MASTER OF SCIENCE IN BIOMEDICAL ENGINEERING

BIOROBOTICS

SSD ING-IND/34, 6 CFU

Objectives

Knowledge and understanding
The course aims to provide to the student the following knowledge in the field of Biorobotics:
• Knowledge of the main biorobotics definitions, taxonomies and applicative fields.
• Knowledge of the main concepts regarding state of the art in biorobotics.
• Theoretical and practical knowledge and skills on methods and instruments for ideation, design and development of biorobotic systems.
• Practilal skills on the use of technological tools for modeling, simulating and control bioinspired robotic systems

Making judgements: the students will be encouraged to develop their analytical and critical skills by proposing: i) examples and applications regarding the theme introduced during frontal lessons and ii) case studies of bioinspired systems used for the validation of scientific hypotheses on natural species or for solving practical problems from an engineering perspective.

Learning skills: the students will be actively involved during the frontal lessons and exercise classes. Practical examples and case studies in the field of Biorobotics will be introduced to motivate the in-depth analysis of topic discussed during frontal lessons. During exercise classes examples will be presented as applications to specific problems.

Communication abilities: particular attention will be provided to the development of communication abilities by actively involving the student during the frontal lessons and exercise classes.

Prerequisites

No mandatory exams.
Recommended exams: Meccatronica per i sistemi biomedicali, Robotica Medica e Industriale, Biomicrosistemi

Contents

The course is organized in one single module, covering the following main topics:
• Introduction to Biorobotics: reference definitions and conceptual schemes.
• Short history and state of the art analysis of the Biorobotics research.
• Biorobotics system taxonomy. Analogies and differences with biological systems.
• Enabling technologies in biorobotics: sensors, actuators and other bio-inspired and bio-mimetics components.
• Robotics systems for biological research: design principles and methods, case studies.
• Bio-inspired and biomimetic robotic systems: design principles and methods, case studies.
• Robotic system for medical-biological applications: design principles and methods, case studies
• Biorobotics future perspectives

Teaching Methods

Frontal lessons (4 CFU) during which the professor introduce course arguments and literature case studies.

Exercise classes (1CFU) with the aim to show the application of the theoretical knowledge illustrated in classroom to biological and robotics fields.

Seminars (1 CFU) made by expert in the field.

Verification of learning

Knowledge acquired during the course is evaluated through a written exam and, in case of positive results, a oral exam.

The written exam will be characterized by an open question e 9 questions with multiple replies with a duration of 45 minutes. The questions will regard theoretical arguments and case studies treated by professor or a specific case study analysed for the first time during exams. In this case the material will be provided by professor with at least an additional time of 30 minutes.

The vote is defined considering: 3 points for each correct answer, 0 point for each missing answer and -0.5 points for each wrong answer. The written exam is passed if the achieved mark is greater than or equal to 18/30. The open question will be evaluated assigning a vote between -0.5 and 3 on the basis of the correctness, completeness and ability to synthetize.

The oral exam will allow to modify the written exam vote of ± 3 points. The oral exams will consist of one open question and of the discussion on written exam. Moreover the student can choose to in depth analyse a course argument by analyzing one research paper, patent, product or developing a short project. The laude is assigned to students who provide: i) correct and exhaustive answers to all questions of the written and oral exams and ii) correct, synthetic and exhaustive answer to the open question of the written exam.

Texts

• Meyer, Jean-Arcady, and Agnes Guillot. "Biologically inspired robots." Springer Handbook of Robotics. Springer Berlin Heidelberg, 2008. 1395-1422. (old ed.)
• Iida, Fumiya, and Auke Jan Ijspeert. "Biologically inspired robotics." Springer Handbook of Robotics. Springer, Cham, 2016. 2015-2034. (new ed.)
• Fitzpatrick, Paul, et al. "Humanoids." Springer Handbook of Robotics. Springer, Cham, 2016. 1789-1818.
• Chung, Woojin, and Karl Iagnemma. "Wheeled Robots." Springer Handbook of Robotics. Springer, Cham, 2016. 575-594.
• Choi, Hyun-Taek, and Junku Yuh. "Underwater Robots." Springer Handbook of Robotics. Springer, Cham, 2016. 595-622.
• Leutenegger, Stefan, et al. "Flying robots." Springer Handbook of Robotics. Springer, Cham, 2016. 623-670.
• Walker, Ian D., Howie Choset, and Gregory S. Chirikjian. "Snake-like and continuum robots." Springer
• Handbook of Robotics. Springer, Cham, 2016. 481-498.
•Papers provided by professors, tutors and invited experts
• Lecture notes provided by the teacher.