CENTRALE NANTES

MASTER OF SCIENCE, TECHNOLOGY AND HEALTH

2024-2025

YEAR 2

CONTROL AND ROBOTICS

ADVANCED ROBOTICS

PROGRAMME SUPERVISOR(S):
Olivier KERMORGANT

YEAR 2 - Autumn Semester

CORE COURSES

Course code	Title	ECTS Credits
AMORO	Advanced Modeling of Robots	6
REMET	Research Methodology	5
TBC	Task-based Control	5

ELECTIVE COURSES

Course code	Title	ECTS Credits
AUVE	Autonomous Vehicle	4
AVG	Advanced Visual Geometry	4
DRONES	Aerial and maritime drones	4
OPKID	Optimal Kinematic Design	4
SOROMO	Soft Robot Modelling	4

LANGUAGE COURSES

Course code	Title	ECTS Credits
CCE3	Cultural and Communication English	2
ESP3	Spanish Language	2
FLE3	French Language	2

YEAR 2 - Spring Semester

CORE COURSES

Course code	Title	ECTS Credits
THESIS	Master Thesis or Internship	30

Master Programme - Control and Robotics - Advanced Robotics

YEAR 2 - Autumn Semester

Advanced Modeling of Robots [AMORO]

LEAD PROFESSOR(S): Sebastien BRIOT

Requirements

Objectives

This course presents advanced modelling techniques (geometric, kinematic and dynamic) of robots (tree structure robots, parallel robots, and hybrid robots) composed of rigid links.

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

- Understand the fundamentals of the mathematical models of robots and their applications in robot design, control and simulation.
- Analyse the mobility of parallel robots and understand the notion of operation modes
- Analyse, identify and illustrate the serial and parallel (including the constraint) singularities of parallel robots
- Identify the geometric and dynamic parameters of a robot
- Use the best methods to develop the required models of a given architecture
- Apply the given techniques to other systems such as mobile robots or passenger cars
- Use the convenient numerical schemes for numerical integration.
- Use modelling, optimization, and signal processing tool box software packages (Matlab, Adams).

Course contents

- Description of complex mechanical systems (tree-structured or closed loop systems),
- Geometric and kinematic models of closed-loop structure robots, constraints equations, mobility analysis, singularity analysis (introduction to DHm convention of tree-structured and closed loop systems)
- Workspace analysis of full-mobility and lower-mobility parallel robots
- Calibration of geometric parameters
- Reminder of dynamics principles (Newton-Euler, Euler-Lagrange, Principle of virtual works) for open and closed-loop mechanism systems
- Dynamic modelling of rigid tree-structure robots: the inverse and direct dynamic problems, the base inertial parameters, computation of the ground forces.
- Dynamic modelling of rigid parallel robots without and with actuation redundancy: the inverse and direct dynamic problems, the base inertial parameters, computation of the ground forces.
- Analysis of the degeneracy conditions of the dynamic model of rigid parallel robots, and singularity crossing
- Identification of dynamic parameters

Practical Work: Exercises will be set, involving modelling, identification and simulation of robots. Advanced technical papers from recent international conferences will be analysed and reviewed.

Course material

- S. Caro, lecture notes on “Geometric and Kinematic Modelling of Serial and Parallel Robots”
- W. Khalil, E. Dombre, Modelling, identification and control of robots, Hermes Penton, London, 2002.
- J. Angeles, Fundamentals of Robotic Mechanical Systems, Springer-¬Verlag, New York, 3rd edition, 2007
- Merlet, J. P., 2006, Parallel Robots (Solid Mechanics and Its Applications), Springer, New York, Vol. 128.
- S. Briot, lecture notes on “Advanced Dynamic Modelling of Robots”
- S. Briot and W. Khalil, Dynamics of Parallel Robots, Springer.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	6	22 hrs	0 hrs	16 hrs	0 hrs	2 hrs

Master Programme - Control and Robotics - Advanced Robotics

YEAR 2 - Autumn Semester

Research Methodology [REMET]

LEAD PROFESSOR(S): Ina TARALOVA

Requirements

Objectives

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

- Research the background and perform a bibliographic review of a specified subject;
- Identify key aspects of research work;
- Use a range of techniques to research and collect information;
- Demonstrate an understanding of how research may be evaluated;
- Plan and prepare a research proposal;
- Deliver a satisfactory written report, including correct citation of related works and analysis;
- Understand the job of researchers and faculty staff.

Course contents

This course aims to provide the students with the necessary skills and tools to carry out and present a research topic. It presents the jobs of researchers and university staff, in research institutions, labs and in R&D departments in companies, and how to apply for them.
This course includes also the bibliographical study for the master thesis topic.

- Setting goals and defining the objectives of the master thesis;
- Bibliographical research and collecting information;
- Written communication: reports, theses, journal & conference papers;
- Oral communication: research presentations, attending conference & presenting a paper;
- Presentation of the researcher positions, and university staff;
- The research institutions in EMARO+ countries;
- How to apply for a faculty position in research institutions in Europe and worldwide;
- Seminars will be organized to present the latest technological developments of advanced topics.

This module is assessed via the bibliography report and defense based on the master thesis topic.

Course material

- J. Collis, R. Hussey, Business Research A Practical Guide for Undergraduate and Postgraduate Students, 2nd Edition, Basingstoke: Palgrave, 2003,
- M. Polonsky, D. Waller, Designing and Managing a Research Project, Sage, 2005
- Turabian Kate Larimore, Booth Wayne Clayton, Colomb Gregory G., Williams Joseph M., & University of Chicago press. (2013). A manual for writers of research papers, theses, and dissertations: Chicago style for students and researchers (8th edition.). Chicago (Ill.) London: University of Chicago Press.
- Bui Yvonne N. How to Write a Master's Thesis. 2nd ed. Thousand Oaks, Calif: Sage, 2014.
- Evans David G., Gruba Paul, Zobel Justin. How to Write a Better Thesis. 3rd edition. Carlton South, Vic: Melbourne University Press, 2011.
- Previous years master thesis

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	16 hrs	0 hrs	0 hrs	15 hrs	1 hrs

Master Programme - Control and Robotics - Advanced Robotics

YEAR 2 - Autumn Semester

Task-based Control [TBC]

LEAD PROFESSOR(S): Olivier KERMORGANT

Requirements

Objectives

This course presents the fundamentals of the modelling and control techniques used in sensor-based and task-based control. The course goes from visual servoing to hierarchical and model-predictive control.
At the end of the course the students will be able to:

- Understand the different properties of visual servoing schemes
- Know how and when to combine simple tasks to get a complex behavior
- Use hierarchical control to handle constraints or specific behavior the robot should have
- Understand the basics of model-predictive control

Course contents

The following subjects will be covered:

- Kinematic control of robots
- Visual servoing (2D, 3D, hybrid, image moments)
- Visual servoing applications (manipulators, mobile robots, aerial robots, parallel robots, humanoids etc)
- Redundancy and task priority
- Unilateral constraints in sensor space (object visibility, obstacle avoidance)
- Model-predictive control

All these aspects are detailed with their mathematical grounds.

Course material

- W. Khalil, E. Dombre: Modeling, identification and control of robots, Hermes Penton,London, 2002.
- F. Chaumette, S. Hutchinson, Tutorial, Visual servo control PART I: Basic approaches, IEEE Robotics and Automation Magazine, December 2006
- F. Chaumette, S. Hutchinson, Tutorial, Visual servo control PART II: advanced approaches, IEEE Robotics and Automation Magazine, March 2007
- Visual Control of Robots: High Performance Visual Servoing, P.I. Corke, Robotics and Mechatronics Series, 2, John Wiley & Sons Inc (November 1996), Language: English
- O. Kanoun, F. Lamiraux, P.-B. Wieber, Kinematic control of redundant manipulators: generalizing the task-priority framework to inequality task, IEEE Trans. on Robotics, 2011

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	5	20 hrs	0 hrs	10 hrs	0 hrs	2 hrs

Master Programme - Control and Robotics - Advanced Robotics

YEAR 2 - Autumn Semester

Autonomous Vehicle [AUVE]

LEAD PROFESSOR(S): Elwan HERY

Requirements

Objectives

This course presents the basics of perception, localization, mapping and path planning for intelligent and autonomous vehicles. Topics covered will include:
· LiDAR perception
· Mapping with occupancy grid using SLAM (Simultaneous Localization And Mapping)
· GNSS localization and geographic to Cartesian coordinates transformation
· Map for road navigation
· V2X (vehicle to everything) communication
· Global path planning using map or occupancy grid and local path planning based on tentacles paradigm

Course contents

· Introduction to autonomous vehicles and Intelligent Transport Systems (ITS)
· LiDAR perception
· SLAM (Simultaneous Localization And Mapping)
· GNSS localization
· Map for autonomous vehicles navigation
· V2X (vehicle to everything) communication
· Global and local path planning

Course material

· A. Eskandarian, Ed., Handbook of Intelligent Vehicles. London: Springer London, 2012. doi: 10.1007/978-0-85729-085-4.
· H. Cheng, Autonomous Intelligent Vehicles: Theory, Algorithms, and Implementation. Springer Science & Business Media, 2011.
· Y. Chen and L. Li, Advances in Intelligent Vehicles. Academic Press, 2014.
· H. Durrant-Whyte and T. Bailey, "Simultaneous localization and mapping: part I," IEEE Robotics & Automation Magazine, vol. 13, no. 2, pp. 99–110, Jun. 2006, doi: 10.1109/MRA.2006.1638022.
· T. Bailey and H. Durrant-Whyte, "Simultaneous localization and mapping (SLAM): part II," IEEE Robotics & Automation Magazine, vol. 13, no. 3, pp. 108–117, Sep. 2006, doi: 10.1109/MRA.2006.1678144.Simultaneous localization and mapping

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	18 hrs	0 hrs	12 hrs	0 hrs	2 hrs

Advanced Visual Geometry [AVG]

LEAD PROFESSOR(S): Vincent FRÉMONT

Requirements

- 3D Geometry
- Linear Algebra
- Image processing and computer vision
- Optimization

Objectives

This course presents the fundamentals of advanced vision-based perception algorithms. Vision is one of the most promising senses to be used in robotics, providing important geometrical information on the surroundings of the robot. In this way, two-view geometry extended to multiple-view geometry will be investigated in order to address the difficult problems of relative pose estimation, 3D registration, pose and velocity estimation, and SLAM (simultaneous localization and mapping).

Depth cameras will also be introduced as they are used more and more in robot perception.

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

- Understand what can be done from visual geometry
- Develop algorithms for visual odometry
- Develop algorithm for SLAM applications
- Perform 3D registration

Course contents

- Projective geometry
- Epipolar geometry (Homography, Essential and fundamental matrix)
- Multi view geometry
- Visual odometry
- Pose and velocity estimation
- 3D registration
- Visual SLAM (Mono, stereo)
- RGB-D cameras

Practical Sessions:

LAB1: Projective Geometry
LAB2: Two-views Geometry
LAB3: Visual Odometry

Course material

- Multiple View Geometry in Computer Vision, Richard Hartley, Andrew Zisserman, Barnes & Noble, 2nd edition 2004
- Three-Dimensional Computer Vision, Olivier Faugeras, MIT Press, November 1993
- An invitation to 3D vision: from images to geometric models, Yi Ma, Stefano Soatto, Jana Kosecka, S. Shankar Sastry, Springer, 2010
- Past, Present, and Future of Simultaneous Localization and Mapping: Toward the Robust-Perception Age, Cadena et al., IEEE Transactions on Robotics (Volume: 32, Issue: 6, Dec. 2016)

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

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

Aerial and maritime drones [DRONES]

LEAD PROFESSOR(S): Olivier KERMORGANT

Requirements

Objectives

This course presents the state of the art and current challenges for aerial and underwater drones.
It covers the modeling, state estimation and control of such robots.
At the end of the course, students should be able to model drones, setup a state estimation scheme depending on the considered environment and perform position and velocity control with various approaches.

Course contents

· Maritime robots
o Applications and Technology
o Modeling: hydrodynamics, thrusters and fins
o Sensors: sonar, DVL, acoustic beacons
o Experimental and simulation challenges
o Control and state estimation

· Aerial drones
o Modeling of multi-rotor aerial vehicles
o Attitude and position control
o Trajectory tracking control
o Formation control of a fleet of drones and consensus
o Modeling of new aerial systems such as flying parallel robots

Course material

· T. I. Fossen (2011). Handbook of marine craft hydrodynamics and motion control
· G Antonelli (2013). Modeling of underwater robots, Underwater Robots, 3rd edn.
· R. Mahony, V. Kumar, P. Corke, Multirotor Aerial Vehicles : Modeling, Estimation and Control of Quadrotor, IEEE Robotics & Automation Magazine, Volume 19, Issue 3, pages 20-32, Sept. 2012
· S. Bouabdallah, R. Siegwart, Backstepping and sliding-mode techniques applied to an indoor micro quadrotor, IEEE International Conference on Robotics and Automation (ICRA), pages 2247–2252, Barcelona, Spain, April 2005.
· S. Bouabdallah, Design and control of quadrotors with application to autonomous flying, PhD thesis, Lausanne Polytechnic University, 2007
· Robotics : Aerial Robotics Coursera, University of Pennsylvania
· Olfati-Saber R., Fax J., and Murray R. Consensus and cooperation in networked multi-agent systems, Proceedings of the IEEE, 95(1), pp. 215-233, 2007

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	18 hrs	0 hrs	12 hrs	0 hrs	2 hrs

Optimal Kinematic Design [OPKID]

LEAD PROFESSOR(S): Philippe WENGER

Requirements

Objectives

This course presents advanced tools and methodologies for the kinematic design of new robots. Both serial and parallel kinematic architecture will be covered. The students will learn how to manage a general kinematic design problem in robotics.

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

- Set an optimal design problem in robotics, taking into account multiobjective criteria,
- Evaluate the kinematic performance of serial and parallel robots,
- Know how to design a cuspidal or a non-cuspidal robot
- Find the best suitable robot for a given task
- Find the best placement of the robot's base,
- Design parallel kinematic robots with given mobility and motion type.

Course contents

- Formalization of relevant criteria for the performance evaluation of robots (accessibility, feasibility of trajectories, dexterity, cuspidality etc),
- Methods for the calculation of robot workspace and of the maximal regions of feasible trajectories, taking into account joint limits and obstacles,
- Classification of cuspidal robots and geometric conditions for a robot to be cuspidal/non-cuspidal
- Optimal design and placement of serial-type robots in cluttered environments,
- Methods for designing parallel kinematic robots (architecture design, geometric design, coping with singularities and operation modes),
- Application examples in typical industrial cases,
- Application examples for the design of innovative robots.

Exercises will be set, which will involve the optimal kinematic design of typical robotic manipulators (serial and parallel). Simulation and verification using Robotic-CAD systems.

Course material

- J. Angeles, Fundamentals of Robotic Mechanical Systems, Springer-Verlag, New York, 2002,
- P. Wenger: "Performance Analysis of Robots", in Robot Manipulators: Modeling, Performance Analysis and Control, E. Dombre, W.Khalil (ed.), ISTE, London, 2006.
- J.P. Merlet, Parallel Robots, Second Edition, Springer, 2006.
- Wenger P. (2019) Cuspidal Robots. In: Müller A., Zlatanov D. (eds) Singular Configurations of Mechanisms and Manipulators. CISM International Centre for Mechanical Sciences (Courses and Lectures), vol 589. Springer, Cham. https://doi.org/10.1007/978-3-030-05219-5_3
- L. Campos et al., "Development of a five-bar parallel robot with large workspace", Proceedings of the ASME 2010 International Design Engineering Technical ▪ Conferences & Computers and Information in Engineering Conference IDETC/CIE 2010 August 15-18, 2010, Montreal, Quebec, Canada
- Bonev I., "Geometric Analysis of Parallel Mechanisms", Ph.D thesis, Laval University, Québec, QC, Canada, 2002
- Gosselin C.M. and Merlet J-P, "On the direct kinematics of planar parallel manipulators: special architectures and number of solutions," Mechanism and Machine Theory, 29(8):1083-1097, November 1994
- X. Kong and C. M. Gosselin, "Forward displacement analysis of third-class analytic 3-RPR planar parallel manipulators",

Mechanism and Machine Theory, 36(6), 1009-1018, 2001
▪ Wenger P, D. Chablat, Zein M.: "Degeneracy study of the forward kinematics of planar 3-RPR parallel manipulators". ASME J. of Mechanical Design, Vol 129(12), pp 1265-1268, December 2007
▪ Chablat D., Wenger P., " Architecture Optimization of a 3-DOF Parallel Mechanism for Machining Applications, the Orthoglide", IEEE Transactions on Robotics and Automation, vol. 19(3), pp 403-410, June 2003
▪ X. Kong and C. M. Gosselin, "Type synthesis of linear translational parallel manipulators," in Advances in Robot Kinematics, J. Lenarcic and F. Thomas, Eds. Norwell, MA: Kluwer, 2002, pp. 453–462.
▪ Zlatanov, D., Bonev, I.A., and Gosselin, C., Constraint singularities of parallel mechanisms. In Proc. IEEE International Conference on Robotics and Automation, Vol. 1, pp. 496–502, 2002.
▪ A. Chebbi and V. Parenti-Castelli, "The potential of the 3-UPU topology for translational parallel manipulators and a procedure to select the best architecture for a given task", Rom. J. Techn. Sci. Appl. Mechanics, Vol. 58, N°s 1-2, P. 5–30, Bucharest, 2013
▪ A. Chebbi and V. Parenti-Castelli, "Geometric and Manufacturing Issues of the 3-UPU Pure Translational Manipulators ", D. Pisla et al. (eds.), New Trends in Mechanism Science:Analysis and Design, 595 Mechanisms and Machine Science 5, DOI 10.1007/978-90-481-9689-0_68, Springer , 2010
▪ D. R. Walter and M. L. Husty, "Kinematic analysis of the TSAI-3UPU parallel manipulator using algebraic methods". In: Proceedings of the 13th World Congress in mechanism and machine science, 2011
▪ Innocenti C., Wenger P, "Position Analysis of the RRP-3(SS) Multi-Loop Spatial Structure", ASME Journal of Mechanical Design, Vol. 128 (1), pp 272-278, 2006
▪ Kanaan D., Wenger P, Chablat D., "Workspace Analysis of the Parallel Module of the VERNE Machine". Problems of Mechanics, Vol. 25, N°4, pp 26-42, 2006
▪ Schadlbauer J., Walter D.R., and Husty M.: "The 3-RPS Parallel Manipulator from an Algebraic Viewpoint", Mechanism and Machine Theory, 75, pp. 161-176, 2014
▪ L. Nurahmi, "Kinematic analysis and design of parallel manipulators with multiple operation modes", Ph.D thesis, Ecole Centrale de Nantes, 2015
▪ Zhao, T. S., Dai, J. S., and Huang, Z., 2002, "Geometric Analysis of Overconstrained Parallel Manipulators With Three and Four Degrees of Freedom," JSME Int. J. Ser. C, 45(3), pp. 730–740.
▪ S. Caro, D. Chablat, R. Ur-Rehman, P. Wenger, "Multiobjective Design Optimization of 3–PRR Planar Parallel Manipulators", Global Product Development, DOI 10.1007/978-3-642-15973-2_37, © Springer-Verlag Berlin Heidelberg, 2011, pp 373-383
▪ M. Husty, "An algorithm for solving the direct kinematics of general Gough-Stewart platforms", Mech. Mach. Theory, vol31 (4), pp365-380, 1996.
▪ Wenger Ph., Chablat D., " Workspace and Assembly modes in Fully-Parallel Manipulators : A Descriptive Study ", Advances in Robot Kinematics and Computational Geometry, Kluwer Academic Publishers, pp. 117-126, 1998
▪ Pashkevich A., Klimchik A, Chablat D., Wenger P : "Stiffness analysis of multi-chain robotic systems with loading". J. of Aut., Mobile Robotics and Intelligent Systems, Vol. 3(3), 2009, pp. 75-82.
07/978-90-481-9689-0_68, Springer , 2010
▪ M. Furet and P. Wenger: "Kinetostatic analysis and actuation strategy of a planar tensegrity 2-X manipulator", Journal of Mechanisms and Robotics, 1-19, https://doi.org/10.1115/1.4044209, 2019

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

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

Master Programme - Control and Robotics - Advanced Robotics

YEAR 2 - Autumn Semester

Soft Robot Modelling [SOROMO]

LEAD PROFESSOR(S): Sebastien BRIOT

Requirements

Objectives

Objectives:
This course presents modelling techniques (geometric, kinematic and dynamic) for some classes of soft robots (for instance: concentric tube robots (CTRs), Tendon-driven continuum robots (TDCRs), Continuum parallel robots (CPRs)) made of thin deformable rods.
At the end of the course the students will be able to:
- Understand the fundamentals of the mathematical models of several classes of soft robots made of thin deformable rods.
- Be able to write their geometric and kinematic models based on ODEs / DAEs
- Analyze their stability performances
- Understand the mathematical fundamentals for the numerical solvers used in order to find the solutions to the model.
- Understand the mathematical fundamentals of some typical numerical integrators.
- Understand the mathematical fundamentals of some typical discretization techniques used in order to solve the ODEs/DAEs representing the robot models.
- Understand the basics of dynamics modeling of flexible rods.

Course contents

Teaching plan
Introduction to soft robots, concepts of continuum mechanics
Statics of the Cosserat rod
Geometrico-static models of tendon-actuated continuum robots (TACR), concentric tube continuum robots (CTR), continuum parallel robots (CPR)
Tangent geometrico-static models of TACR, CTR, CPR
Introduction to numerical methods (solvers, (Newton, Levenberg-Marquardt), integrators (Newton, Runge-Kutta, spectral integration, shooting methods, finite differences)
Stability analysis
Geometrico-static model of Cosserat rods on Lie groups, application to TACR, CTR, CPR
Strain-assumed modes method in statics

Practical Work: Labs will be set, involving modeling and simulation of robots. Experimental setup will serve to compare models with physical reality.

Course material

Recommended texts:
DC Rucker, RJ Webster III. Statics and dynamics of continuum robots with general tendon routing and external loading. IEEE Transactions on Robotics 27 (6), 1033-1044.
DC Rucker, BA Jones, RJ Webster III. A geometrically exact model for externally loaded concentric-tube continuum robots. IEEE transactions on robotics 26 (5), 769-780.
CB Black, J Till, DC Rucker.Parallel continuum robots: Modeling, analysis, and actuation-based force sensing. IEEE Transactions on Robotics 34 (1), 29-47
F. Boyer, V. Lebastard, F. Candelier, F. Renda. Dynamics of continuum and soft robots: a strain parametrization based approach. In IEEE Transactions on Robotics ; éd. IEEE, 2020.
S. Briot, and A. Goldsztejn. Singularity Conditions for Continuum Parallel Robots. IEEE Transactions on Robotics, 2022, Vol. 38, No. 1, pp. 507-525.

Further readings:
will be provided during the course

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	4	18 hrs	0 hrs	12 hrs	0 hrs	2 hrs

Master Programme - Control and Robotics - Advanced Robotics

YEAR 2 - Autumn Semester

Cultural and Communication English [CCE3]

LEAD PROFESSOR(S): David TROYA

Requirements

Objectives

- Understand the fundamental principles of scientific writing and the importance of clarity and precision in communication.
- Structure scientific documents effectively, adhering to genre-specific conventions.
- Employ appropriate language and tone for diverse scientific audiences.
- Integrate and cite sources correctly to support research arguments and findings.
- Edit and revise their writing for coherence, style, and grammatical accuracy.
- Prepare and deliver scientific presentations, both written and oral.

Course contents

Introduction to Scientific Writing

Overview:

This course provides an essential foundation in scientific writing, equipping students with the skills necessary to effectively communicate research findings and scientific concepts. Through a combination of lectures, workshops, and practical assignments, students will learn the conventions of scientific writing, including structure, style, and clarity. The course will cover various types of scientific documents, such as research papers, literature reviews, grant proposals, and poster presentations.

Course Structure:

The course will be organized into weekly sessions that include lectures on theoretical concepts, hands-on writing exercises, peer review workshops, and discussions of exemplary scientific literature. Students will engage in collaborative projects and receive constructive feedback to enhance their writing skills.

Assessment:

Students will be assessed through a combination of assignments, including written documents, peer review participation, and presentations. Active participation in workshops and discussions is also required to foster a collaborative learning environment.

Course material

Hoogenboom BJ, Manske RC. How to write a scientific article. Int J Sports Phys Ther. 2012 Oct;7(5):512-7. PMID: 23091783; PMCID: PMC3474301.

Paré G, Kitsiou S. Chapter 9Methods for Literature Reviews. In: Lau F, Kuziemsky C, editors. Handbook of eHealth Evaluation: An Evidence-based Approach [Internet]. Victoria (BC): University of Victoria; 2017 Feb 27. Available from: https://www.ncbi.nlm.nih.gov/books/NBK481583/

How to Create a Research Poster. A guide fo creating a research poster. https://guides.nyu.edu/posters

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	2	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

Spanish Language [ESP3]

LEAD PROFESSOR(S): Marta HERRERA

Requirements

N/A

Objectives

For beginners:
Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction)
Acquisition of vocabulary and linguistic structures
Be able to talk about yourself and those around you
Be able to express oneself during daily activities
Know how to give your opinion

For advanced students:
Practice and reinforcement of the five skills (oral and written expression and comprehension as well as interaction)
Acquisition of specialised vocabulary
Be able to understand the essential content of concrete or abstract subjects including a technical discussion
Be able to communicate spontaneously and fluently
Be able to express oneself in a clear and detailed manner, to express an opinion on a topical subject

Course contents

For beginners:
Personal environment (introduce yourself, express yourself, your tastes, your character, your hobbies, etc.), your surroundings (friends, family, location, climate), your interests (sports, leisure)
Present tense (regular and irregular)
Language patterns to express habit, obligation, "gustar" and its equivalents,
Possessive adjectives
Differences between "es", "está", "hay"
Use of "por" and "para"
Adverbs and frequency patterns
Numeral adjectives

For advanced students:
Knowledge of the Hispanic world (economic, technical, cultural and social environment)
Present tense (regular and irregular)
Imperative
Past tenses
Direct / indirect style
Future tense
Conditional tense
Present and past subjunctive moods

Course material

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

Assessment

Individual assessment: EVI 1 (coefficient 1)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
Spanish	2	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

French Language [FLE3]

LEAD PROFESSOR(S): Silvia ERTL

Requirements

N/A

Objectives

The objective is to familiarize the learner with the French language and French culture through an entertaining task-based communicative language teaching, focused on speaking combined with:
- Phonetics
- Self-correcting exercises on our learning platform
- Learning Lab activities
- Project work
- Tutoring

Course objectives include the acquisition and reinforcement of vocabulary, syntax, and pronunciation by both traditional means and through the use of digital resources. Students will learn general French, develop language skills of oral and written comprehension and expression.

After completing this course (32 hours + personal work), the students will be able to communicate in spoken and written French, in a simple, but clear manner, on familiar topics in the context of study, hobbies etc. Another important goal of this course is to introduce the student to French culture.

At the end of the course, complete beginners can achieve an A1
level and some aspects of the A2 of The Common European Framework of Reference for Languages. More advanced students may aim for B1/B2 levels. Those who already completed the first year of the French course will be prepared for working in a French business environment.

Course contents

Two different tracks are proposed: track 1 for students newly arrived at Centrale Nantes and track 2 for students who have completed the first year of the French course. Track 1:
Full range of practical communication language exercises: reading comprehension, listening comprehension, written expression, oral expression.
Learners will be able to use the foreign language in a simple way for the following purposes:

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

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

3. Carrying out certain transactions:

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

Track 2:
This track follows on directly from the first-year French course, developing and completing the concepts studied thus far. The main themes are: housing, health and work. These topics will help prepare students for their future work environment. For example, housing is explored in the form of a search for accommodation upon arrival in a new city. Special workshops for CVs and cover letters, elevator pitches and job interviews.

Course material

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

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	2	0 hrs	32 hrs	0 hrs	0 hrs	0 hrs

Master Programme - Control and Robotics - Advanced Robotics

YEAR 2 - Spring Semester

Master Thesis or Internship [THESIS]

LEAD PROFESSOR(S): Olivier KERMORGANT

Requirements

Objectives

- Be exposed to and adapt to an industrial or research environment
- Put in practice the scientific and technical skills acquired in the previous semesters
- Strengthen interpersonal and communication skills
- Be part of or manage a project
- Organize tasks, analyze results and build deliverables

Course contents

Students should be pro-active and career-oriented in the search for their thesis/internship. The topics are validated by the program supervisor to ensure an adequate Master level. The thesis/internship is evaluated through the submission of a written report and an oral defense.

Course material

- Turabian Kate Larimore, Booth Wayne Clayton, Colomb Gregory G., Williams Joseph M., & University of Chicago press. (2013). A manual for writers of research papers, theses, and dissertations: Chicago style for students and researchers (8th edition.). Chicago (Ill.) London: University of Chicago Press.
- Bui Yvonne N. How to Write a Master's Thesis. 2nd ed. Thousand Oaks, Calif: Sage, 2014.
- Evans David G., Gruba Paul, et Zobel Justin. How to Write a Better Thesis. 3rd edition. Carlton South, Vic: Melbourne University Press, 2011.

Assessment

Individual assessment: EVI 1 (coefficient 1.0)

LANGUAGE OF INSTRUCTION	ECTS CREDITS	LECTURES	TUTORIALS	LAB	PROJECT	EXAM
English	30	0 hrs	0 hrs	0 hrs	0 hrs	0 hrs