- ECAM LaSalle Mechanical and Electrical Engineering Programme
- EENG - Year 3
- Semester 6
- Robotics and Automation Engineering 6

Robotics and Automation Engineering 6

Données Générales			
Programme Académique	**ECAM LaSalle Mechanical and Electrical Engineering Programme**		Responsable(s) Module GIBERT Guillaume
Type de module : Unité d'Enseignement	**Robotics and Automation Engineering 6** (LIIEEng06URoboAutoEng6)		
Crédits (ECTS)	8		
Effectif maximum	250		
Durée totale : 88h00	Periode Semester 6	Langue d'enseignement : English	

- ECAM LaSalle Mechanical and Electrical Engineering Programme
- EENG - Year 3
- Semester 6
- Robotics and Automation Engineering 6
- Introduction to Robotics

Introduction to Robotics

Données Générales

Programme Académique	**ECAM LaSalle Mechanical and Electrical Engineering Programme**
Type d'EC : Cours	**Introduction to Robotics** (LIIEEng06EIntoRobotics)

TD : 12h00 TP : 8h00 Cours : 12h00 Travail personnel : 22h00 Durée totale: 54h00	Statut	Periode Semester 6	Langue d'enseignement : English

Acquis d'apprentissage

By the end of this course, students will be able to:
1. Define robotics and its various fields
2. Face the difficulty of hardware programming
3. State a problem, read and write technical specifications
4. Compute Forward, Inverse and Differential Kinematics for simple robotic systems
5. Compute motion planning for mobile robots
6. Program mobile robot kinematics and autonomous behavior with sensors interactions
7. Program robot arm kinematics
8. Develop good programming practices (documentation, test, git/gitflow)

Contenu

-Introduction to robotic systems and controllers
-Robots in their contexts
-Mechanical structures: serial and parallel robots, mobile robots
-Forward, Inverse and Differential Kinematics for Robot Arm
-Differential Drive robots
-Motion planning for mobile robot (Dijkstra, A*)
-Practical introduction to robot programming (mBot, poppy)

Prérequis

-Mathematics for engineers 1
-Mathematics for engineers 2
-Mathematics for engineers 3
-Mathematics for engineers 4
-Mathematics for engineers 5
-Computer programming
-Object-oriented programming
-Simulation and numerical calculation 1

Prérequis

-Simulation and numerical calculation 2
-Electronics 1 – Components and technology
-Electronics 2 – Functions and applications
-Digital design and embedded software 1
-Digital design and embedded software 2

Bibliographie

Essential resources: None
Recommended resources:
Corke P. (2011) Robotics, Vision and Control. Springer Tracts in Advanced Robotics, vol 73. Springer, Berlin, Heidelberg.
https://doi.org/10.1007/978-3-642-20144-8_15

Évaluation(s)

N°	Nature	Coefficient	Objectifs
1	1, 2, 3, 4, 8	0,3	Observable objectives: mid-term exam in which students will be evaluated on their ability to analyze the kinematics of a simple robotic system.
2	6, 7, 8	0,3	Observable objectives: labs in which students will be evaluated on their ability to program robot arms and mobile robots using good coding practices.
3	Written exam	0,4	Observable objectives: final exam in which students will be evaluated on their ability to analyze the kinematics of a simple robotic system and on motion planning for simple mobile robots.

- ECAM LaSalle Mechanical and Electrical Engineering Programme
- EENG - Year 3
- Semester 6
- Robotics and Automation Engineering 6
- Sensing & Perception

Sensing & Perception

Données Générales

Programme Académique	**ECAM LaSalle Mechanical and Electrical Engineering Programme**
Type d'EC : Cours	**Sensing & Perception** (LIIEEng06ESensPerc)

TD : 4h00 TP : 12h00 Cours : 8h00 Travail personnel : 12h00 Durée totale: 36h00	Statut	Periode Semester 6	Langue d'enseignement : English

Acquis d'apprentissage

By the end of this course, students will be able to:
1. Understand the physics and functioning of various sensors used in robotics
2. List all the elements of the Data Acquisition Chain and their features
3. Acquire the know-how for characterizing and calibrating sensors
4. Acquire the methodology to dimensioning sensors for specific applications
5. Apply knowledge in signal processing and statistics to robotic contexts
6. Create a Data Acquisition Chain from scratch
7. Program a microcontroller to sample data accurately
8. Learn the basics of image processing
9. Develop good programming practices (documentation, test, git/gitflow)

Contenu

-Inertial sensors, GPS and odometry / sonar sensing / vision, bio-inspired sensors, force sensors
-Transformation of information into electric properties and its implication
-Signal conditioning
-ADC: sampling, quantization, windowing
-MCU: Application of data acquisition, data analysis, data processing
-Introduction to image processing

Prérequis

-Metrology
-Computer programming
-Object-oriented programming
-Simulation and numerical calculation 1
-Simulation and numerical calculation 2
-Electronics 1 – Components and technology
-Electronics 2 – Functions and applications
-Digital design and embedded software 1
-Digital design and embedded software 2
-Signal processing

Bibliographie

Essential resources: None
Recommended resources:
Handbook of Modern Sensors, Fraden J., AIP Press, Springer
Corke P. (2011) Image Processing. In: Robotics, Vision and Control. Springer Tracts in Advanced Robotics, vol 73. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-20144-8_12

Évaluation(s)

N°	Nature	Coefficient	Objectifs
1	6, 7, 8, 9	0,3	Observable objectives: labs in which students will be evaluated on their ability to define and implement the components of a Data Acquisition Chain, to program a microcontroller and to program an image processing application using good coding practices.
2	1, 2, 3, 4, 5, 9	0,3	Observable objectives: mid-term exam in which students will be evaluated on their ability to analyze a Data Acquisition Chain and all its components from the physical quantity to processing performed on the MCU.
3	Written exam	0,4	Observable objectives: final exam in which students will be evaluated on their ability to analyze a Data Acquisition Chain and all its components and to apply image processing techniques to gray/color images.

- ECAM LaSalle Mechanical and Electrical Engineering Programme
- EENG - Year 3
- Semester 6
- Robotics and Automation Engineering 6
- Signal Processing + Wireless Communications

Signal Processing + Wireless Communications

Données Générales

Programme Académique	**ECAM LaSalle Mechanical and Electrical Engineering Programme**
Type d'EC : Cours	**Signal Processing + Wireless Communications** (LIIEEng06ESigProcess)

TD : 12h00 TP : 8h00 Cours : 12h00 Travail personnel : 24h00 Durée totale: 56h00	Statut	Periode Semester 6	Langue d'enseignement : English

Acquis d'apprentissage

By the end of this course, students will be able to:
1. Acquire the fundamentals features of signal
2. Perform a spectral analysis of a signal
3. Estimate the filter coefficients from filtering specifications
4. Analyze the stability of filters
5. Analyze random signals with temporal and spectral methods
6. Apply and analyse time-frequency to any signal
7. Learn image processing techniques and apply them
8. Develop good programming practices (documentation, test, git/gitflow)

Contenu

-Signals: general properties and transformations (convolution…)
-Spectral analysis (DFT, FFT…)
-Sampling
-Signals and systems (stability, causality…)
-Filters (FIR, IIR)
-Random signals (autocorrelation, intercorrelation…)
-Time-frequency analysis
-Image processing

Prérequis

-Mathematics for engineers 1
-Mathematics for engineers 2
-Mathematics for engineers 3
-Mathematics for engineers 4
-Mathematics for engineers 5
-Metrology
-Computer programming
-Object-oriented programming
-Simulation and numerical calculation 1

Prérequis

-Simulation and numerical calculation 2
-Electronics 1 – Components and technology
-Electronics 2 – Functions and applications
-Digital design and embedded software 1
-Digital design and embedded software 2

Bibliographie

Essential resources: None
Recommended resources:
Digital Processing of Signals: Theory and Practice, 3rd Edition

Évaluation(s)

N°	Nature	Coefficient	Objectifs
1	1, 2, 3, 4, 5, 6, 7	0,3	Observable objectives: mid-term exam in which students will be evaluated on their ability to analyze unknow signals and systems by applying temporal or spectral techniques.
2	1, 2, 3, 4, 5, 6, 7, 8	0,3	Observable objectives: labs in which students will be evaluated on their ability to define and implement signal/image processing techniques to analyze unknown signals using good coding practices.
3	Written exam	0,4	Observable objectives: final exam in which students will be evaluated on their ability to analyze unknow signals, images and systems by applying temporal or spectral techniques.