level languages (C++ and Python).
Be aware of the performance/expressiveness trade-off by comparing the two languages.
Master basic technical knowledge in order to correctly program in the C++ & Python languages.
Know how to code operators and implement polymorphism notion in the C++ & Python languages
Master basic knowledge of scientific computing in Python

Pedagogical methodology and specific aspects of teaching

Classical pedagogy: courses, TD and TP. These two programming languages are used in other practical sessions or projects during the second and third year

Summary description of the lessons

C++, object-oriented language and related concepts:

- Abstract types: class, operator overload, generic types.
- Dynamic allocation: memory management, tables, memory leaks, intelligent pointers.
- Dynamic polymorphism: inheritance, abstract classes, interfaces,...

Python language and related concepts:

- Classes, typing, common data structures.
- Functional programming, iterators, generators, decorators.
- Primitive types, advanced types.
- Accessible scientific tools and libraries, vectorized computation

Prerequisites

UE Computer Science and C language (S5) ; UE Object Oriented Programming (S5) and UE Object Oriented Design in java (S6).

Bibliographical references

[1] A. Guidet. Programmation Objet en Langage C++. Ellipses, 2008.
[2] A. Martelli. Python en concentré. http://www.amazon.fr/dp/284177452X.

Keywords

Object programming, classes, methods, inheritance, scientific computing, data structure, …

UE	UEST4	9 ECTS	Semester 7
Discipline	**Industrial and Mobile Robotics**	Organization	26 h C, 18 h TD, 26 h TP

Learning outcomes and skills

Understanding Robot Modeling: industrial manipulator arm and mobile robot
Understanding a robotic system: from mechanical to sensors and actuators
Integrate industrial robots to perform industrial tasks using industrial tools.
Synthesize an elementary position controller of a rigid serial manipulator robot (PD and PID feedback, gravity compensation, feedforward control, feedback linearization)
Understand how to control a wheeled mobile robot

Pedagogical methodology and specific aspects of teaching

Classical pedagogy: courses, TD; Pedagogy by projects through BE carried out on AIP robotic platforms.

Summary description of the lessons

- Mechanical architecture for motion.
- Geometric modeling.
- Kinematic modeling.
- Sensors and Actuators.
- Dynamic modeling.
- Feedback control of manipulator robots:
  - joint space control,
  - introduction to force control.
- Robots integration.
- Introduction to mobile robotics: modeling, static localization and basic control method.

Labs on AIP-PRIMECA with industrial software and hardware (Staubli, Kuka, ROS, ...).

Prerequisites

UE " Introduction to robotic and interactive systems - SRI" (S6)

Bibliographical references

[1] W. Khalil, E. Dombre.Modélisation, identification et commande des robots. Hermès, 1999.
[2] M.W. Spong, S. Hutchinson, M. Vidyasagar. Robot Modeling and Control. Wiley, 2005.
[3] F.L. Lewis, D.M. Dawson, C.T. Abdallah. Robot Manipulator Control – Theory & Practice. CRC Press 2003.
[4] R. Siegwart, I. Nourbakhsh, D. Scaramuzza. Introduction to Autonomous Mobile Robots – MIT Press, 2011.

Keywords

Robot Modeling, Robot control, integration on robotic platforms

UE	UEST4	9 ECTS	Semester 7
Discipline	**Control and Optimization for Robotics**	Organization	12 h C, 9 h TD, 15 h TP

Learning outcomes and skills

Be able to model and apply non-linear optimization techniques on robotic engineering problems
Analyze and control-law design in state space. Robotics problems.

Pedagogical methodology and specific aspects of teaching

Classical pedagogy : courses, TD and TP

Summary description of the lessons

State-space Design

- Analysis of State Equations.
- Output Feedback.
- State feedback.
- Digital control

Optimization

- Non-linear programming without constraints: optimality conditions, numerical methods.
- Non-linear programming with constraints: optimality conditions, numerical methods.
- Sequential Quadratic Programming.

Robotics Applications

Prerequisites

UE “Mathematical tools for the engineer”: matrix computations, probabilities, , differential calculus…(S5)

Bibliographical references

[1] E. Walter. Méthodes numériques et optimisation,Fluctuant Nec Merguntur, 2015
[2] M. Bierlaire. Introduction à l'optimisation différentiable. PPUR presses polytechniques, 2006.
[3] R. Fletcher. Practical Methods of Optimization. Wiley. 2000.
[4] G. F. Franklin, J. D. Powell, A.Emami-Naeini.Feedback Control of Dynamic Systems. Pearson 2014.

Keywords

State Space - Nonlinear mathematical programming

4. 2nd Year – Semester 8

UE	UESHSL4	*6* ECTS	Semester 8
Discipline	**Foreign Languages – English (FL1)** **Profesional Communication**	Organisation	16 h TD Third module

Learning outcomes and skills .

To be completed

Pedagogical methodology and specific aspects of teaching

Workshop on the various elements of academic rhetoric for science and engineering.

Summary description of the lessons

- To be completed

UE	UESHSL4	*6* ECTS	Semester 8
Discipline	**Foreign Languages (FL2)** **Reinforced English / Spanish / Gernam / Japanese**	Organisation	24 h TD Third module

Learning outcomes and skills .

To be completed

Pedagogical methodology and specific aspects of teaching

Workshop on the various elements of academic rhetoric for science and engineering.

Summary description of the lessons

- To be completed

UE	UESHSL4	6 ECTS	Semester 8
Disciplines	**Physical Education and Sports Preparation Sliding Sport, Golf, Climbing, Muscular Strengthening, Volleyball**	Organization	16 h TD

Learning outcomes and skills

- Design and propose a warming-up sequence based on general and specific knowledge of the activity in order to gain some autonomy.
- Define the objectives of an individual or collective project based on the student knowledge, resources and experience in the activity.
- Mobilize and develop all the student resources required to raise his/her level of training (repetition, intensity, ...) in order to enrich his/her specific motricity.

UE	UESHSL4	6 ECTS	Semester 8
Discipline	**Quality Management**	Organisation	8 h C, 14 h TD

Learning outcomes and skills

- Understand the principles of Quality Management
- Develop a Quality Plan including assurance and control of the
- Quality
- Use ISO 9000
- Define a set of Quality indicators

Summary description of the lessons

- Quality management issues
- Quality Approaches
- Quality Assurance
- Documentary Quality System
- Continuous improvement tools
- Accreditation mechanisms

UE	UEST5	9 ECTS	Semester 8
Discipline	**Multi-task programming and real-time systems**	Organization	12 h C, 14 h TD, 18 h TP

Learning outcomes and skills

Understand problems associated with parallel execution of processes
Learn to synchronize parallel processes using the semaphore concept
Understand basic principles and concepts of real-time systems,
Identify and take into account real-time constraints inherent to critical systems
Understand real time scheduling to manage real time constraints
Understand the role of real-time scheduling in managing real-time constraints and know how to calculate maximum response times and execution times for real-time tasks

Pedagogical methodology and specific aspects of teaching

Classical pedagogy: courses, TD and TP.Second and third year projectswill enablethe implementation of real time and multitask system

Summary description of the lessons - Description synthétique des enseignements

- Introduction to parallelism (processes and resources).
- Programming and synchronization of processes under UNIX (processes, semaphores).
- Basics of real-time systems.
- Mechanisms of multi-tasking systems (communication, synchronization, etc.).
- Specificities and functionalities of a real-time executive.
- Operation of a real time kernel.
- Applicable to embedded systems.

Practical implementation: UNIX parallel programming, data acquisition, real-time process processing and control. Transversal Projects based on this UE skills.

Prerequisites

Good knowledge of sequential programming in C language; Use of UNIX system (UE Computer Science S5).

Bibliographical references

[1] M. Ben-Ari. Processus concurrents. Introduction à la programmation parallèle. Edition Masson.
[2] G. Padiou, A. Sayah. Techniques de synchronisation pour les Applications Parallèles. Edition Cepadues.
[3] A. Tanenbaum, J.A. Hernandez, R. Joly. Systèmes d'exploitation : Cours et exercices. Edition Pearson Education – 2éme Édition, 2003.

Keywords

Real time system, parallelism, process synchronization, embedded systems

UE	UEST5	9 ECTS	Semester 8
Discipline	**AI and solving problem methods**	Organization	12 h C, 10 h TD, 24 h TP

Learning outcomes and skills - Objectifs d'apprentissages et compétences

Characterize and analyze a decision problem as a combinatorial problem
Represent a combinatorial problem using Graph Theory
Solve a combinatorial problem by search and/or heuristics

Pedagogical methodology and specific aspects of teaching

Classical pedagogy in courses, TD and TP. Main concepts will be mastered thanks to dedicated projects.

Summary description of the lessons - Description synthétique des enseignements

- Different modes of representation and reasoning for decision-making systems.
- Examples of BI systems illustrating some of the most common problem classes (satisfaction problems, partitioning, scheduling, etc.).
- Study of the principles implemented in the field of operational research (complete and local methods for finding solutions in graphs, application to a classic AI problem).
- Modeling a decision problem with constraints and study of resolution methods (CSP programming).

Prerequisites

UE "Scientific tools for engineers" including "Computer modelling tools".

Bibliographical references

[1] D. Crevier. A la recherche de l'intelligence artificielle. Editions Champs Flammarion (Poche).
[2] J-M. Alliot, T. Schiex. Intelligence artificielle et informatique théorique. Editions Cepadues.
[3] H. Farreny. Recherche heuristiquement ordonnée. Editions Masson.
[4] S. Russel, P. Norvig. Artificial Intelligence, a modern approach. Editions Prentice Hall.

Keywords

Problem Representation, Modelling, Decision problem

UE	UEST5	9 ECTS	Semester 8
Discipline	**AI – Machine learning and Deep Learning**	Organization	16 h C, 12 h TD, 16 h TP

Learning outcomes and skills

Identifying the appropriate type of machine learning to apply to a given decision problem
Implementing/using standard algorithms on classification, clustering, or reinforcement learning problems
Understanding and applying typical Deep Learning architectures
Understanding risks and limitations of machine learning approaches

Pedagogical methodology and specific aspects of teaching

Classical pedagogy: courses, TD and TP. Main concepts will be mastered thanks to dedicated projects.

Summary description of the lessons

Basics of learning approaches:
- Reminder of the statistical tools for data processing (statistics, notion of distance, data preparation).
- Problems of artificial learning (typology of methods and problems, space of hypotheses, inductive principles).
- Formalization of artificial learning (PAC model, VC-dim, bias-variance compromise).

Learning from digital and categorical data:
- supervised: K nearest neighbors, decision trees, SVM, perceptron
- Unsupervised learning/clustering
- Reinforcement learning

Deep learning: common architectures for speech and image processing: CNN, RNN
Ethical considerations

Prerequisites

Basics of artificial intelligence and problem solving methods (operational research – S8).
Statistics and Probability basics

Bibliographical references

[1] X. Cornuéjols, L. Miclet, Y. Kodratoff. Apprentissage Artificiel : Concepts et algorithmes. Editions Eyrolles, 2002.
[2] Ian Goodfellow, Yoshua Bengio and Aaron Courville.Deep Learning, MIT Press, 2016. https://www.deeplearningbook.org/

Keywords

Artificial Intelligence, Machine Learning , Classification, Supervised and Unsupervised Methods, , Deep Neural Network architecture.

UE	UEST6	9 ECTS	Semester 8
Discipline	**Robot Motion and Navigation**	Organization	18 h C, 12 h TD, 16 h TP

Learning outcomes and skills

Design and implement a visual servoing control law to control a given robotic system
Be able to design and implement localization schemes based on Kalman filtering
Master the specificities of 3D sensors in robotics and 3D calibration and reconstruction methods.
Savoir générer et planifier une trajectoire
Know and apply the methods for trajectory generation and motion planning.

Pedagogical methodology and specific aspects of teaching

Classical pedagogy in courses, TD; Pedagogy by Projects withTPs/BE on AIP robotic platforms.

Summary description of the lessons

3D perception

- 3D sensors for robotics: passive/active sensors, camera model, associated 3D calibration.
- Acquisition and reconstruction of 3D scenes; applications to mobile robotics.

Localization

- Kalman filtering.
- Application to mobile robot localization.

Vision based control

- Problem modelling and visual features.
- Design of a vision-based control la using the task functions formalism.

Motion

- Trajectory generation for industrial robots.
- Motion planning for wheeled mobile robots.

Implementation of the perception-decision-action loop on small-size projects using AIP-PRIMECA robots

Prerequisites

UE Estimation and Optimization (S7), Advanced Control, Basics of IT (S5 and S6) and Image Processing (S6)

Bibliographical references

[1] R.Horaud, O.Monga. Vision par Ordinateur, outils fondamentaux. Hermès, 1993.
[2] H. Choset and all. Principles of Robot Motion. MIT Press, 2005.
[3] M.W. Spong, S. Hutchinson, M. Vidyasagar. Robot Modeling and Control. Wiley, 2005.
[4] S. Thrun, W. Burgard, D. Fox. Probabilistic Robotics. MIT Press, 2005.

Keywords

Vision-based control, localization, 3D perception, trajectory generation, motion planning

UE	UEST6	9 ECTS	Semester 8
Discipline	**Speech Processing and synthesis**	Organization	16 h C, 8 h TD, 20 h TP

Learning outcomes and skills

Master the concepts related to speech modeling
Know and apply the fundamentals of speech synthesis
Understand the role of language models in the process of automatic speech recognition and understanding and be able to develop a voice command application.

Pedagogical methodology and specific aspects of teaching

Classical pedagogy: courses, TD and TP. Main concepts will be mastered thanks to dedicated projects.

Summary description of the lessons

- Modeling for Automatic Speech Recognition – Speech to text (STT)
  - Mixture of Gaussian laws,
  - Hidden Markov Models
  - (Deep) Neural Networks
- Learning problems
  - EM type algorithms (Viterbi, Baum-Welch),
  - MAP type adaptation
- Language modeling and basics of speech understanding
  - Rule-based models (grammars),
  - Statistical models (ngrams)
  - Word Embeddings (word2vect)
- Voice synthesis – Text-to-speech (TTS): Synthesis from text, Synthesis by elementary units (phonemes, diphones, etc.)

Implementation of complete systems (speaker verification, keyword recognition, spoken command system etc.).

Prerequisites

UE Computer Sciences, Mathematical tools for engineers (S5), Signal processing, Introduction to Robotic and Interactive Systems (S6), Python Programming (S7) and Machine learning and deep learning (S8)

Bibliographical references

[1] JP. Tubach. La parole et son traitement automatique. Edition Masson, 1989.
[2] J.P. Haton, C. Cerisera, D. Fohr, Y. Laprie. Reconnaissance automatique de la parole. Edition Dunod, 2006.
[3] D. Jurafsky, J.H. Martin. Speech and Language Processing: an Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition. Edition Pearson International (3ème édition – draft 2019)
https://web.stanford.edu/~jurafsky/slp3/

Keywords

Speech to text (STT), Pattern recognition, Text-to-speech (TTS), Speech understanding

UE	UEST6	9 ECTS	Semester 8
Discipline	**Image Processing and synthesis**	Organization	16 h C, 10 h TD, 18 h TP

Learning outcomes and skills

Understand and apply standard approximation and interpolation functions.
Basics for representing and rendering 3D objects.
Be able to create and render an animated 3D scene with a dedicated software.
Using different filters to improve the visual content of an image before applyingng more complex process
Estimating an intensity gradient by different means to detect contours in an image
Producing regional segmentation, supervised or not, to locate objects in images
Applying morphomathematic operators to refine the shape of automatically identified regions

Pedagogical methodology and specific aspects of teaching

Classical pedagogy: courses, TD, TP ; Specific projects will improve student skills in these domains.

Summary description of the lessons

Image Synthesis:

- Introduction to approximating and interpolating curves and surfaces.
- Representing 3D objects with meshes.
- Visualizing meshes for computing images and animations.

Image processing:

- Linear and non-linear filtering of images.
- Improved rendering.
- Gradient estimation and regional segmentation.
- Mathematical morphology.

Mini cross-disciplinary project common to the subjects of this UE Science and Technology (UEST7).

Prerequisites

C++ programming, vector space, notion of computer system architecture. Notions of signal processing and set theory. Proficiency in linear algebra calculations.

Bibliographical references

[1] John F. Hughes, Andries van Damm, Morgan McGuire, David F. Sklar, James. Computer Graphics: Principles and Practice (3ème édition). D. Foley, Steven K. Feiner, Kurt Akeley. 2013.
[2] Rafael C. Gonzalez, Richard E. Woods. Digital Image Processing. Pearson Prentice Hall, 3ème edition, 2008.

Keywords

3D objects, animated 3D scenes ; image filtering, image segmentation,

5. *3rd Year – Semester 9*

UE		*3 E*CTS	Semester 9
Discipline	Foreign Languages – English (FL1)	Organization	

Learning outcomes and skills

To allow the awareness, the analysis and the interpretation that is brought about the rapid and brutal fracture of a technological and/or scientific revolution.

Pedagogical methodology and specific aspects of teaching

- Understanding, analysis and synthesis of video documents on disruptive technology for an oral presentation.
- Preparatory work in subgroups on the documents with a view to drafting a corpus of questions to be put to a third party group that will help to identify the key elements of the documents studied.
- Training in the format of academic/professional communication.

Prerequisites

This type of approach allows a good management of the linguistic heterogeneity.

Bibliographical references - Références bibliographiques

Internet

UE	Sciences Humaines et Sociales 3 *Human and Social Sciences 3*	*9* ECTS	Semester 9
Matière	*Innovation et législation* *Innovation and law*		10h C 20h TD

To be completed

Learning outcomes and skills –

Compétence 1. *Skills 1*
Compétence 2 - *Skills 2*
Compétence 3 - *Skills 3*

Pedagogical methodology and specific aspects of teaching

Par exemple : pédagogie par projet, classe inversée, sondages (clickers), études de cas, etc

Summary description of the lessons

Prerequisites

Bibliographical references - Références bibliographiques *(facultatif)*

[1] référence biblio
[2] référence biblio

Keywords - Mots clés *(facultatif)*

English keywords

UE	UEST7	9 ECTS	Semester 9
Discipline	**Robotic systems**	Organization	30h C, 18 h TD, 44 h TP

Learning outcomes and skills

Master the specificities of 3D sensors in robotics. Master the associated techniques of calibration and 3D reconstruction.
Master particle filtering techniques - Know the main solutions to the simultaneous localization and mapping (SLAM) problem in Robotics
Master the motion planning problem
Apply advanced software techniques for autonomous systems. Master robotic integration.

Pedagogical methodology and specific aspects of teaching

Pedagogy by projects dedicated to robotic integrationon AIP platforms

Summary description of the lessons

Motion planning

- Deterministic methods and algorithms
- Probabilistic methods and algorithms
- Industrial applications within and outside robotics

3D perception functions for robotics

- Calibration of 3D sensors for robotics
- 3D reconstruction from such sensors (on boarded or ambient)

Particle Filtering

- Recursive exact solution to Bayesian filtering
- Approximate solution based on particle filters: sequential importance sampling, sequential importance resampling, Rao-Blackwellized filter

Simultaneous Localization and Mapping (SLAM)

- Problem statement and properties
- SLAM solutions based on Extended Kalman filtering, Rao-Blackwellized particle filtering, and optimization

Control architectures for robotics

- Design of robot control software architectures.
- Hardware architecture and Technology

Robotic Integration: mechanical, electrical, security and software constraints

Prerequisites

Image processing (S8), linear and nonlinear optimization, dynamic modeling (S7)

Bibliographical references

[1] S. Thrun, W. Burgard, D. Fox. Probabilistic Robotics. MIT Press, 2005
[2] S. Lavalle. Planning Algorithms. Cambridge Univ. Press, 2006
[3] M. Dhome. Perception visuelle par imagerie vidéo. Hermès, 2003

Keywords

3D sensors for robotics and associated calibration for 3D reconstruction
Particle filtering, SLAM, Motion Planning, Control architecture, Integration

UE	UEST7	9 ECTS	Semester 9
Discipline	**Design and implementation of SRs**	Organization	10h C, 10h TD, 8 h TP

Learning outcomes and skills

Understand the means of dependability dedicated to critical systems based on generic concepts of fault tolerance mechanisms
Implement fault tolerance mechanisms based on parallel programming concepts such as multithreading
Apply project management methods to robotic integration applications

Pedagogical methodology and specific aspects of teaching

Classical pedagogy : courses, TP and TP ; Pedagogy by projects to improve the students skills in the context of robotic integration project.

Summary description of the lessons

- Operational safety: failure, error, faults.
- Means for Operational Safety: forecasting, prevention, elimination.
- Testing: test quality, test and process, simulation and virtual prototyping.
- Fault tolerance: error detection, error recovery.
- Temporal criticality: modelling of temporal constraints and uncertainty management.

Prerequisites

System Dependability (S5) ; Project Management (S6) Parallel programming (S7)

Bibliographical references

[1] V. Giard. Gestion de projets. Edition Economica, 1991.
[1] C. Aubry. SCRUM: le guide pratique de la méthode agile la plus populaire. Edition Dunod, 2010.
[1] M. Bouissou. Gestion de la complexité dans les études quantitatives de sûreté de fonctionnement de systèmes. Edition Tec & doc, DL 2008.

Keywords

Critical systems, dependability, parallel programming, fault tolerance, integration project, project management methods

UE	UEST8	6 ECTS	Semester 9
Discipline	**Advanced Robotics**	Organization	16h C, 8 h TD, 26 h TP

Learning outcomes and skills

Master the ROS middleware
Use redundancy of a robotic system to perform complex tasks
Understand humanoid robotics and its applications
Understand trajectory optimization and advanced control tools for robotic applications

Pedagogical methodology and specific aspects of teaching

Pedagogy by projects dedicated to robotic integrationon AIP platforms

Summary description of the lessons

Optimization and Control

- Trajectory optimization by numerical methods of open-loop optimal control
- Introduction to Model Predictive Control

Redundant and Humanoid robots

- Robot redundancy
- Dynamic modeling
- Control of humanoid robots

Drones

Integration on the ROS II middleware

Prerequisites

UE Industrial and Mobile Robotics (S7) UE Robotic systems (S9)

Bibliographical references

[1] S. Kajita, S. Sakka, H. Hirukawa, K. Harada, K. Yokoi. Introduction à la commande des robots humanoïdes: De la modélisation à la génération du mouvement. Springer 2005
[2] Betts, John T. Practical Methods for Optimal Control and Estimation Using Nonlinear Programming.SIAM, 2010

Keywords

Trajectory optimization, redundancy, humanoid, ROS II

UE	UEST8	6 ECTS	Semester 9
Discipline	**Advanced Interactive systems**	Organization	16h C, 8 h TD, 26 h TP

Learning outcomes and skills - Objectifs d'apprentissages et compétences

Master current approaches in the development of chatbots and voicebots and other conversational interactive applications
Learn the specificities related to human users
Know how to design and develop interactive systems taking into account some specificities (accessibility, communication, ...)

Pedagogical methodology and specific aspects of teaching

Pedagogy by projects dedicated to the integration of multimodal interactive systems

Summary description of the lessons

Chatbot / Voicebot

- New technologies for conversational agents: methods, concepts and tools
- Dialogue management based on deep reinforcement learning
- Response generation issues

Accessibility - Human Factors

- Design applications for people with special needs
- Evaluation methods of interactive systems

Integration : AI solutions for interactive systems

Prerequisites

UE Interactive Systems (S9) – UE Speech Processing (S8) UE Introduction to SRI (S6)

Bibliographical references

[1] D. Jurafsky, J.H. Martin. Speech and Language Processing: an Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition. Edition Pearson International (3ème édition – draft 2019) https://web.stanford.edu/~jurafsky/slp3/
[2] The Design of Everyday Things, Donald A. Norman, MIT Press, 2001
[3] Usability Engineering, M-B Rosson, J. M. Carroll, Morgan Kaufmann Publisher, 2002
[4] Mismatch - How inclusion Shapes Design, Kat Holmes, MIT Press, 2018
[5] The laws of simplicity, John Maeda, MIT Press, 2006

Keywords

Dialog policy, chatbot applications, application accessibility, user needs.

UE	UEST8	6 ECTS	Semester 9
Discipline	**Project Management and coaching**	Organization	4h C, 4h TD, 16h TP

Learning outcomes and skills

Be able to structure a project based on customer needs
Know how to draw up a planning, anticipate risks and monitor the progress of a project
Manage a customer relationship, know how to communicate and report on your work properly

Pedagogical methodology and specific aspects of teaching

Pedagogy by project – all the project management steps are carried out in the context of the industrial end-of-study project through coaching sessions

Summary description of the lessons

- Product breakdown structure (PBS), Work breakdown structure (WBS)
- Scheduling and monitoring
- Risk Analysis
- Specification, architecture

Application to the realization of a major project in terms of number of students, duration and deliverables

Prerequisites

UE Project Management (S6) and expertise acquired during first and second year projects.

Keywords

Risk analysis, planning, project structure, project management methodology

UE	UEST9	9 ECTS	Semester 9
Discipline	**Interactive Systems**	Organization	22h C, 16 h TD, 48 h TP

Learning outcomes and skills

Know how to extract the different characteristics of an image and apply the most appropriate processing method
Master the architecture of image analysis systems based on deep neural networks
Understand the issues related to conversational agents and voice interaction Person/System (robot or voice assistant)
Be aware of the difficulties of processing the spoken dialogue between a user and a system and be able to propose solutions appropriate to the task at hand.
Know how to implement applications using innovative devices and technologies.
Know how to model and realize a multimodal application from scenarios

Pedagogical methodology and specific aspects of teaching

Classical pedagogy in courses and TD ; BE dedicated to pedagogy by projects to increase student skills in current technologies on interactive systems

Summary description of the lessons

Vision

- Image characterization (texture, shape and color)
- Mathematical transforms of images
- Current approaches of image processing based on Deep learning (CNN, …)
- Video Analysis

AI and machine learning methods for multimodal interactive systems

- Data fusion methods
- Decision process in multimodal context

Multimodal HMI

- User Models.
- Sound and gestural interaction.
- Design of multimodal systems

Spoken dialogue systems

- Spoken dialog system architecture
- Concepts and Models dedicated to speech understanding and dialogue management
- Evaluation of the dialogue systems

Prerequisites

Introduction to SRI (S6) Machine learning (S7)Image processing (S8). Speech processing and Synthesis (S8)

Bibliographical references

[1] D. Jurafsky, J.H. Martin. Speech and Language Processing: an Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition. Edition Pearson International (3ème édition – draft 2019)
[2] +Sketching User Experiences, Saul Greenberg, Sheelagh Carpendale, Nicolai Marquardt, Bill Buxton, Morgan Kaufmann Publisher, 2012
[3]Text Entry Systems, I. Scott Mackenzie, K. Tanaka-Ishii, Morgan Kaufmann Publisher, 2007
[4] Feature extraction and Image processing for computer vision, M. Nixon, A. Aguado, Academic Press, 2012
[5] Convolutional Neural Networks in Visual Computing: A Concise Guide, R. Venkatesan, B. Li, CRC Press, 2017

Keywords

Multimodal interaction; speech, gesture, spoken dialog; pattern recognition; image understanding

UE	UEST9	9 ECTS	Semester 9
Discipline	**Design and integration of interactive systems**	Organization	10h C, 6 h TD, 8 h TP

Learning outcomes and skills

Design systems composed of several sensors, organize them into networks, make them interact and merge information
Implement project management methods based on agility by organizing sprints, releases and interacting with the customer in order to take into account the evolution of his needs.

Pedagogical methodology and specific aspects of teaching

Pedagogy by project dedicated to the integration of different sensors providing information through different protocols in the context of interactive system projects.

Summary description of the lessons

Distributed interactions:

- distributed communication protocols;
- sensor fusion.

Agile development:

- Demonstration of agile methods,
- SCRUM method and adaptation to the professionalization & qualification project.

Prerequisites

Be familiar with basic network concepts. Project management (S6 and S9)

Bibliographical references

[1] V. Giard. Gestion de projets. Edition Economica, 1991.
[2] C. Aubry. SCRUM: le guide pratique de la méthode agile la plus populaire. Edition Dunod, 2010.
[3] Carlos A. Varela, Gul Agha, Programming Distributed Computing Systems: A Foundational Approach, MIT Press, ISBN : 978-0262018982, 2013

Keywords

Protocols, network paradigms, sensors, project management methodology, agility,

6. SRI Social and Technical Skills

Cross table between UE and Skill domains

UE 1A, 2A & 3A	Systems and software engineering · Project engineering and organization management · Robotics & Human Machine Interaction	UESHSL 1	UEOS I1	UEST 1	UESHSL 2	UEOSI 2	UEST 2	UESHSL3	UEST 3	UEST 4	UESHSL4	UEST 5	UEST 6	2A 3-month internship	UESHSL 5	UEST 7	UEST 8	UEST 9	Professionnalisation & Qualification	3A 5-month internship
	Skill Domaines SRI	S5			S6			S7			S8				S9				S10	
		UE 1	UE 2	UE 3	UE 4	UE 5	UE 6	UE 7	UE 8	UE 9	UE 10	UE 11	UE 12	UE ST	UE 13	UE 14	UE 15	UE 16	UE PR	UE ST
C1	Software Development		●	●	●	●	●	●	●			●		●	●			●	●	●
C2	System command and control		●	●		●	●	●	●	●				●		●			●	●
C3	Acquisition and processing of audio and video signals		●	●			●	●	●			●	●	●		●		●	●	●
C4	AI and Machine Learning		●	●				●	●			●		●		●	●	●	●	●
C5	Legislation, safety, ethics, economics, innovation	●			●			●						●	●		●	●	●	●
C6	Project Management and Agility	●	●	●	●	●	●	●			●			●				●	●	●
C7	Teamwork, communication and international	●			●		●	●			●			●	●	●		●	●	●
C8	Multimodal interaction and spoken human-machine dialogue						●	●	●			●	●	●			●	●	●	●
C9	Industrial robotics						●	●	●	●			●	●		●			●	●
C10	Service robotics							●	●	●		●	●	●		●	●		●	●
C11	Real-time control architecture for robotic systems					●		●	●			●	●	●		●	●		●	●