ME-436

Micro/Nano robotics

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Cursus	Sem.	Type
Life Sciences Engineering	MA2, MA4	Opt.
Mechanical engineering minor	E	Opt.
Mechanical engineering	MA2, MA4	Opt.
Robotics, Control and Intelligent Systems		Opt.
Robotics	MA2, MA4	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	During the semester
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly
Number of positions	

Summary

The objective of this course is to expose students to the fundamentals of robotics at small scale. This includes a focus on physical laws that predominate at the nano and microscale, technologies for fabricating small devices, bioinspired design and control paradigms, and applications of the field.

Content

The course will cover the micro/nanoscale physics, sensors, actuators, manipulators, power sources, interfacing, robotic design, and control issues. After providing the basic background, we will explore the current trends in the literature, discuss select case studies, and develop conceptual novel solutions for outstanding issues. The course will be divided into the following sections:

- Multiphysics and Scaling Laws
- Design and Manufacturing
- Sensors
- Actuators
- Energy (power) Sources
- Manipulation and Locomotion
- Control and Localization
- Applications

Keywords

multiphysics, design and manufacturing of small scale machinery, wireless power transmission, bioinspired engineering, principles of biological actuation, mobile robots

Learning Prerequisites

Recommended courses

ME-426 Micro/Nanomechanical devices

Learning Outcomes

By the end of the course, the student must be able to:

- Formulate the specifications of a mechatronic system, A17

- Design mechatronic systems (choice of sensors, actuators, embedded systems), A20
- Explain and apply the concepts of mass, energy, and momentum balance, E1
- Model design, and optimize energy conversion systems and industrial processes, E22
- Characterize expermentally the steady-state or dynamic response of solids and fluids, S11
- Apply adapt, and synthesize learned engineering skills to create novel solutions, CP14
- Expound and iterate multiple design concepts based on the models and simulations, CP15
- Describe in scientific terms and apply the principles of tribology and contact mechanics, S13

Transversal skills

- Make an oral presentation.
- Summarize an article or a technical report.
- Write a scientific or technical report.
- Access and evaluate appropriate sources of information.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.

Teaching methods

- Ex catedra
- Exercises
- Presentation from students on different reports/articles
- Presentation from students on their project

Expected student activities

- Active participation
- Reading of background literature suggested in the class
- Critical reading of technical articles and presentation in class

Assessment methods

- Literature Review Report (25%)
- Assignments (25%)
- Final Project (50%)

Supervision

Office hours	Yes
Assistants	Yes
Forum	No

Resources

Bibliography

- Microrobotics: Methods and Applications. Yves Bellouard. CRC Press, 2009.
- Microsystem Technology and Microrobotics. S. Fatikow and U. Rembold. Springer Verlag, 1997.
- Mobile Microrobotics. Metin Sitti. The MIT Press, 2017.

- Intermolecular and Surface Forces. J. Israelachvili. Academic Press Ltd, 2011

Moodle Link

- https://go.epfl.ch/ME-436