PhD Courses offered (2022-2023)

Sommario

Outline of Courses

The offered courses can be roughly grouped into three distinct classes:

Crossover courses oriented to scientific methodology, writing, results exploitation, and intellectual property protection.

Foundation courses oriented to basic disciplines of robotics and bioengineering

Specialty courses oriented to specific doctorate curricula.

In the following, the courses offered in each class by the doctorate are listed along the instructors and the number of credits.

Crossover Courses

Mandatory Courses (24 Credits)

Theatrical techniques for scientific presentation[1]	Sgorbissa A.	5
Ethics and Bioethics in Bioengineering and Robotics[1]	Battistuzzi L.	5
Paper Writing[1]	Marchese M.	5
Grant writing[2]	Leone C.	5
Open Science and Research Data Management (OS&RD)	Pasquale V./Pastorini A.M.	4

Basic Courses

Data acquisition and data analysis methods	Canali C./Pistone A.	2

Foundation Courses

Programming

C++ programming techniques	Solari F./Chessa M.	6
Computational models of visual perception[*]	Solari F.	6
Effective habits and skills for successful young scientists	Roli F.	5
Theory and practice of virtual reality systems[*]	Chessa M.	6
Robot programming with ROS	Recchiuto C.	5
Modern C++	Accame M.	9
Mechanical Drawing Fundamentals (BASIC)	Torazza D.	2
Computer aided design	Torazza D.	4
Perceptual Systems	Gori M./Tonelli A.	4
Optics for Microscopy and Spectroscopy	Slenders E. / Zunino A.	4

[1] Recommended for 1st year students

[2] Recommended for 2nd and 3rd year students

[*] Offered by the Phd in Computer Science and Systems Engineering

[§] Offered by the Phd in Security Risk and Vulnerability

Electronics and Circuits (level 1)	Sartore M.	3
Electronics and Circuits (level 2)	Sartore M.	3
Electronics and Circuits (level 3)	Sartore M.	3
Electronics and Circuits (level 4)	Sartore M.	3
Motion control drivers (level 1)	Sartore M.	3
Motion control drivers (level 2)	Sartore M.	3
Motion control drivers (level 3)	Sartore M.	3
Motion control drivers (level 4)	Sartore M.	3

Speciality Courses

Advanced EEG analyses	Inuggi A./Campus C.	5
Research oriented structural and functional neuroimaging	Inuggi A.	5
The 3Rs approach: Replacement, Reduction and Refinement of animal procedures in biomedical research	Pastorino L. Di Lisa D.	4
An introduction to body-machine interface	Pierella C.	4

Robot behavior modelling	Colledanchise M.	4
Polymers an biopolymers for sustainable future	Perotto G. /Papadopoulou E.	6
Microfluidics and nanofluidics: theory, methods, and applications	Surdo S./ Perego E.	4

Cognitive Robotics for Human-Robot Interaction	Rea F./ A. Sciutti	5
Artificial Robotic Cognition for the Representation of Purposive Actions	Morasso P.	2
Functional quantitative assessment in sport, ergonomics and rehabilitation	Zenzeri J.	4
An introduction to modern neurophysiology: bridging experimental tools and computational strategies to unlock the brain	Maffulli R. / Panniello M.	4
Deep Learning: a hands-on introduction*	Noceti N.	6
Computer Vision Crash Course*	Odone F.	6
Adversarial Machine Learning	Roli F. / Demetrio L.	3
Topics in Modern Machine Learning (ModML)*	Rosasco L.	6

Robotic technologies for sensorimotor rehabilitation	Morasso P./Zenzeri J.	5
Robotic Virtual Prototyping Design	Cannella F. /D'Imperio M.	6
Mechatronics and AI	Cannella F. / Marchello G.	6
Photocatalysis and photocatalytic materials	Papadopoulou E./ Fazli A.	4
Trustworthy Artificial Intelligence§	Oneto L.	5

Ethics and Bioethics in Bioengineering and Robotics

Scientific Disciplinary Sector: MED02/MED43/M-FIL03

Number of hours: 15

Credits: 5

AIMS AND CONTENT

Learning Outcomes (short)

Upon successful completion of this course, students will be able to

- explain some of the key ethical and bioethical issues in bioengineering and robotics
- identify ethically problematic facets of a project
- apply an ethical decision-making framework to a scenario in order to determine an ethically appropriate course of action.

Learning Outcomes (further info)

How can we develop models of human-robot interaction that preserve human values? Can ethical considerations be incorporated into the design of novel artifacts? What duties and obligations do researchers have towards research participants?

Increasingly, researchers and professionals in the fields of bioengineering and robotics are faced with ethical questions like these. The goal of this course is therefore twofold: first, to develop PhD students' sensitivity to the ethical issues that arise in research and professional practice, and, second, to provide them with the knowledge and tools that will help them navigate ethically complex scenarios and reach ethically appropriate decisions.

Syllabus/Content

Topics covered may include:

- Ethics and bioethics: concepts and frameworks
- Ethical decision-making
- The requirements of ethical research
- Research protocols and ethical review
- Informed consent
- Personal data and privacy
- Ethical issues in human-robot interaction
- Value Sensitive Design in bioengineering

WHO

Teacher(s): Linda Battistuzzi, e-mail: linda.battistuzzi@unige.it.

HOW

Teaching Methods

The course will be delivered using a range of teaching and learning methods, including lectures and group discussions and activities. Case-Based learning, an approach to learning and instruction that uses factual or fictional scenarios exemplifying the issues at hand, will be extensively used.

Exam Description

Students will be split into groups and each group will be asked to develop an ethically problematic case of their own, explaining the issues it raises and proposing an ethically appropriate course of action.

Assessment Methods

Students will present their case and discuss it during class time. Contributions to class discussion will be considered a part of the assessment.

WHERE AND WHEN

Lesson Location

UNIGE.

Lesson Schedule

Friday January 27 (15.30 – 17.30)

Monday January 30 (15.30 – 17.30)

Wednesday February 1 (15.30 – 17.30)

Friday February 3 (15.30 – 17.30)

Friday February 10 (15.30 – 17.30)

Thursday February 16 (15 - 17.30)

Friday February 17 (15 – 17.30)

Office hours for student

I can generally be reached by email. Appointments can be organized if necessary.

CONTACTS

Students should contact me by email.

Grant Writing

Scientific Disciplinary Sector: ING-INF/05

Number of hours: 12 hours

Credits: 5 CFU

AIMS AND CONTENT

Learning Outcomes (short)

The course will present and discuss guidelines on how to design a research grant proposal and on the coordination of a research grant, with a special focus on European Horizon Europe Framework Programme. The students will be invited to participate to concrete exercise and the drafting of real and possible project ideas. A part of the lessons is dedicated to participatory activities.

Learning Outcomes (further info)

A particular focus will be on project proposals to be developed by PhD students and Early Stage Researchers. Use cases of successful projects coordinated by the teacher will be studied and analysed. A short simulation of the development process of a draft research proposal will conclude the course.

Syllabus/Content

European research grants, EU Horizon Europe, Project Drafting.

WHO

Teacher(s): Cinzia Leone, email: cinzia.leone@unige.it

HOW

Teaching Methods

Direct instruction (slides and course material) followed by a flipped classroom final short session.

Exam Description

Written exam (test and open questions) followed by a discussion of an example of case study.

Assessment Methods

Exam (test and oral discussion)

WHERE AND WHEN

Lesson Location

@UNIGE: TBA

Lesson Schedule

- September 13, 2023 (09:00-13:00)
- September 14, 2023 (09:00-13:00)

- September 15, 2023 (09:00-13:00)

Office hours for student

Emails and appointments on request.

CONTACTS

The teacher is available by email (cinzia.leone@unige.it).

Theatrical techniques for scientific presentation

Scientific Disciplinary Sector: ING-INF/05

Number of hours: 12

Credits: 5

AIMS AND CONTENT

Learning Outcomes (short)

Upon successful completion of this course, students will be able to successfully prepare a scientific presentation for a specific audience, and to deliver it to the public by using their voice, their body and the space around them in the most efficient way as possible.

Syllabus/Content

Topics covered will include:

- How to prepare a presentation by taking into account the scientific context and the public;
- Structuring the presentation: the importance of the beginning and the end;
- Scientific journals and conferences;
- Theatrical techniques to use the space;
- Theatrical techniques to use the body;
- Theatrical techniques to use the voice.

WHO

Teacher(s):

Antonio Sgorbissa, +393204218938, antonio.sgorbissa@unige.it

HOW

Teaching Methods:

The course will be delivered using a range of teaching and learning methods, including lectures, group discussions and activities, as well as acting exercises to control the body, the voice, and the surrounding spaces.

Assessment Methods:

Students will be required to 1) prepare a presentation to be delivered to other students, and 2) participate to short theatrical performance to test the techniques they have learnt during lessons.

WHERE AND WHEN

Lesson Location

@UNIGE: TBA

Lesson Schedule

- June 29, 2023 (10:00-13:00)
- July 5, 2023 (10:00-13:00)
- July 12, 2023 (10:00-13:00)
- July 15, 2023 (14:30-17:30)

Office hours for student

Contact the teacher to fix an appointment.

CONTACTS

Via Opera Pia 13, Second Floor. Contact the teacher via phone and email.

Open Science and Research Data Management (OS&RDM)

Scientific Disciplinary Sector: ING-INF/04 OR ING-INF/05 OR ING-INF/06 OR any other valid code

Number of hours: 10

Credits: 4

AIMS AND CONTENT

Learning Outcomes

This training module for PhD Students aims to introduce early-career researchers to the principles of scholarly communication, Open Science and Research Data Management. Students will gain a better understanding of the available research e-infrastructures, tools, and services for Open Access publishing, Research Data Management and FAIR Data. Students will also learn the importance and the transformative potential of Open Science practices in research, especially to improve reproducibility and increase research integrity. They will learn what means to make data FAIR, as required by many funders, including the European Commission, and how to draft a data management plan. Finally, they will have the chance to practice on common tools for Research Data Management, like Data Stewardship Wizard, Zenodo, and Dataverse.

Contents

Module 1:

The transformative potential of Open Science for research (V. Pasquale, A. M. Pastorini)

Definition of Open Science; potential and benefits for different stakeholders.

Scholarly communication (A. M. Pastorini)

What is scholarly communication; the publication cycle and type of publications; peer-review process; bibliometrics (impact factor, h-index, other indicators, bibliometrics limits); citation databases; avoid plagiarism; literature search engines and reference managers.

The management of rights in scholarly communication (A. M. Pastorini)

Intellectual property: trademarks and patents; author's rights and copyright (Italian and European contexts); fair use vs exceptions and limitations to rights; editorial policies: contract and license; open access as an economic model; open licenses for sharing contents and data

Module 2:

Open access in scholarly communication (A. M. Pastorini)

Overview on open access; open digital repositories and institutional archives; open access journals and bibliometrics; the different business models of open access; cOAlitionS and PlanS; OA policies and regulations (with specific reference to Unige and IIT context).

Author's rights and PhD Thesis (A. M. Pastorini)

Author's rights and PhD Thesis; regulation about PhD Thesis; the submissions of PhD Thesis in the institutional repository (IRIS UniGe); information and support: the OS UniGe website www.openscience.unige.it; open science & RDM support in IIT (*V. Pasquale*).

Module 3

What is Research Data Management? (V. Pasquale)

Research data management: a definition; Research data lifecycle: from data management planning to sharing.

The Research Data Lifecycle: Plan & fund (V. Pasquale)

Funder requirements; data management planning; support for DMP at IIT.

Hands-on activity: using online tools for data management planning (V. Pasquale)

Students will be asked to draft a data management plan of their PhD project by using online tools (e.g., Data Stewardship Wizard).

Module 4

The Research Data Lifecycle: Work with data (V. Pasquale)

Secure storage & backup; tips & tricks: file formats, data organisation, filenaming conventions, version control and "house-keeping" rules; data documentation; electronic lab notebooks.

The Research Data Lifecycle: Preserve & share (V. Pasquale)

FAIR data: how to make your data FAIR; data and metadata standards; digital preservation: repositories, open data licenses, persistent identifiers, how to make your research outputs (data, models, code) citable.

Hands-on activity: share a dataset in a trusted repository (V. Pasquale)

Students will be asked to create a dataset and share it by using a trusted repository (e.g., Zenodo, Dataverse, figshare, etc.)

WHO

Teacher(s): Anna Maria Pastorini, SBA UNIGE, annamp@unige.it; Valentina Pasquale, IIT, valentina.pasquale@iit.it.

HOW

Teaching Methods

Frontal lectures, hands-on activities.

Exam Description

To be recognized credits (CFU), students will have to take an exam. The exam may consist in a combination of multiple-choice tests and/or practical activities, such as the elaboration of a sample data management plan and/or sharing a research dataset.

Assessment Methods

Students will be evaluated on the basis of the multiple-choice tests, and/or on the execution of practical activities.

WHERE AND WHEN

Lesson Location

UNIGE and IIT (locations TBA)

Lesson Schedule

Feb. 13 – 14, 10-12 AM @Unige

Feb. 15 – 16, 10-12 AM @IIT

+ last lecture for Q&A / exam to be decided

CONTACTS

Anna Maria Pastorini, Servizio Sistema Bibliotecario di Ateneo, Ufficio Biblioteca Digitale e Open Access, Università di Genova

Email: annamp@unige.it

Valentina Pasquale, Research Data Management specialist, Via Morego 30, 16163, Genova (1st floor)

Email: valentina.pasquale@iit.it

Office hours for student

Students can ask questions sending emails to the teachers. Office hours: 8.30-17.30.

Data Acquisition and Data Analysis Methods

Scientific Disciplinary Sector: ING-INF/04 OR ING-INF/05 OR ING-INF/06 OR any other valid code

Number of hours: 15

Credits: 2

AIMS AND CONTENT

Learning Outcomes (short)

The course is aimed at students who intend to acquire knowledge to develop measurement systems and data analysis algorithms to be adopted in general applications (robotics, test benches, sensor data acquisition). This course presents an overview about data acquisition and data analysis methods. In a first part methods used in modern data acquisition systems will be described with a special focus on hardware and electronics. The second part will focus on the data analysis side of a measurement process. The aim is to learn how to get the information hidden inside the data, even in presence of noise, using statistical and computing methods.

Learning Outcomes (further info)

When successfully accomplished the course the student will have a comprehensive view on how to set up a data acquisition system: the course will give to the student the capabilities to choose the most appropriate hardware depending from the quantity to be measured and the application. Part of the course will be dedicated to learn how to properly design a DAQ system and all the related problematic (sampling rate, noise, amplification, etc.). An overview about Electronics (including microcontrollers, FPGA, amplifiers and analogue electronics, commonly used BUS and sensors) will be discussed. Moreover the course will give an overview of the data analysis process: starting from the raw data, acquired using the instruments presented in the first part of the course, and ending with the physical information. After a brief review about measurements and uncertainty, an overview of random variables, outcomes of experiments and propagation of uncertainty will be presented. Then useful statistical methods to present and treat the data will be discussed. Finally some real examples of data analysis using MATLAB® will be shown.

Syllabus/Content

9 hours

- Data acquisition methods
- Sensors and measurements methods
- Introduction to Electronics 1 (Amplifiers, Filters, S/N ratio, ADC)
- Introduction to Electronics 2 (Real Time systems and Data Acquisition)
- Example and applications

6 hours

- Dealing with uncertainties (1h)
- Introduction to statistical methods (1h)
- Data analysis using MATLAB® (4h)

- Curve fitting and parameters identification
- Periodicity analysis and pre-processing tools

Prerequisites

Students will need access to MATLAB®. A basic knowledge of MATLAB® is also required.

WHO

Teacher(s):

Name: Dr. Carlo Canali

Phone number: +39.010.2896793

Email: carlo.canali@iit.it

Name: Dr. Alessandro Pistone

Phone number: +39.010.2896810

Email: alessandro.pistone@iit.it

HOW

Teaching Methods:

- Lectures (slides of the course will be provided)
- Hands-on lectures (hardware will be provided)
- Practical demonstration coding and computation

Exam Description:

Short thesis describing a practical implementation of the contents of the course. The project can be done in groups of maximum 2 students (must be agreed with the teachers). The aim of the project can be proposed by the student and/or by the teachers. The work can include one or both of the following tasks:

- Construction of a real Data Acquisition System
- Implementation of a Data Analysis program/code

Assessment Methods:

Thesis will be evaluated by teachers.

WHERE AND WHEN

Lesson Location

Istituto Italiano di Tecnologia, Via Morego 30 (Bolzaneto), Genova. – Room to be defined.

Lesson Schedule

- April 11, 2023 (10:00-12:00)
- April 18, 2023 (10:00-12:00)
- April 26, 2023 (10:00-12:00)
- May 2, 2023 (10:00-12:00)
- May 9, 2023 (10:00-12:00)
- May 16, 2023 (10:00-12:00)
- May 23, 2023 (10:00-12:00)

CONTACTS

The Teachers' office is at CJIR Laboratory, Via Greto di Cornigliano 4-6r (Campi) Genova. Teachers can be contacted by email or by phone to arrange an appointment.

Dr. Carlo Canali, carlo.canali@iit.it, +39.010.2896793

Dr. Alessandro Pistone, alessandro.pistone@iit.it, +39.010.2896810

Modern C++

Scientific Disciplinary Sector: ING-INF/05 / ING-INF/06

Number of hours: 30

Credits: 9

AIMS AND CONTENT

Learning Outcomes (short)

The students will learn the new syntax and philosophy of Modern C++ (releases C++11, -14, -17, -20) with hands on the code at every lesson.

Learning Outcomes (further info)

The course has been renewed by adding the latest new features, hands-on sessions, and useful tools we daily use for our robots in iCub Tech at IIT. The students will learn the latest modern C++ syntax, its application with modern SW development techniques and finally they will challenge themselves with an online assignment where they will put in practice what learnt.

Syllabus/Content

Each of the following modules will be 3.0 hours each with theory and hands-on

1. Introduction 1: presentation of the course, basics of used tools (CMake, gitpod, git, Markdown, etc).
2. Introduction 2: refresh of C++98.
3. The basics 1: nullptr, auto, type aliases, initializer list, uniform initialization
4. The basics 2: range based loops, constexpr, scoped enums, override and final.
5. Advanced topics 1: lambda functions, STL containers, algorithms
6. Advanced topics 2: move semantics, smart pointers.
7. Advanced topics 3: multithread.
8. Advanced topics 4: new features in C++20
9. Language applied 1: extreme programming, unit testing
10. Language applied 2: hands on code

WHO

Teacher(s):

Marco Accame (coordinator): +39 010 2898201, marco.accame@iit.it

Valentina Gaggero (valentina.gaggero@iit.it),

Nicolo' Genesio (nicolo.genesio@iit.it),

Luca Tricerri (luca.tricerri@iit.it)

Davide Tome' (davide.tome@iit.it).

HOW

Teaching Methods:

Slides with code examples, hand on code using gitpod or other environment (each student needs a laptop), open discussion and questions.

Exam Description:

An online assignment with some questions and development of a simple project using what learned during the course.

Assessment Methods:

To be admitted to the online assignment the student must have attended at least 7 lessons. The assessment is passed if it the developed code compiles, produces reasonable results and a simple report is presented.

WHERE AND WHEN

Lesson Location

IIT-CRIS (Center for Robotics and Intelligent Systems), Via San Quirico 19D, 16163 Genova, Italy

Or remotely through Teams platform in case of impossibility to attend in person.

Lesson Schedule

1. Introduction 1: on **30 May 2023**, 1400-1700
2. Introduction 2: on **31 May 2023**, 1400-1700
3. The basics 1: on **1 June 2023**, 1400-1700
4. The basics 2: on **13 June 2023**, 1400-1700
5. Advanced topics 1: on **20 June 2023**, 1400-1700
6. Advanced topics 2: on **21 June 2023**, 1400-1700
7. Advanced topics 3: on **22 June 2023**, 1400-1700
8. Advanced topics 4: on **26 June 2023**, 1400-1700
9. Language applied 1: on **27 June 2023**, 1400-1700
10. Language applied 2: on **28 June 2023**, 1400-1700

The assignment will start the day of the last lesson. The students will have one (or two) weeks to complete it and solutions will be discussed at a date to be arranged together in a two-hour session, possibly on Teams.

Office hours for student

0900-1700 Monday to Friday.

CONTACTS

Place: First floor of IIT-CRIS (Center for Robotics and Intelligent Systems), Via San Quirico 19D, 16163 Genova, Italy.

Preferred interaction modes:

- email with subject beginning with the string “[MODERN-C++]” so that your email can be filtered out and immediately spotted.
- Teams platform after arranged appointment.
- Face to face.

Perceptual systems

Scientific Disciplinary Sector: M-PSI/01

Number of hours: 12

Credits: 4

AIMS AND CONTENT

Learning Outcomes

From birth, we interact with the world through our senses. How the brain process and transform sensory signals into perceptual outputs is one of the main questions in the field of experimental psychology. The goal of the course is to present the perceptual from the anatomical, physiological, and functional points of view. A particular focus will be on how physical stimuli are transduced into sensory signals by our peripheral sensory apparatus in a hierarchy organize complex behaviour. In the last part of the course, these topics will be described in relation with cross-sensory interaction and multisensory integration in the adult and the developing brain.

Students will learn how the functioning of the main sensory systems, i.e. vision, audition, touch, small and taste. Moreover, it will be explain the process of multisensory integration and cross-modal interaction.

Syllabus/Content

Class 1 (3 hours): Visual system I.
Class 2 (3 hours): Auditory and tactile systems.
Class 3 (3 hours): Multisensory integration and development of sensory systems.
Class 4 (2 hours): Olfactory and gustatory systems and cross-modal interaction.
Class 5 (1 hours): Final Exam.

WHO

Teacher(s):

Name:

Monica Gori – Istituto Italiano di Tecnologia – +39 0108172217, monica.gori@iit.it

Alessia Tonelli – Istituto Italiano di Tecnologia – +39 0108172232, alessia.tonelli@iit.it

HOW

Teaching Methods:

Frontal lessons and presentations.

The exam will consist of a multiple-choice questionnaire, which must be completed in one hour.

Assessment Methods:

In order to obtain the 4 CFU, students have to answer correctly at least at the 65% of the questions.

WHERE AND WHEN

Lesson Location

The lessons will be held at IIT – Erzelli or on Teams platform. The name of the room depends on availability and will be communicated in advance.

Lesson Schedule

The course will be held:

TBA

CONTACTS

Students can contact the teacher by email:

Monica Gori – monica.gori@iit.it

Alessia Tonelli – alessia.tonelli@iit.it

Robot programming with ROS

Scientific Disciplinary Sector: ING-INF/05

Number of hours: 15 hours

Credits: 5 CFU

AIMS AND CONTENT

Learning Outcomes (short)

Learning the ROS communication architecture.

Applying ROS functionalities to selected case studies.

Understanding the ROS2 basic concepts.

Learning Outcomes (further info)

ROS is a robotic middleware that offers a collection of packages for commonly used functionality, low-level control, hardware abstraction, and message passing. Given all these aspects, it has become a standard in robotics. The course will explore its most relevant functionalities, with the help of different examples, analyzing how the ROS framework may help in solving common problems in robotics. The course will describe in detail the ROS framework, also giving some general operative instructions (classes I – II- III), and it will then deal with some specific aspects (class IV-V), in particular, 3D simulations with ROS and ROS2. ***The course is particular suggested to students who have never used ROS, which will receive some insights about its features.***

The course will foresee the usage of some commonly used robotic simulators, such as Gazebo, giving the possibility of practically testing the ROS features. During the course, a Docker image with ROS and ROS2 already installed will be given to students.

Syllabus/Content

- Class I (3 hours) – Introduction to ROS Topics. Class examples.
- Class II (3 hours) – Services and Nodes. Class examples.
- Class III (3 hours) – Custom messages and services. ROS Actions. Class examples.
- Class IV (3 hours) – Robot modelling and 3D simulations. Class examples and Assignment I.
- Class V (3hours) – ROS2 Topics, Services and Nodes. Class examples and Assignment I.

WHO

Teacher(s): Prof. Carmine Tommaso Recchiuto, +393480667920, carmine.recchiuto@dibris.unige.it

HOW

Teaching Methods. The teaching methodology will combine lectures together with supervised exercises that will address all most relevant theoretical aspects. Slides of the course will be provided before each lecture. Two mandatory assignments will be given at the end of the 3nd and of the 5th lecture.

Exam Description. The assignments will consist of the implementation of robotic simulations based on software written using the ROS framework. Simulation environments will be shown during the courses. The students will be required to write some ROS nodes, re-use existing ROS packages and create/modify robotic models for the simulation. The final exam will consist of an oral discussion about the implementation of the assignments.

Assessment Methods. The teachers will assess the appropriateness of the code and the effectiveness of the simulations. The students will present their work during an oral examination, after making an appointment with the teacher. The assessment will take in consideration how the students have learnt, selected, and implemented the techniques shown during the course.

WHERE AND WHEN

Lesson Location

@UNIGE

Lesson Schedule

Wednesday 6 Sep 2022, 14:00-17:00

Thursday 7 Sep 2022, 10:00-13:00

Thursday 7 Sep 2022, 14:00-17:00

Friday 8 Sep 2022, 10:00-13:00

Friday 8 Sep 2022, 14:00-17:00

Office hours for student

The teacher may be contacted by mail or by phone (see contacts)

CONTACTS

Dr. Carmine Tommaso Recchiuto, Assistant Professor, Laboratorium (DIBRIS, E building 2nd floor)

Phone: +393480667920

Mail: carmine.recchiuto@dibris.unige.it

Electronics and Circuits

Scientific Disciplinary Sector: ING-INF/01

Number of hours: 48 (divided in 4 Levels of 12 hours each)

Credits: 3 per Level

AIMS AND CONTENTS

Learning Outcomes (short)

Level 1: analog and digital electronics

Level 2: mixed signals and data conversion

Level 3: advanced design techniques

Level 4: CAD design of Printed Circuit Boards (PCBs)

Learning Outcomes (further info)

Level 1: learning basic Operational Amplifier circuit design and practices; learning digital electronics basics.

Level 2: understanding Analog-to-Digital and Digital-to-Analog conversion and being able to write the specifications of an analog system for signal conditioning and of a mixed-signal system (signal conditioning, data acquisition, filtering) to provide to a thirdy-part designer or to select an off-the-shelf solution available on the market

Level 3: more electronic components; schematic circuit design of "standard modules" to be used as building-blocks in more complex or custom systems, more advanced technical issues (e.g. circuit layout dos and don'ts), circuit design best practices

Level 4: learning a CAD tool for the design of circuit schematics and of the related customized Printed Circuit Boards.

Syllabus/Content

Level 1: students will learn the Operational Amplifier and will be able to go through a typical Datasheet, understanding the various features and characteristic curves. In this module they will practice with basic circuits while learning how to optimize the design in terms of requested features (e.g. noise, stability, etc.).
In the second part students will go through the basics of digital design, confining the activities on typical digital building blocks useful for the following Level 2 module.

Level 2: students will mix the acquired concepts into the A/D and D/A technologies, learning how to select the appropriate converter for a given application especially in terms of resolution and speed. They will afford a real-case situation where an input analog signal must be pre-processed and filtered before the converter stage. They will also learn the main communication protocols to interface with converters and other programmable integrated circuits (SPI, I2C, etc.).

Level 3: this module will offer some details about other components useful to afford the design of more complex systems. Based on the knowledge of the two preceding modules, students will be ready to design circuits intended as more or less standard building blocks for complex applications, determining the design parameters and selecting the best options vs. the case study. Examples of real-life schematics will offer a good dictionary of solutions that the student can add to a library for future use in the real life. It will be then the time to go into some insights of the electronic design with a series of good and bad circuits to analyze and discuss,

exploiting what learned till now and being ready to understand what are the best practices of "the art of electronics".

Level 4: this module is intended as the natural final stage of the preceding learning. Here the student will learn Kicad, a cross platform and Open Source electronics design automation suite. We will start with the circuit schematics, then adding a physical footprint to each component , defining a set of PCB rules to respect while routing and finally designing the corresponding Printed Circuit Board, up to the generation of the fabrication output files ready to be sent to a PCB facility.

WHO

Teacher:

Marco Sartore, 3472207478, Via Roma 10 – 57030 Marciana (LI)

HOW

Teaching Methods

The students will be equipped with Kits containing breadboards, components and test instruments to practically experiment on the class' subjects. Personal Computers will NOT be available but are strongly recommended. Classes will be held in a Laboratory and formed by two intersected types:

- taught-lessons to offer a clear explanation of the theoretical foundations and methods of circuit design

- practical-lessons where students will be guided to physically realize the explained circuits using a set of provided components, performing all the measurements to test and verify them by means of provided instruments.

Exam Description

The students will be asked to design circuits, realize them in the Lab and demonstrate their proper operation with the necessary measurements. Drill problems will be submitted during the lessons and the Students will be asked to answer with short reports.

Assessment Methods

Continuous assessment throughout the course with verification of students' interest and care, plus a final evaluation of the exam result and reports.

WHERE AND WHEN

Lesson Location

Lessons will be done @ UNIGE

Lesson Schedule

Lessons will be offered during 4 weeks (from Tuesday to Friday) in January, February, March 2023, one module of 12 hours per week, with the following schedule (extremes included):

January	23th	Level 1	from 3 PM to 6 PM
January	24th	Level 1	from 9 AM to 12 AM and from 3 PM to 6 PM
January	25th	Level 1	from 9 AM to 12 AM
January	25th	Level 2	from 3 PM to 6 PM
January	26th	Level 2	from 9 AM to 12 AM and from 3 PM to 6 PM
January	27th	Level 2	from 9 AM to 12 AM
February	6th	Level 3	from 3 PM to 6 PM

February	7th	Level 3	f from 9 AM to 12 AM and from 3 PM to 6 PM
February	8th	Level 3	f from 9 AM to 12 AM
February	8th	Level 4	from 3 PM to 6 PM
February	9h	Level 4	f from 9 AM to 12 AM and from 3 PM to 6 PM
February	10th	Level 4	f from 9 AM to 12 AM

Office hours for students

Students can ask info to the teacher by phone, email or asking for an appointment.

CONTACTS

Students can write to sartore@elbatech.com or can freely phone to +393472207478 either to ask information or to arrange for an appointment.

*The course has an operational cost of € 250,00 for the Phd students and € 500,00 for external students. The cost for the Phd students will be covered using the Phd student budget.

Motion control drivers

Scientific Disciplinary Sector:

Number of hours: 48 (divided in 4 Levels of 12 hours each)

Credits: 3 per Level

AIMS AND CONTENTS

Learning Outcomes (short)

Level 1: Stepper Motors and their drivers - basics

Level 2: Stepper Motors advanced topics

Level 3: Brushless Motors and their drivers - basics

Level 4: Brushless Motors advanced topics

Learning Outcomes (further info)

Level 1: learning how a Stepper Motor is composed and how it must be correctly driven, combining its mechanical features with driver's requirements, up to the realization of a simple electronic circuit to interface a Stepper Motor.

Level 2: understanding the insights of fine drivers for Stepper Motors, learning microstepping techniques and their practical application in the physical realization of an advanced driver.

Level 3: understanding the structure of Brushless Motors as compared with the brushed ones, their driving needs and how to fulfill their requirements, with the practical realization of a simple driver using dedicated integrated circuits.

Level 4: learning the details of Brushless Motors drivers up to programming a microcontroller as the smart portion of an advanced driver.

Syllabus/Content

Level 1: students will learn the internal structure of a Stepper Motor and its physical pros and cons in motion control applications. Then we will focus on drivers and learn how to design a simple circuit making use of dedicated integrated circuits. Students will learn how to program a software to instruct the driver circuit, thus getting on-field experience of a practical application.

Level 2: students will exploit the acquired concepts into a more advanced design, where the driver will no longer be a dedicated IC but a programmable microcontroller or IC. They will then realize a real driver where micro stepping will be applied and they will get a fine positioning of the motor. Torque/speed and acceleration issues will be also addressed.

Level 3: this module will offer the basic details about Brushless Motors, including their internal structure and function. Students will learn which signals are needed to properly drive such motors and will design a simple real circuit to test in practice, making use of dedicated integrated circuits.

Level 4: as for Level 2 above, students will take advantage of the acquired concepts and skills towards a more complex design where they will learn how to implement all the blocks needed in a software for a microcontroller. Among these blocks they will figure out how to deal with Clarke and Park transforms and will finally realize an advanced driver to test in practice.

WHO

Teacher:

Marco Sartore, 3472207478, Via Roma 10 – 57030 Marciana (LI)

HOW

Teaching Methods

The students will be equipped with Kits containing the parts, components and motors to practically experiment on the class' subjects. Personal Computers will NOT be available but are strongly recommended.

Classes will be held in a Laboratory and formed by two intersected types:

- taught-lessons to offer a clear explanation of the theoretical foundations and methods of circuit design (at the various Levels enumerated above)

- practical-lessons where students will be guided to physically realize the explained circuits using a set of provided components, performing all the measurements to test and verify them by means of provided instruments.

Exam Description

The students will be asked to realize the described drivers in the Labs and to demonstrate their functioning when connected to a test motor, performing the necessary measurements. They will write a report describing the driver(s) and the related results.

Assessment Methods

Continuous assessment throughout the course with verification of students' interest and care, plus a final evaluation of the exam result and report.

WHERE AND WHEN

Lesson Location

Lessons will be done @ UNIGE

Lesson Schedule

Lessons will be offered during 4 weeks (from Monday to Thursday) in January, February, March 2023, one module of 12 hours per week, with the following schedule (extremes included):

June	5th	Level 1	from 3 PM to 6 PM
June	6th	Level 1	from 9 AM to 12 AM and from 3 PM to 6 PM
June	7th	Level 1	from 9 AM to 12 AM
June	7th	Level 2	from 3 PM to 6 PM
June	8th	Level 2	from 9 AM to 12 AM and from 3 PM to 6 PM
June	9th	Level 2	from 9 AM to 12 AM
July	10th	Level 3	from 3 PM to 6 PM
July	11th	Level 3	f from 9 AM to 12 AM and from 3 PM to 6 PM
July	12th	Level 3	f from 9 AM to 12 AM
July	12th	Level 4	from 3 PM to 6 PM
July	13th	Level 4	f from 9 AM to 12 AM and from 3 PM to 6 PM
July	14th	Level 4	f from 9 AM to 12 AM

Office hours for students

Students can ask info to the teacher by phone, email or asking for an appointment.

CONTACTS

Students can write to sartore@elbatech.com or can freely phone to +393472207478 either to ask information or to arrange for an appointment.

*The course has an operational cost of € 250,00 for the Phd students and € 500,00 for external students.
The cost for the Phd students will be covered using the Phd student budget.

C++ programming techniques

Scientific Disciplinary Sector: INF/01

Number of hours: 20

Credits: 6 CFU

AIMS AND CONTENT

Learning Outcomes (short)

This course introduces the specificities of C++ object oriented programming language and focuses on the use of C++ for the implementation of object-oriented software modules. In particular, programming techniques to tackle the issues of memory management, robustness and efficiency are considered.

Syllabus/Content

- Basic Facilities: The C and C++ languages: pointers, arrays, and structures. Functions. Namespaces and exceptions.
- Abstraction Mechanisms: Classes and objects. Operator overloading. Class hierarchies. Polymorphism. Templates.
- Case studies: Containers and algorithms. Iterators.

WHO

Teacher(s):

Fabio Solari, fabio.solari@unige.it, +39 010 3536756

Manuela Chessa, manuela.chessa@unige.it, +39 010 3536626

HOW

Teaching Methods

Classroom lectures with theory and examples.

Exam Description

The exam will consist in the development of a specific software module/application.

Assessment Methods

Discussion about the implemented software module. A short document describing the application is required.

WHERE AND WHEN

Lesson Location

@ UNIGE, via Dodecaneso 35

Lesson Schedule

January 30 – February 3, morning, a room at second floor, via Dodecanso 35.

CONTACTS

The teachers will be available on appointment (fabio.solari@unige.it manuela.chessa@unige.it)

Mechanical Drawing Fundamentals

Scientific Disciplinary Sector: ING-IND/15

Number of hours: 18 hours

Credits: 2 CFU

AIMS AND CONTENT

Learning Outcomes

This course provides an introduction to Mechanical Technical Drawing with mention to manufacturing techniques. The aim of the course is to give a base knowledge in understanding and preparing mechanical technical drawings, so there is no need of prior background of mechanical drawing.

Mechanical drawing is the main way to communicate design need to technicians, workshops, suppliers. A base knowledge of rules and methods helps the researcher, even if not directly engaged in mechanical design, to better contribute to interdisciplinary team working when involved in the design of experimental setups, scientific devices, and the writing/understanding of technical specifications.

Syllabus/Content

- **Introduction** (projection methods and orthogonal projections theory)
- **Technical Drawing Rules** (lines rules, sections, dimensioning)
- **Drawing for manufacturing** (proper dimensioning and prescriptions according to production method)
- **Tolerances and surface finish** (dimensional and geometrical tolerances, roughness)
- **Representation of main removable and non-removable connections** (welds, threads)

WHO

Teacher(s): Diego Torazza, +39 010 2897 231, Diego.Torazza@iit.it

HOW

Teaching Methods: Frontal lessons with projected slides

Exam Description: Written test with multiple answer questions

Assessment Methods: In order to obtain the CFU students need to be present at minimum 15 hours of lessons and successfully pass the written test.

WHERE AND WHEN

Lesson Location

Lesson will be held in the following classrooms: 9, 10, 11, 12/1: room B7; 13/1: room B9

Both are located in Via all'Opera Pia, B pavillion, 10 in this map:

https://www.perform.unige.it/images/Cyber/mappa_sede.pdf

Lesson Schedule

Monday, 9th January 2023, 9-13

Tuesday, 10th January 2023, 9-13

Wednesday, 11th January 2023, 9-13

Thursday, 12th January 2023, 9-13

Friday, 13th January 2023, 9-11

Office hours for student

The teacher is available on appointment by phone/mail.

CONTACTS

Teacher's office is located in:

Istituto Italiano di Tecnologia, CRIS

Via San Quirico 19 D, Genova.

+39 010 2897 231, Diego.Torazza@iit.it

Robotic Virtual Prototyping Design

Scientific Disciplinary Sector:

Number of hours: 18 hours

Credits: 6 CFU

AIMS AND CONTENT

Learning Outcomes (short)

The aim of the Robotic Virtual Prototyping Design course is to give the basic knowledge about the Finite Element Analysis (FEA) and Multi-Body Simulations (MBS) applied to the robotics. These computational techniques predict the behavior of physical systems: joined together permit to study the dynamics taking in account the body flexibility, the control and optimization. It will be introduced mainly applied to the mechanical field, in particular to the robotic anthropomorphic arm. The student gets 6 credits if he/she attends the entire course and accomplishes the final project.

Learning Outcomes (further info)

Virtual Prototyping Design is the basic part of the Computer Aided Engineering (CAE) that in the last decades involved more and more the R&D of the industries and the Research Centres. The reason is that the physical models need more time and energies for being improved than virtual ones. Moreover, running numerous simulations, these models permit to be optimized depending on several parameters.

Thus the course will give an overview on the virtual prototyping design building the models with the main worldwide mechanical numerical simulation software (MSC.Nastran, Ansys/Workbench and MSC.Adams). In the second part of the course, Multibody and Finite Element Analysis will be integrated in order to take the best advantage from the virtual prototyping technique and applied to some mechanisms and robot arms. Then the control (Matlab/Simulink) and the optimization (ModeFRONTIER) will be applied to the simulations.

Even if the training solutions concern the mechanical and robotic problems, it is designed to provide to attendants with both the comprehensive and subject-specific knowledge; the students need to effectively apply software tools to solve general problems: static, dynamic, linear, non-linear and motion or multi-physics analysis. So the aim of the course is not only knowing the performances of the software used to build the basic models, but it is also to be able to improve their skill by themselves.

Syllabus/Content

- class 1 (C1)
  - Overview on Virtual Prototyping: Finite Element Analysis (FEA), Multibody Simulation (MBS)
- class 2 (C2)
  - Anthropomorphic Arm Modelling (FEA+MBS)
- class 3 (C3)
  - Anthropomorphic Arm Modelling (MBS + FEA)
- class 4 (C4)
  - Anthropomorphic Arm Modelling (MBS + FEA + Co-Simulation Control)
- class 5 (C5)
  - Anthropomorphic Arm Modelling (MBS+ FEM + Co-Simulation Control+ Optimisation)
- class 6 (C6)
  - Final Project Assignment

WHO

Teachers:

Ferdinando Cannella *0102896562* *ferdinando.cannella@iit.it*
Mariapaola D'Imperio *0102896562* *mariapaola.dimperio@iit.it*

Teacher assistant:

Gabriele Marchello *0102896562* *gabriele.marchello@iit.it*

HOW

Teaching Methods

Methods

The course will be based on 6 traditional teacher-led mixed to hand-on lectures
Slides of the course will be provided before each lectures
Final project for the exam will be prepared with the teachers during the 6th lectures

Prerequisites

Basic knowledge: classical physics and programming.

Installed Software: MSC ADAMS, ANSYS/Workbench, MatLab/Simulink and ModeFRONTIER should be already installed before the lectures (the software will be provided by the teachers for those who have not got them).

Reading List

- Klaus-Jurgen Bathe, Finite Element Procedures, Prentice-Hall of India, 2009
- Robert D. Cook, David S. Malkus, Michael E. Plecha & Robert J. Witt, "Concepts and Applications of Finite Element Analysis", 4th Edition, John Wiley & Sons, 2001 (ISBN: 0 471 35605 0)
- Rajiv Rampalli, Gabriele Ferrarotti & Michael Hoffmann, Why Do Multi-Body System Simulation?, NAFEMS Limited, 2011
- R.J.Del Vecchio, Design of Experiments, Hanser Understanding Books, 1971.

Remarks

Weekly homework will be assigned at the end of each lecture with an estimated average workload of 1 hours per week. Nevertheless the Project Assignment has an estimated average workload of 1-2 days.

- the minimum attendance is 4 out 6 classrooms (the Project Assignment is not mandatory);
- the Project Assignment should be pass according to the policy.

Exam Description

- the minimum mark to pass the Project Assignment is 75%;
- the Project Assignment is due 4 weeks after they are assigned and should be done in a neat and orderly fashion on PowerPoint presentation following the template (provided with the Project Theme). Late submission will not be accepted;
- the project can be:
  1) standard project (proposed by teachers)
  2) project related to the student PhD project (proposed by the student)
  3) quick paper publication on a topic to be decided (teachers and student together)

Assessment Methods

The Students should provide the:

- kinematics, dynamics of the project mechanism with rigid and flexible component(s)
- numerical models, drawings and charts of comparison of these two conditions
- PowerPoint presentation (according to the provide template)

WHERE AND WHEN

Lesson Location

In presence: Istituto Italiano di Tecnologia, Via Morego 30 (Bolzaneto), Genova. The Meeting room will be communicate to the attendees two weeks in advance the course.
Online: via Teams call conference

Lesson Schedule

May 30, 2023 (09:30-12:30)
May 31, 2023 (09:30-12:30)
June 1, 2023 (09:30-12:30)
June 13, 2023 (09:30-12:30)
June 22, 2023 (09:30-12:30)
June 26, 2023 (14:30-17:30)

Office hours for student

The teachers will be available (on the office or on skype) every Wednesday morning from 11:00 to 14:30 from 1st July to the 31st July 2021

CONTACTS

The Teachers' office is in Unità di Robotica Industriale at 4th floor at Istituto Italiano di Tecnologia, Via Morego 30 (Bolzaneto), Genova.

Ferdinando Cannella *0102896562* *ferdinando.cannella@iit.it*
Mariapaola D'Imperio *0102896562* *mariapaola.dimperio@iit.it*

Mechatronics and AI

Scientific Disciplinary Sector:

Number of hours: 18 hours

Credits: 6 CFU

AIMS AND CONTENT

Learning Outcomes (short)

The aim of the Mechatronics and Artificial Intelligence (AI) course is to give the basic knowledge about AI and Deep Learning (DL) applied to mechatronics. The course will provide the students with an overview of AI, DL and the possible applications, and will focus in the last lectures on reinforcement learning (RL) techniques. AI, DL and especially RL can be adopted to control the behavior of mechatronic systems acting in complex environment, and solving tasks too hard to be tackled with traditional approaches. The student gets 6 credits if they attend the entire course and passes the final project.

Learning Outcomes (further info)

Understanding mechatronics is becoming essential for the engineers of today since almost all automation systems, from industries to home appliances, utilize mechatronics for their proper functioning. A proper understanding of the modeling of mechatronics systems gives us a powerful tool to improve the performances of our systems.
At the same time, traditional modeling methodologies sometimes are too complex to be implemented. One may use another powerful tool developed in recent years that can come to the rescue there, named Artificial Intelligence. Although AI in itself is a very diverse topic, with many applications, the course will focus on obtaining an overview about AI and machine learning and how we can apply AI to aid in the control of mechatronic systems.
The course will provide a foundation for the students to explore modeling and design of AI methodologies, expanding their understanding and horizons. Python and Keras will be used for design exercises.

Syllabus/Content

- class 1 (C1)
  - Introduction to Artificial Intelligence and Deep Learning
- class 2 (C2)
  - Neural Network and Deep Learning
- class 3 (C3)
  - Deep Learning ethics and potential
- class 4 (C4)
  - Reinforcement Learning
- class 5 (C5)
  - Deep Reinforcement Learning
- class 6 (C6)
  - Final Project Assignment and Development

WHO

Teachers:

Ferdinando Cannella *0102896562* *ferdinando.cannella@iit.it*
Gabriele Marchello *0102896562* *gabriele.marchello@iit.it*

HOW

Teaching Methods

Methods

The course will be based on 6 traditional teacher-led mixed to hand-on lectures
Slides of the course will be provided before each lectures
Final project for the exam will be prepared with the teachers during the 6th lecture

Prerequisites

Basic knowledge: classical physics and programming.

Installed Software: Python will be used, it is preferable if the students have Conda/Anaconda installed, otherwise a quick installation guide will be given before the lectures.

Reading List

- Hands-On Machine Learning with Scikit-Learn, Keras, and Tensorflow: Concept, Tools, and Techniques to Build Intelligent Systems, Aurelien Geron, O'Reilly 2019
- Reinforcement Learning: Industrial Applications of Intelligent Agents, Phil Winder, O'Reilly, 2020

Remarks

Weekly homework will be assigned at the end of each lecture with an estimated average workload of 3 hours per week. Nevertheless the Project Assignment has an estimated average workload of 2-3 days.

- the minimum attendance is 4 out 6 classrooms;
- the Project Assignment should be passed according to the policy.

Exam Description

- the minimum mark to pass the Project Assignment is 75%;
- the Project Assignment is due 10 weeks (31st August 2022) after they are assigned and should be done in a neat and orderly fashion on PowerPoint presentation following the template (provided with the Project Theme). Late submission will not be accepted;
- the project can be:
  1) standard project (proposed by teachers)
  2) project related to the student PhD project (proposed by the student)
  3) quick paper publication on a topic to be decided (teachers and student together)

Assessment Methods

The Students should provide the:

- Solutions of AI-based problems
- PowerPoint presentation (according to the provided template)

WHERE AND WHEN

Lesson Location

Online: via Teams call conference (the students will receive the link)

Lesson Schedule

June 19, 2023 (09:30-12:30)
June 20, 2023 (09:30-12:30)
June 21, 2023 (09:30-12:30)
June 26, 2023 (09:30-12:30)
June 27, 2023 (09:30-12:30)
June 28, 2023 (09:30-12:30)

Office hours for student

The teacher will be always available via email, with the possibility to schedule one-to-one meetings.

CONTACTS

The Teachers' office is in Unità di Robotica Industriale at 4th floor at Istituto Italiano di Tecnologia, Via Morego 30 (Bolzaneto), Genova or via TEAMS.

Ferdinando Cannella *0102896562* *ferdinando.cannella@iit.it*
Gabriele Marchello *0102896562* *gabriele.marchello@iit.it*

Robot behaviour modelling

Scientific Disciplinary Sector: ING-INF/04 OR ING-INF/05 OR ING-INF/06 OR any other valid code

Number of hours: 16 hours (12 class, 4 lab exercises)

Credits: 4

AIMS AND CONTENT

Learning Outcomes

The students will be able to successfully design robot behaviors by combining simple robot's skills, with a special focus on manipulation and navigation skills. The student will also be able to identify the correct behavior modeling tools that fit best a use case.

Syllabus/Content

Topics covered include:

- Introduction to robot behavior modelling
- Quick introduction to ROS2 and Docker
- Finite state machines
- Behavior Trees
- Challenges in task and motion planning

The course requires basic knowledge of C++ (from C++11) and ROS (either ROS1 or ROS2).

WHO

Teacher(s):

Name: Michele Colledanchise

Phone number: +39 010 2898 211

Email: michele.colledanchise@iit.it

HOW

Teaching Methods:

The course consists of classroom (with the remote attendance option) lectures and lab exercises.

Exam Description:

The exam consists of a small project, with a technical report, to be carried out by each student individually.

Assessment Methods:

The teacher will evaluate the project and the technical report

WHERE AND WHEN

Lesson Location

IIT-CRIS (Center for Robotics and Intelligent Systems) @ Natta Room, Via San Quirico 19D, 16163 Genova

Lesson Schedule

January 16, 09:30 12:30 Introduction, past and modern robot behavior modeling

January 17 09:30 12:30 Behavior Trees design

Monday 18 09:30 12:30 Architecture for reactive robot behaviors

Tuesday 19 09:30 12:30 Experimental setup with ROS2

Thursday 20 09:30 13:30 Lab exercises and hands on examples

CONTACTS

The teacher is available via email.

Advanced EEG analyses (aEEGa)

Scientific Disciplinary Sector: ING-INF/06

Number of hours: 15 hours

Credits: 5 CFU

AIMS AND CONTENT

Learning Outcomes (short)

Learn how to analyze EEG data, starting from artefact removal from raw data to the group statistical analysis of both sensors' and sources' data.

Learning Outcomes (further info)

The present course will introduce the student to the most advanced technique to process the EEG signal and infer over the cortical areas that create it. The course will consist on a first part based on sensors analysis and a second part on distributed sources analysis. Analysis will be performed in both the time and time-frequency domain and will be performed within the Matlab and R environments, using a semi-automatic analysis framework developed in the RBCS department.

Syllabus/Content

- Class 1 (3h) EEG signal origin and spatial-temporal-spectral characteristics. Data recording, preprocessing (referencing, filtering and epoching) and artefact removal through independent analysis as implemented in EEGLAB. *Teacher Alberto Inuggi and Claudio Campus*.
- Class 2 (2h) Electrode analysis of ERP. Peak analysis, clustering electrodes and averaging time interval. Subject and group level analysis. Statistical analysis in EEGLAB and R. *Teacher Claudio Campus.*
- Class 3 (2h) Spectral analysis of ERSP. Peak analysis, clustering electrodes and averaging time interval. Subject and group level analysis. Statistical analysis in EEGLAB and R. *Teacher Claudio Campus.*
- Class 4 (2h) Introduction to EEG source analysis. Theory, forward model and inverse problem resolution. Differences between dipoles and distributed source analysis. Alternative models. *Teacher Alberto Inuggi.*
- Class 5 (3h) Results post-processing (dimensionality reduction) approaches. Source analysis in Brainstorm. *Teacher Alberto Inuggi.*
- Class 6 (3h). Statistical analysis in SPM. Comparison between EEG, fMRI and TMS tools. Final Examination. *Teacher Alberto Inuggi and Claudio Campus.*

WHO

Teacher(s):

Alberto Inuggi alberto.inuggi@gmail.com

Claudio Campus**,** +39 010 2097 208**,** claudio.campus@iit.it

HOW

Teaching Methods:

Projected slides

Exam Description:

Students will undergo a 45 minutes written examination consisting in 30 multiple selection questions. 15 questions will regard sensors analysis, 15 the source analysis part.

Assessment Methods:

In order to obtain the 5 CFU, students are expected to correctly answer to a total of at least 18 questions. Moreover, at least 7 correct answers for each of the two section (sensors and sources) are required.

WHERE AND WHEN

Lesson Location

Lessons will be either done remotely through Teams platform or at Center for Human Technologies, Via Enrico Melen 83, Building B,16152 Genova, Italy, IIT Erzelli. In the latter case, the exact room will be later indicated.

Lesson Schedule

TBA

Office hours for student

Students enquires about course content and organization should be sent by e-mail. Personal appointment shall be arranged when necessary.

CONTACTS

Students should preferably interact with the teachers by e-mail.

Research Oriented Structural and Functional Neuroimaging

Scientific Disciplinary Sector: ING-INF/06

Number of hours:15 hours

Credits:5 CFU

AIMS AND CONTENT

Learning Outcomes (short)

The present course will review the current neuroimaging methodologies used to extract in-vivo information over functional and structural organization of human brain. The aim of the course is teaching students how to read and understand most of the current neuroimaging literature. No practical analysis techniques will be presented.

Learning Outcomes (further info)

Medical Imaging was born in 1895 when Roentgen, while experimenting with the peculiar radiation he had just discovered, asked his wife to place the left hand over a photographic plate. Relatively little progress followed until about 1970, when the cost/performance ratio of electronics and computing equipment made digital imaging possible. As a result, almost at the same time, echography, computed tomography and nuclear medicine blossomed and then melted: radiology gave place to medical imaging. Around mid/end of 80's two further steps were done with the discovery of the BOLD effect and the development of the Diffusion MRI technique. With the former the scanner could be programmed to obtain non-invasive maps of functional brain activity, with the latter it became possible to assess the path and the integrity of the white-matter bundles that connect the different brain areas. Neuroimaging was born and rapidly became the most powerful and influencing research approach in neuroscience and a fundamental tool for clinical diagnoses.

The goal of the course is to give a broad perspective of the main neuroimaging technologies available today. The course will concentrate on the most used technique in clinical and research context with the clear aim to enable each student to easily read and understand a neuroimaging paper. Special attentions will be given to those non-invasive techniques able to estimate the structural and functional properties of human brain. Among the former, we will introduce the voxel based morphometry (VBM) and the cortical thickness (CT) to assess the status of gray matter and two post-processing approaches of the diffusion tensor imaging, the tracto-based spatial statistic (TBSS) and the tractograpy, used to assess the integrity of the white matter fibers bundles. Among the former, we will focus on functional MRI, introducing the independent component analysis to extract the cortical networks present at rest and the methods to assess task-related cortical activation. Finally, a comparison between fMRI and EEG methods to reconstruct cortical activity will be shown, together with a brief introduction to structural and functional connectomics.

Syllabus/Content

- Class 1 (3h). Common MRI preprocessing steps. Structural MRI.
  - Evaluating gray matter: density (VBM)
- Class 2 (3h). Structural MRI. Evaluating gray matter:
  - Cortical Thickness

  Pediatric templates, longitudinal coregistration
- Class 3 (3h) Structural MRI. Evaluating white matter. Diffusion Images analysis,
  - TBSS
  - Tractography

  Functional MRI. Origin of the BOLD signal, fMRI vs EEG comparison. *(Teacher Alberto Inuggi)*
- Class 4 (3h) Functional MRI at rest. Brain functional connectivity (FC).
  - Within networks FC (Melodic analysis).
  - Whole brain FC (seed-based FC)
  - simple (fslnets) and advanced (connectomics) between network FC

- Class 5 (3h) Functional MRI during a task. Task-based FC (DCM, PPI) and fMRI.
  Epi correction within high field scanners
  Final Examination.

WHO

Teacher(s):

Alberto Inuggi, alberto.inuggi@gmail.com

HOW

Teaching Methods

Projected slides

Exam Description

Students will undergo a 45 minutes written examination consisting in 30 multiple selection questions.

Assessment Methods

In order to obtain the 5 CFU, students are expected to correctly answer to a total of at least 18 questions.

WHERE AND WHEN

Lesson Location

Location will be defined according to students' number and affiliation

Lesson Schedule

April 10, 2023 (10:00-13:00)

April 12, 2023 (10:00-13:00)

April 14, 2023 (10:00-13:00)

April 17, 2023 (10:00-13:00)

April 19, 2023 (10:00-13:00)

Office hours for student

Students enquires about course content and organization should be sent by e-mail. Personal appointment shall be arranged when necessary.

CONTACTS

Students should preferably interact with the teachers by e-mail.

An introduction to modern neurophysiology: bridging experimental tools and computational strategies to unlock the brain

Scientific Disciplinary Sector:

Number of hours: 12 (including assessment)

Credits: 4

AIMS AND CONTENT

Learning Outcomes

The recent convergence between experimental and computational tools is vital to uncover fundamental principles of brain function that have been inaccessible for decades.

Dramatic technological developments have recently allowed neurophysiologists to measure and manipulate brain activity from more individual neurons than ever, simultaneously. Such experiments provide a complex and multidimensional picture of the brain. To navigate such complexity, new data-analysis approaches, as well as theoretical tools, must be developed. By the end of the course, students will have:

1. Learnt about the principles at the basis of the most advanced techniques currently used in neurophysiology (focus on in vivo microscopy, optogenetics, large scale electrical recordings);
2. Explored the most relevant mathematical models of single neurons and neuronal networks, and **worked hands-on** to test them;
3. Gained knowledge of computational strategies to analyze high-dimensional neural data obtained with the techniques in *outcome 1*;
4. Familiarized with relevant literature where computational methods are applied to the analysis of neurobiological data.

Syllabus/Content

The course includes both a theoretical and a practical part. Overall, students will learn how to apply computational methods to the modelling and the analysis of neurophysiological data obtained using the most advanced experimental tools currently available.

h1: single neuron physiology (from action potentials to synapses);

h2: single neuron models of the brain (LIF and generalized LIF) - includes programming homeworks;

h3: modeling synapses, neuronal networks, connectivity matrices - includes programming homeworks;

h4 to h6: the optical revolution: from microscopy to optogenetics, the new tools to read and write brain; activity at high resolution;

h7 to h8: information theoretical strategies applied to the analysis of large-scale brain recordings;

h9 to h10: group presentations and discussion of few seminal papers that have combined experimental and computational strategies to link brain activity to behaviour.

Final assessment

WHO

Teacher(s):

Roberto Maffulli – Istituto Italiano di Tecnologia – roberto.maffulli@iit.it

Mariangela Panniello – Istituto Italiano di Tecnologia – mariangela.panniello@iit.it

HOW

Teaching Methods:

In person or online classes (depending on covid-19 emergency) including 1) presentation slides, 2) group discussion, 3) guided programming tasks (MATLAB).

Exam Description:

The final exam will consist in:

1) A programming task to be carried out by students at home in their own time;
2) A written work including a multiple-choice questionnaire and a brief discussion of a research article (2 hours to be allocated)

Assessment Methods:

Interest and active participation to the classes will be assessed throughout the course.

Students must be able to at least set up, and possibly complete, the programming assignement.

Minimum 75% correct answers in the quastionnaire.

WHERE AND WHEN

Lesson Location

TBA

Lesson Schedule

February 20, 2023 (09:00-12:00)

February 21, 2023 (09:00-11:00)

February 22, 2023 (09:00-11:00)

February 23, 2023 (09:00-11:00)

February 24, 2023 (09:00-12:00)

CONTACTS

Roberto Maffulli – Istituto Italiano di Tecnologia, Via Enrico Melen, 83 - Genova – roberto.maffulli@iit.it

Mariangela Panniello – Istituto Italiano di Tecnologia, Via Morego, 30 - Genova – mariangela.panniello@iit.it

Trustworthy Artificial Intelligence

Scientific Disciplinary Sector: ING-INF/05

Number of hours: 20

Credits:5

AIMS AND CONTENT

Learning Outcomes

It has been argued that Artificial Intelligence (AI) is experiencing a fast process of commodification. This characterization is of interest for big IT companies, but it correctly reflects the current industrialization of AI. This phenomenon means that AI systems and products are reaching the society at large and, therefore, that societal issues related to the use of AI and Machine Learning (ML) cannot be ignored any longer. Designing ML models from this human-centered perspective means incorporating human-relevant requirements such as reliability, fairness, privacy, and interpretability, but also considering broad societal issues such as ethics and legislation. These are essential aspects to foster the acceptance of ML-based technologies, as well as to be able to comply with an evolving legislation concerning the impact of digital technologies on ethically and privacy sensitive matters.

Syllabus/Content

- Trustworthy AI;
- Reliable AI: Sensitivity Analysis, Robustness, Non-Regressivity, and Adversarial Machine
- Learning;
- Fair AI: from Pre-, In-, and Post-Processing Models to Learn Fair Representations;
- Private AI: Anonymization, Federated Learning, Differential Privacy, Homomorphic
- Encryption;
- Interpretable/Explainable AI: making models more understandable.

References:

- L. Oneto, et al. Towards learning trustworthily, automatically, and with guarantees on graphs: an overview. Neurocomputing, 2022
- Winfield, A. F. et al. "Machine ethics: the design and governance of ethical AI and autonomous systems." Proceedings of the IEEE 107.3 (2019): 509-517.
- Floridi, L. "Establishing the rules for building trustworthy AI." Nature Machine Intelligence 1.6 (2019): 261-262.
- L. Oneto and S. Chiappa. Fairness in machine learning. Recent Trends in Learning From Data. Springer, 2020
- Biggio, B. and Roli F. "Wild patterns: Ten years after the rise of adversarial machine learning." Pattern Recognition 84 (2018): 317-331.
- Guidotti, R. et al. "A survey of methods for explaining black box models." ACM computing surveys (CSUR) 51.5 (2018): 1-42.
- Liu, B. et al. "When machine learning meets privacy: A survey and outlook." ACM Computing Surveys (CSUR) 54.2 (2021): 1-36.

WHO

Teacher(s):

Luca Oneto

email: luca.oneto@unige.it

How

Teaching Methods:

Frontal Lessons

Exam Description:

Small presentation (max 30 min) on how the concepts presented in the course ca be used/extended during the student PhD.

Assessment Methods:

Students will be evaluated based on their ability to understand and apply the concepts of the course on a real problem.

Where and When

Lesson Location

Lessons will be performed @ UNIGE. Room to be confirmed.

Lesson Schedule

July 10, 2023 (08:00-12:00)

July 11, 2023 (08:00-12:00)

July 12, 2023 (08:00-12:00)

July 13, 2023 (08:00-12:00)

July 14, 2023 (08:00-12:00)

Office hours for student

On appointments scheduled by email luca.oneto@unige.it

Contacts

On appointments scheduled by email luca.oneto@unige.it

More details at the page https://www.lucaoneto.it/teaching/tpld

An introduction to Body-Machine Interface

Scientific Disciplinary Sector: ING-INF/06

Number of hours: 12 hours

Credits: 4 CFU

AIMS AND CONTENT

Learning Outcomes (short) The course will introduce the field of body-machine interface (BoMI). It will present different concepts for dimensionality reduction to be applied in the domain of biological signals to control external devices. It will also discuss current scientific and technological perspectives and limitations.

Emphasis will be given to the study of the learning process while using a BoMI both from a modeling and from a data analysis point of view.

Learning Outcomes (further info) Controlling an external device, like a computer or a robotic manipulator, can play a crucial role in improving lives of individuals especially assisting those with motor impairments (Beckerle et al 2017, Park et al 2020) or augmenting the abilities of healthy people (Penaloza et al 2018, Guggenheim et al 2020). In recent years, body-machine interfaces (BoMIs) through a linear or non-linear mathematical function have been proven to be able to transform body signals issued by the user into 2D/3D signals to control an external device like a cursor on a screen (Casadio et al 2011), a virtual and real wheelchair (Thorp et al 2016) or a virtual robotic arm (Rizzoglio et al 2020), and it could be customized to fit the ability of each user.

Syllabus/Content The first part of the course will introduce the general concept of redundancy and its application in body-machine interface and we will do an interactive discussion on the state of the art, highlighting perspective and limitations. We will then analyze more in details linear and non-linear dimensionality reduction techniques to map body movement into a control command for an external device.

In the second part we will approach the BoMI from a modeling point of view, trying to understand how humans solve the dimensionality reduction problem and how they deal with the redundancy while learning to use a BoMI.

WHO

Teacher(s):

Name: Camilla Pierella

Email: camilla.pierella@edu.unige.it

HOW

Teaching Methods

Lectures with theory and examples

Exam Description

There will be a final examination decided by the instructor

Assessment Methods

The teacher will evaluate the final examination

WHERE AND WHEN

Lesson Location

The lessons will be done @ UNIGE. Room to be confirmed.

Lesson Schedule

July 17, 2023 (14:30-17:30)

July 18, 2023 (14:30-17:30)

July 19, 2023 (14:30-17:30)

July 20, 2023 (14:30-17:30)

Office hours for student

Students can ask info to the teacher by appointments or through e-mail

CONTACTS

camilla.pierella@edu.unige.it

The 3Rs approach in biomedical research and advanced 3D in vitro tissue models.

Scientific Disciplinary Sector: ING-IND/34

Number of hours: 12 hours

Credits: 4 CFU

AIMS AND CONTENT

Learning Outcomes

Replacement, Reduction, and Refinement:

3Rs methods are becoming an essential element in the whole field of biomedical research, from its most fundamental aspects to its daily applications. Today 3Rs methods represent a multidisciplinary scientific area comprising animal science, basic biology, test development, pharmacology, toxicology, regulations and regulatory practices, as well as ethics and behavioral sciences. The aim of the course is to raise consciousness for the scientific soundness of the 3Rs methodology.

Advanced 3D in vitro models:

Bioprinting can be applied to engineer 3D in vitro tissue models by mimicking the structure and function of native tissue through the precise assembly of materials and cells. This approach allows the spatiotemporal control over cell–cell and cell–extracellular matrix communication and thus the recreation of tissue-like structures. Tissue models are applied in regenerative medicine, pharmaceutical, diagnostic, and basic research, reducing the use of laboratory animals according to the 3Rs principle.

According to European Directive 2011/63/eU1, all personnel working with experimental animals should be educated to be competent to work with animals.

Syllabus/Content

The topics cover the 3Rs principle, basic research, toxicological applications, method development and validation, regulatory aspects, case studies and ethical aspects of 3Rs approaches.

- Drivers for the change towards 3Rs
- The 3R concept
- Regulatory testing, validation and applicability domains
- Scaffold free in vitro models: spheroids, organoids and assembloids.
- Scaffold supported in vitro models: 3D bioprinting and microfluidics.

WHO

Teacher(s):

Laura Pastorino, 0103536547, laura.pastorino@unige.it

Donatella Di Lisa, 0103536547, Donatella.Dilisa@edu.unige.it

HOW

Teaching Methods:

Frontal lessons and lab activities

Exam Description:

The course will be assessed by a lab project

Assessment Methods:

Evaluation of the lab project

WHERE AND WHEN

Lesson Location

@ UNIGE Room to be confirmed

Lesson Schedule

July 17-18-19 2023 (09:00-13:00)

CONTACTS

laura.pastorino@unige.it

Donatella.Dilisa@edu.unige.it

Polymers an biopolymers for sustainable future

Scientific Disciplinary Sector: ING-IND/22

Number of hours: 12

Credits: 6

AIMS AND CONTENT

Learning Outcomes

Polymers are ubiquitous materials due to their broad range of properties, light weight and low cost. In this PhD course, we will show the main reasons that determine the final properties of polymers and how polymer composites can further expand the properties and applications of the base materials. We will describe techniques and methodologies for their fabrication, modification and characterization. Applications in the in packaging will be discussed.

The fabrication methods include standard synthetic and manufacturing (e.g., extrusion, injection molding…) processes.

The characterization ranges from spectroscopies, to investigate the chemical composition, the polymer structure and the molecular arrangement, to the characterization of macroscopic mechanical, thermal and functional properties.

The end-of-life of polymeric material and their environmental sustainability will be discussed.

An overview of the applications of polymers and their composites in different fields, such as food packaging and circular economy, will be presented.

Objectives of this course are the description of the synthetic methodologies and the experimental techniques used for polymer preparation and characterization. The approach is very applied, starting from some samples concerning the fabrication of the most commonly used polymers and the theory for each technique, leading to practical strategies for material testing, result interpretation and device design.

Syllabus/Content

Polymer preparation methods: synthetic routes for the fabrication of polymers from both a lab and industrial scale point of view. Different manufacturing processes and strategies for polymer synthesis will be shown and discussed.

Physical-Chemical characterization: UV/VIS, infrared and Raman spectroscopies and nuclear magnetic resonance, thermal characterization, X-ray diffraction, tests for mechanical and electrical properties, wetting properties.

Approaches to design polymeric materials with improved sustainability: substitution of raw materials with renewable components and strategies to improve their end-of-life: recyclability, biodegradation, composting. End of life of polymeric material and their recyclability.

Fabrication methods: Different fabrication methods, for both lab and industrial scale production, such as spray coating, dip coating, injection molding, extrusion etc will be discussed.

Sustainable packaging: we will discuss the development of sustainable materials and the physical properties they must possess for efficient food packaging and smart packaging (wetting properties, oxygen/water vapour permeability etc).

Naturally-derived polymers: chemical structures and physico-chemical properties of natural polysaccharides and protein-based materials will be presented, together with their supply and extraction processes. Basic concept of polymeric chain conformation and secondary structures will be reviewed, as closely related to the processing and usage of naturally-derived materials. A panoramic of the applications of natural polymers in various fields (such as medical, pharmaceutical, tissue engineering, biosensors, cosmetics) will be given.

WHO

Teacher(s):

Giovanni Perotto, giovanni.perotto@iit.it; 010 71781 773

Evie Papadopoulou, paraskevi.papadopoulou@iit.it; 010 71781 705

HOW

Teaching Methods:

Lectures

Exam Description:

The examination consists in a written test (multiple-choice and open-ended questions).

Assessment Methods:

Formative assessment (feedback with the students by oral questions during lessons).

WHERE AND WHEN

Lesson Location

Lessons will be done @ IIT

Lesson Schedule

Lessons will be in April 2023. Specific dates will be decided in Ferbuary (6 sessions of 2 hours).

CONTACTS

Teachers' offices are in the 4th floor of the IIT building (via Morego 30, 16163, Genova). Students asking info to the teachers can contact them by email anytime.

Cognitive Robotics for Human-Robot Interaction

Scientific Disciplinary Sector:

Number of hours: 15 hours

Credits: 5 CFU

AIMS AND CONTENT

Learning Outcomes (short)

The participants will learn the key aspects regulating the interaction between human and robots, and will have an overview of good features and limitations of currently available platforms for HRI. Students will learn how to conduct an HRI study and which metrics are appropriate to characterize the interaction.
Participants will be provided with an overview of some computer vision useful to make robots able to understand the nonverbal behaviors of the human partner (e.g. facial expressions and body movements) and other perceptual models of cognitive robotics. Further the participants will be provided with an overview on how actions can close the action-perception loop with human partners and how these models integrate in broader cognitive architectures for HRI. The survey across cognitive models of perception and action will give to the participants the opportunity to successfully design new behaviors for interacting robots.
Moreover, participants will have the chance to program the humanoid robot iCub.

Learning Outcomes (further info)

In this course the students will learn the different roles a robot could play in the context of human-robot interaction, as for instance the tutor, the collaborator, the companion or the tool of investigation, and the corresponding different models of interaction. The course is aimed at providing a clear understanding of what are the good features and limitations of the robotic platforms currently available.
The students will learn how to use computer vision and machine learning techniques to endow the robot with the capability of understanding human behaviors (for instance motion and facial expressions) that are relevant in a natural human-robot interaction.
The participants will learn how to design and implement robot perceptual, motor abilities structured in a cognitive framework for natural human-robot interaction, and will have the chance to learn how to program the humanoid robot iCub.

Syllabus/Content

- Taxonomy and Open Challenges for HRI
- The importance of Robot Shape, Motion and Cognition
- Metrics and Experimental Design
- Computer Vision for HRI
- Models of Robot Perception and Action in HRI
- Software Development of perception and action models in HRI

WHO

Teacher(s):

Francesco Rea, Francesco.Rea@iit.it

Alessandra Sciutti Alessandra.Sciutti@iit.it

HOW

Teaching Methods:

The course will be structured as a series of frontal lessons progressing from an introduction to the basis of HRI to the specific description of the principal methodologies supporting the analysis and the realization of effective HRI. It will be proposed to the students to proactively participate as groups in short exercise and practical sessions or in group discussions addressing the topics of the lectures.

Exam Description:

At the end of the course the students will be involved in designing either an HRI experiment or practical solutions for specific HRI case studies. The participants will work together in small groups of 3/4 persons and will have to leverage on the methods learned during the previous lessons in order to provide an effective solution to the proposed HRI problem.

Assessment Methods:

The teachers will assess the effectiveness and appropriateness of the HRI solution or HRI experiment designed during the exam. The assessment will take in consideration how the students selected and implemented the techniques learnt during the course.

WHERE AND WHEN

Lesson Location

The lessons will take place at the Italian Institute of Technology, Center for Human Technologies (room to be defined) and at the same time the students will be provided with the possibility to attend from remote.

Lesson Schedule

September 4, 2023 (09:00-12:00)

September 5, 2023 (09:00-12:00)

September 6, 2023 (09:00-12:00)

September 11, 2023 (09:00-12:00)

September 12, 2023 (09:00-12:00)

Office hours for student

Office time is flexible and the student can agree with the teacher an appointment by sending an email either to

Francesco.Rea@iit.it, Alessandra.Sciutti@iit.it

CONTACTS

The offices are located at

Robotics Brain and Cognitive Sciences Unit (RBCS) and
COgNiTive Architecture for Collaborative Technologies Unit (CONTACT)
Istituto Italiano di Tecnologia
Center for Human Technologies
Via Enrico Melen 83, Building B
16152 Genova, Italy

Microfluidics and nanofluidics: theory, methods, and applications

Scientific Disciplinary Sector: ING/INF01, ING/INF06, FIS/07

Number of hours: 12 hours

Credits: 4 CFU

AIMS AND CONTENT

Learning Outcomes

This course is intended for Ph.D. students interested in a better understanding of microfluidics and its integration with other scientific fields such as optics, electronics, or nanotechnologies, enabling new applications in several fields such as spectroscopy, microscopy, biology, and robotics.

The course illustrates operational principles and functionalities of advanced microfluidics systems through physics and various examples. No prerequisites are required.

Syllabus/Content

The course is divided into four sections: 1) Introduction to microfluidics: history, definitions, and fundamental concepts; 2) Microfluidics: the physics of liquids below the microliter scale; 3) Manufacturing technologies materials; 4) applications: sensors, optics, electronics, microscopy, biology.

WHO

Teacher(s):

Dr. Eleonora Perego, +39 3338423226, eleonora.perego@iit.it

Dr. Salvatore Surdo, +39 010 28961, salvatore.surdo@iit.it,

HOW

Teaching Methods:

Remotely with PPT and in presence.

Exam Description

Short thesis or project proposal (2 pages max) dealing with the contents of the course.

Assessment Methods:

Evaluation of the thesis/proposal

WHERE AND WHEN

Lesson Location

Class will take place remotely on Teams and at CHT Erzelli, Istituto Italiano di Tecnologia, Via Enrico Melen 83, Building B, 16152 Genova, Italy, 10th floor;

Lesson Schedule

May 15, 17, 19, 22, 24

CONTACTS

Office hours for student

Ask for an appointment via email

Office: CHT Erzelli, Istituto Italiano di Tecnologia, Via Enrico Melen 83, Building B, 16152 Genova, Italy, 10th floor; E-mail: salvatore.surdo@iit.it, eleonora.perego@iit.it

Functional quantitative assessment in sport, ergonomics and rehabilitation

Scientific Disciplinary Sector: ING-INF/06

Number of hours: 12 hours

Credits: 4 CFUs

AIMS AND CONTENT

Learning Outcomes

The present course will introduce the topic of functional quantitative assessment. This subject is becoming fundamental in all the fields where is important to understand human sensorimotor performance and in general in all the applications where the human is physically in the loop, such as collaborative robotics, wearable robotics, rehabilitation robotics, and many others. The difficulty to quantify human performance is due to the complexity of human behaviour. In fact, the human nervous system is capable of a simultaneous, integrated, and coordinated control of 100-150 mechanical degrees of freedom via tensions generated by about 700 muscles. There is also a different number of sensors (visual, auditory, proprioceptive) and actuators (muscles and skeletal system) to take into account.

The course will initially review the traditional techniques adopted to quantitatively assess human sensorimotor performance in the fields of sport, rehabilitation and ergonomics. In the second part of the course will be deeply analysed all the potential technologies that can be exploited to innovate the traditional techniques, with special emphasis on robotic technologies.

Syllabus/Content

- The concept of functional quantitative assessment and the application scenarios
- Lower limb traditional techniques
- Upper limb traditional techniques
- Lower limb robot-based techniques
- Upper limb robot-based techniques
- New trends and potential future technologies

WHO

Teacher(s): Jacopo Zenzeri, 3408311387, jacopo.zenzeri@rewingtech.com

HOW

Teaching Methods:

Slide presentation and critical discussion of a reading list
No Prerequisites
Reading List: Specific readings will be assigned for each class.

Exam Description:

There will be a final examination decided by the instructor and communicated to the students at the beginning of the course, after contacting the students and evaluating their background.

Assessment Methods:

The assessment method will be decided by the instructor and communicated to the students at the beginning of the course.

WHERE AND WHEN

Lesson Location

DIBRIS, University of Genova (room to be decided)

Lesson Schedule

June 23,29, 30 2023, time 14-18

CONTACTS

Jacopo Zenzeri, ReWing s.r.l., 6th floor, Via XII Ottobre 1, 16121, Genova, 3408311387, jacopo.zenzeri@rewingtech.com

Photocatalysis and photocatalytic materials

Scientific Disciplinary Sector: ING-IND/22

Number of hours: 12

Credits: 4

AIMS AND CONTENT

Learning Outcomes

Photocatalysts are the type of materials for the exploitation of solar energy to produce a chemical reaction. Therefore, they have been widely used to absorb light and carry out the reactions in CO_2 reduction, hydrogen production, water contaminant degradation, biomass waste photoreforming, etc. In this PhD course, we will discuss the basic concepts of photocatalysis and the approaches to enhance the performance of photocatalysts in absorbing sunlight. Moreover, their synthesis methods, characterization techniques, and application in green energy production and antibacterial properties will be considered. Consequently, the learning outcome is expected to be as follows:

- The overall performance of photocatalysts.
- The principles of using different methods, such as using metal or non-metal dopants in the structure of photocatalysts or preparing Z-scheme photocatalysts to boost the efficiency of the semiconductors in absorbing sunlight.
- The synthesis methods of photocatalysts from a lab and industrial scale point of view.
- Various structural and morphological characterization methods for evaluating the so-synthesized photocatalysts.
- Application of photocatalysts in the production of hydrogen as a storable, fossil-free energy source.
- Applications of photocatalysts as antibacterial materials.

Syllabus/Content

- **Concept of single-component photocatalysts**: The performance of semiconductors in absorbing light and electron-hole excitation will be discussed. The concept of band gap energy, valance band, conduction band, charge carrier separation, work function, fermi levels, etc., will be described.
- **Approaches in enhancing the performance of single-component photocatalysts**: Different methods, such as doping metal or non-metal to the structure of photocatalysts and preparing the Z-scheme heterojunctions from coupling two semiconductors, will be discussed. The mechanism of each method in reducing the bandgap of photocatalysts, separating electron-hole, and finally increasing the overall performance of the system will be demonstrated with the schematic figures.
- **Synthetic methods:** The widely used synthesis methods, such as the sol-gel process, hydrothermal and solvothermal techniques, direct oxidation reactions, sonochemical methods, microwave methods,

etc., will be discussed. Moreover, the effect of each method on the variation of the photocatalytic properties will be considered.

- **Structural and morphological characterization:** X-ray diffraction, scanning or transmission electron microscopy, X-ray photoelectron spectroscopy, UV/VIS, infrared and Raman spectroscopies, and Brunauer-Emmett-Teller surface area analysis will be considered in discussions.
- **Application of photocatalysts in the energy sector:** We will discuss using sustainable photocatalysts to apply sunlight and split water into hydrogen and oxygen. The advances in this field and limitations of the photocatalytic reactions in generating hydrogen will be discussed from the industrial point of view.
- **Application of photocatalysts as antibacterial materials:** We will discuss the use of photocatalysts in the fabrication and use of antibacterial materials. The production of reactive oxygen species (ROS) and the different kinetics analysis applied to photocatalytic degradation of organic pollutants.
-

WHO

Teacher(s):

Evie Papadopoulou, paraskevi.papadopoulou@iit.it; 010 71781 705

Arezou Fazli, arezou.fazli@iit.it

HOW

Teaching Methods:

Lectures

Exam Description:

The examination consists of a written test (multiple-choice and open-ended questions).

Assessment Methods:

Formative assessment (feedback with the students by oral questions during lessons).

WHERE AND WHEN

Lesson Location

Lessons will be done @ IIT

Lesson Schedule

Lessons will be in April 2023. Specific dates will be decided in Ferbuary (6 sessions of 2 hours).

CONTACTS

Teachers' offices are in the 4th floor of the IIT building (via Morego 30, 16163, Genova). Students asking info to the teachers can contact them by email anytime.

Deep Learning: a hands-on introduction

Scientific Disciplinary Sector: INF01

Number of hours: 20

Credits: 6

AIMS AND CONTENT

Learning Outcomes

Deep Learning (DL) is a branch of Machine Learning that has recently achieved astonishing results in several different domains. This course will provide a hands-on introduction to DL, starting from its foundations and discussing the various types of deep architectures and tools currently available. The theoretical classes will be coupled with hands-on activities in lab (in Python using Keras), which will constitute an integral part of the course, giving the possibility of practicing deep learning with examples from real-world applications, with particular focus on visual data. Besides well-established approaches, the course will also highlight current trends, open problems, and potential future lines of research.
Although the DL course can be taken independently, for the second year it will be held in synergy with the "Computer Vision Crash Course" (CVCC). Computer Vision is indeed one of the most classical and effective applications of DL in the real world. Contributions from the CVCC course will constitute a complementary deepening on basic principles of computer vision and visual perception in artificial agents, but also providing a guided tour using deep learning for computer vision problems.

Syllabus/Content

Core DL Program (for those attending the DL course only)

	DAY1	DAY2	DAY3	DAY4	DAY5
9:00-9:30	Welcome				
9:30-11:00	DL intro		CNN	GANs	Group Project
11:00-11:30	Coffee break		Coffee break	Coffee break	Coffee break
11:30-13:00	Image proc. Intro		Applications	LAB	Group Project
13:00-14:30	Free lunch		Free lunch	Free lunch	Free lunch
14:30-16:00	LAB		LAB	Transformers	Group Project
16:00-16:30	Coffee break		Coffee break	Coffee break	Closing
16:30-18:00	Intro to Group Project		Poster session and ape	LAB	

Both DL only

Integrated DL and CVCC program

	DAY1	DAY2	DAY3	DAY4	DAY5
9:00-9:30	Welcome				
9:30-11:00	DL intro	Image features	CNN	GANs	Group Project
11:00-11:30	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
11:30-13:00	Image proc. Intro	LAB	Applications	LAB	Group Project
13:00-14:30	Free lunch	Free lunch	Free lunch	Free lunch	Free lunch
14:30-16:00	LAB	Motion+Depth	LAB	Transformers	Group Project
16:00-16:30	Coffee break	Coffee break	Coffee break	Coffee break	Closing
16:30-18:00	Intro to Group Project	LAB	Poster session and ape	LAB	

Both CVCC only DL only

WHO

Teachers:

Name: Nicoletta Noceti

Phone number: +39 010 3536704

Email: Nicoletta.noceti@unige.it

Name: Francesca Odone

Phone number: +39 010 3536667

Email: Francesca.odone@unige.it

HOW

Teaching Methods: Theoretical classes and hands-on activities

Exam Description: a group project, whose goal is to suggest the use of one (or more) methodology studied in the course in real-world applications. The project is presented at the end of the course with slides

Assessment Methods: the feasibility of the proposed task and the clarity of the presentation will be both evaluated.

WHERE AND WHEN

Lesson Location

Classes will be in presence in via Dodecaneso 35, 16146, Genova. The room will be defined in due time

Lesson Schedule

June 12-16, 2023

CONTACTS

Giulia Casu (MaLGa lab manager), giulia.casu@ext.unige.it

Computer Vision Crash Course

Scientific Disciplinary Sector: INF01

Number of hours: 20

Credits: 6

AIMS AND CONTENT

Learning Outcomes

Visual perception, as a key element of Artificial Intelligence, allows us to build smart systems sensitive to surrounding environments, interactive robots, video-cameras with real time algorithms running on board. With similar algorithms, our smart phones can log us in by recognizing our face, read text automatically, improve the quality of the photos we shoot. At the core of these applications are computer vision models, often boosted by machine learning algorithms.
This crash course is conceived as a complement to the "Deep Learning: Hands on introduction" course (henceforth DL) although it can be taken independently.
It covers the basic principles of computer vision and visual perception in artificial agents, including theoretical classes, application examples, hand-on activities.
Within CVCC, we present elements of classical computer vision (introduction to image processing, feature detection, depth estimation, motion analysis).
At the same time, by borrowing from DL, we also present deep learning approaches to computer vision problems such as image classification, detection, and semantic segmentation.

Syllabus/Content

Core DL Program (for those attending the CVCC course only)

	DAY1	DAY2	DAY3	DAY4	DAY5
9:00-9:30	Welcome				
9:30-11:00	DL intro	Image features	CNN		Group Project
11:00-11:30	Coffee break	Coffee break	Coffee break		Coffee break
11:30-13:00	Image proc. Intro	LAB	Applications		Group Project
13:00-14:30	Free lunch	Free lunch	Free lunch		Free lunch
14:30-16:00	LAB	Motion+Depth	LAB		Group Project
16:00-16:30	Coffee break	Coffee break	Coffee break		Closing
16:30-18:00	Intro to Group Project	LAB	Poster session and ape		

Both CVCC only

Integrated DL and CVCC program

	DAY1	DAY2	DAY3	DAY4	DAY5
9:00-9:30	Welcome				
9:30-11:00	DL intro	Image features	CNN	GANs	Group Project
11:00-11:30	Coffee break	Coffee break	Coffee break	Coffee break	Coffee break
11:30-13:00	Image proc. Intro	LAB	Applications	LAB	Group Project
13:00-14:30	Free lunch	Free lunch	Free lunch	Free lunch	Free lunch
14:30-16:00	LAB	Motion+Depth	LAB	Transformers	Group Project
16:00-16:30	Coffee break	Coffee break	Coffee break	Coffee break	Closing
16:30-18:00	Intro to Group Project	LAB	Poster session and ape	LAB	

Both CVCC only DL only

WHO

Teachers:

Name: Francesca Odone

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Name: Nicoletta Noceti

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HOW

Teaching Methods: Theoretical classes and hands-on activities

Exam Description: a group project, whose goal is to suggest the use of one (or more) methodology studied in the course in real-world applications. The project is presented at the end of the course with slides

Assessment Methods: the feasibility of the proposed task and the clarity of the presentation will be both evaluated.

WHERE AND WHEN

Lesson Location

Classes will be in presence in via Dodecaneso 35, 16146, Genova. The room will be defined in due time

Lesson Schedule

June 12-16, 2023

CONTACTS

Giulia Casu (MaLGa lab manager), giulia.casu@ext.unige.it

Adversarial Machine Learning

Scientific Disciplinary Sector: ING-INF/05

Number of hours: 12

Credits: 3

AIMS AND CONTENT

Learning Outcomes

Today machine-learning algorithms are used for many real-world applications, including image recognition, spam filtering, malware detection, biometric recognition. In these applications, the learning algorithm can have to face intelligent and adaptive attackers who can carefully manipulate data to purposely subvert the learning process. As machine learning algorithms have not been originally designed under such premises, they have been shown to be vulnerable to well-crafted attacks, including test-time evasion and training-time poisoning attacks (also known as adversarial examples). In particular, the security of cloud-based machine-learning services has been questioned through the careful construction of adversarial queries that can reveal confidential information on the machine-learning service and its users. This course aims to introduce the fundamentals of the security of machine learning, the related field of adversarial machine learning, and some techniques to assess the vulnerability of machine-learning algorithms and to protect them from adversarial attacks. We report application examples including object recognition in images, biometric identity recognition, spam and malware detection, with hands-on on attacks against machine learning and defences of machine-learning algorithms using the SecML software library, https://secml.readthedocs.io/en/v0.15/.

Syllabus/Content

1. Introduction to adversarial machine learning: introduction by practical examples from computer vision, biometrics, spam, malware detection.
2. Design of learning-based pattern classifiers in adversarial environments. Modelling adversarial tasks. The two-player model (the attacker and the classifier). Levels of reciprocal knowledge of the two players (perfect knowledge, limited knowledge, knowledge by queries and feedback). The concepts of security by design and security by obscurity
3. System design: vulnerability assessment and defense strategies. Attack models against machine learning. Vulnerability assessment by performance evaluation. Taxonomy of possible defense strategies.
4. Hands-on classes on attacks and defences of machine-learning algorithms using the SecML open-source Python library for the security evaluation of machine learning algorithms (https://secml.readthedocs.io/en/v0.15/).
5. Summary and outlook. Current state of this research field and future perspectives

WHO

Teacher(s):

Name: Fabio Roli

Phone number: 320 4372999

Email: fabio.roli@unige.it

Name: Luca Demetrio

Email: luca.demetrio.roli@unige.it

HOW

Teaching Methods: Lectures. The lecturer will use slides. Copies of slides will be provided to the students. Hands-on classes on attacks and defences of machine-learning algorithms using the SecML open-source Python library for the security evaluation of machine learning algorithms (https://github.com/pralab/secml).

Exam Description: 2 written assessments

Assessment Methods: 2 written assessments with open-ended questions

WHERE AND WHEN

Lesson Location

online on MS Teams

Lesson Schedule

July 3-5 2023, 3 half-days, 09 – 13:00 a.m.

CONTACTS

Fabio Roli

DIBRIS, Via Dodecaneso 35, Room 207

Email: fabio.roli@unige.it

Luca Demetrio

Email: luca.demetrio.roli@unige.it

Effective habits and skills for successful young scientists

Scientific Disciplinary Sector: ING-INF/05

Number of hours: 20

Credits: 5

AIMS AND CONTENT

Learning Outcomes

Although tons of books on effective habits and soft skills have been published, they have not been thought for scientists, and, therefore, issues that are relevant for them are not easily available. This short course aims to collect spread ideas and place them in a coherent framework useful for young scientists and provide a small tactical guide for scientists at the first stages of their career. First, I review the main concepts of Steve Covey's personal and time management paradigm, the inspirational speeches of the late Professor Randy Pausch, and the paradigm of atomic habits of James Clear, and discuss their utility for daily activity of a young scientist. Then, I focus on a few practical skills, namely, on how to write a great paper and give a great talk. I try to convey the message that succeeding in science and technology requires skills and habits beyond the pure intelligence and intellectual abilities, and that good habits and skills of personal and time management are extremely important for young scientists.

Syllabus/Content

1. Basic concepts of theory of habits. Effective habits for young scientists.
2. Basis concepts of personal and time management. Effective personal and time management for young scientists.
3. Survival skills in the game of science. Know yourself: match your goals to your character and talents.
4. How to write a great paper.
5. How to give a great talk.

WHO

Teacher(s):

Name: Fabio Roli

Phone number: 320 4372999

Email: fabio.roli@unige.it

HOW

Teaching Methods: Lectures. The lecturer will use slides. Copies of slides will be provided to the students.

Exam Description: written assessments

Assessment Methods: written assessments with open-ended questions

WHERE AND WHEN

Lesson Location

online on MS Teams

Lesson Schedule

June 26-30 2023, 5 half-days, 09 – 13:00 a.m.

CONTACTS

Fabio Roli

DIBRIS, Via Dodecaneso 35, Room 207

Email: fabio.roli@unige.it

Optics for Microscopy and Spectroscopy

Scientific Disciplinary Sector: ING-INF/06 and FIS/07

Number of hours: 12 h

Credits: 4 CFU

AIMS AND CONTENT

Learning Outcomes

Light is an essential tool for many important scientific applications, such as optical microscopy and spectroscopy. This course is intended to provide the essential theoretical background of optics and imaging. In particular, the course will focus on traditional and state-of-the-art optical techniques. Additionally, students will have the opportunity to attend a demonstration with custom-built optical setups. The student will acquire a general overview of the physical principles of modern optical techniques and their most relevant applications.

Syllabus/Content

The course will focus on theory and applications.
A minimum knowledge of mathematics is expected from the students.

Class 1 (2h): Fundamentals of optics (geometrical, scalar, and vectorial optics)

Class 2 (2h): Imaging and wide-field microscopy

Class 3 (2h): Confocal microscopy, Image Scanning Microscopy, STED microscopy

Class 4 (2h): Non-linear optics, multiphoton fluorescence and second harmonic generation microscopy

Class 5 (2h): Fluorescence correlation spectroscopy, fluorescence fluctuation spectroscopy, fluorescence lifetime

Class 6 (2h): Visit of the laboratory and experimental demonstrations

WHO

Teacher(s):

Dr. Eli Slenders, eli.slenders@iit.it, +39 010 28 97 619

Dr. Alessandro Zunino, alessandro.zunino@iit.it, +39 010 28 97 619

HOW

Teaching Methods:

This course requires the active participation of all class members through active listening and discussion. For the lessons, a blackboard and slide presentations will be used. In addition, the course includes a visit to the microscopy laboratory.

Exam Description: The examination will be a short, written test containing multiple questions regarding the key messages of the course.

Assessment Methods: Class attendance and regular participation are required for this course. The assessment will be in written form.

WHERE AND WHEN

Lesson Location

Lessons will take place at the IIT-Center for Human Technology, Via Enrico Melen 83, Building B, Genoa. The room will be specified one week before the beginning of the course. In case of "social distancing" rules, the course will include the remote option.

Lesson Schedule

The course will be organized into six lessons of two hours each. Every lesson will start at 10.00 am and will finish at noon. The lessons are tentatively scheduled for the first week of March. The calendar will be confirmed one month before the beginning of the course.

CONTACTS

Dr. Eli Slenders

Molecular Microscopy and Spectroscopy

Istituto Italiano di Tecnologia (IIT) – Center for Human Technologies (CHT)

Via Enrico Melen, 83, Building B, 16152, Genoa, Italy

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Dr. Alessandro Zunino

Molecular Microscopy and Spectroscopy

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e-mail: alessandro.zunino@iit.it

Artificial Robotic Cognition for the Representation of Purposive Actions

Scientific Disciplinary Sector: ING-INF/06

Number of hours: 8

Credits: 2

AIMS AND CONTENT

Learning Outcomes

The new generation of robot for industry 4.0 is supposed to cooperate and communicate with humans in a direct and bidirectional way. In the framework of Cybernetic tradition this implies that humans and robots are characterized by cognitive that are somehow similar, although different for implementation and technological details. The course will clarify the difference between Artificial Intelligence and Artificial Cognition, focusing on the concept of Embodied Cognition, in opposition to mind-body dualism, for representing purposive actions in both humans and robots.

Syllabus/Content

- Cybernetics – Embodied Cognition -Artificial Intelligence
- Optimality of Biological Motion – Space-time invariants
- Degrees of Freedom Problem
- Equilibrium Point Hypothesis
- Neural Simulation of Actions – Motor Imagery - Passive Motion Paradigm
- Symbolic AI vs. Connectionist AI
- Behavioral and Computational Self-organization principles
- Topology Representing Networks – Hopfield Networks
- Neural fields and neuromorphic engineering

WHO

Teacher(s):

Name: Pietro Morasso

Phone number: 3281003224

Email: pietro.morasso@iit.it

HOW

Teaching Methods: Slide presentation and discussion of a reading list

Exam Description: The students will be asked to prepare a short paper (2-3 pages) that describes how the topics covered by the course may impact the development of their doctoral project.

Assessment Methods: Evaluation of the paper

WHERE AND WHEN

Lesson Location

@ UNIGE (DIBRIS)

Lesson Schedule

Tuesday May 2, 2023 (8-10); Wednesday May 3 (8-10); Thursday May 4 (8-10); Friday May 5 (8-10).

CONTACTS

Pietro Morasso, IIT Campus Erzelli, 7th floor, 3281003224, pietro.morasso@iit.it

Topics in Modern Machine Learning (ModML)

Scientific Disciplinary Sector: ING-INF/04, ING-INF/05, ING-INF/06

Number of hours: 20

Credits: 6

AIMS AND CONTENT

Learning Outcomes

This is an advanced machine learning course covering some of the topics of interest in modern machine learning. After a 6-hour boot camp on the first day (on statistical learning, machine learning models and optimization for machine learning), the rest of the week will be dedicated to introducing modern topics including, for example, interpolation and overparameterization, implicit regularization, optimal transport for machine learning, machine learning for inverse problems, fairness in machine learning and reinforcement learning. Each presentation, held in the morning, will be introductory and self-contained, with an associated practical session in the afternoon. The last day will be dedicated to a workshop with invited speakers.

Syllabus/Content

The detailed program will be provided later.

WHO

Teacher(s):

Name: Lorenzo Rosasco, DIBRIS

Email: lorenzo.rosasco@unige.it

Name: Giovanni Alberti, DIMA

Email: giovanni.alberti@unige.it

Name: Simone Di Marino, DIMA

Email: simone.dimarino@unige.it

HOW

Teaching Methods:

TBA

Exam Description:

TBA

Assessment Methods:

TBA

WHERE AND WHEN

Lesson Location

DIBRIS, Via Dodecaneso 35

Lesson Schedule

19-23 June 2023

CONTACTS

Students can interact with instructors via email.

Analysis of (Networks of) Nonlinear Oscillators

Number of hours: 20

Credits: 5

AIMS AND CONTENT

Learning Outcomes

Course specific educational goals: This course aims to provide the students with mathematical and numerical tools for the analysis of nonlinear dynamical systems, even networked, with either fixed or changing parameters (in the latter case the lessons' topic will be the so-called bifurcation analysis). In particular, the lessons will be focused on both geometrical methods for qualitative analysis and the most diffused numerical methods for quantitative analysis. The main theoretical results will be applied to dynamical systems arising from different fields and will be illustrated through computer demos in the MATLAB programming environment.

Course essential contents:

1. Introduction to nonlinear dynamical systems (both continuous-time and discrete-time)

2. Phase portraits, invariant sets and stability

3. Geometrical method

4. State space, parameter space and control space

5. Bifurcations

6. Networks of nonlinear dynamical systems

7. Master Stability Function

8. Numerical analysis methods

Bibliography and reference textbooks:

-) Material provided by the lecturer (main reference textbook, in Italian)

-) S.H. Strogatz, Nonlinear dynamics and chaos, Addison-Wesley, 1994.

-) Y.A. Kuznetsov, Elements of Applied Bifurcation Theory, Springer-Verlag, 1998.

-) M. Parodi, M. Storace, Linear and Nonlinear Circuits: Basic and Advanced Concepts, Vol. 2, Springer, 2020.

WHO

Teachers

Marco Storace: marco.storace@unige.it

Matteo Lodi: matteo.lodi@unige.it

HOW

Teaching Methods:

TBA

Exam Description:

TBA

Assessment Methods:

TBA

WHERE AND WHEN

Lesson Location

Via Opera Pia 11 (DITEN), room D2 (ground floor)

Lesson Schedule:

24 January - 2.5h - (9.30 - 12)

26 January - 2.5h - (9.30 - 12)

31 January - 2.5h - (9.30 - 12)

3 February - 2.5h - (9.30 - 12)

6 February - 2.5h - (9.30 - 12)

8 February – 2.5h - (9.30 - 12)

13 February - 2.5h - (9.30 - 12)

15 February - 2.5h - (9.30 - 12)

Registration: by e-mail to marco.storace@unige.it

CONTACTS

Students can interact with instructors via email.