Soft microrobotics

Titulaire
Pierre LAMBERT (Coordonnateur)

Mnémonique du cours
MECA-H501

Crédits ECTS
5 crédits

Langue(s) d'enseignement
Anglais

Période du cours
Année académique

Campus
Solbosch

Contenu du cours

This course presents some of the recent advances in soft/wet microrobotics, namely:

- Active materials and design methodologies to produce soft actuators and tunable stiffness mechanisms
- Compliant mechanisms for microrobotics (mainly produced in elastic metal by electro-discharge machining or glass for femtosecond laser machining), used to measure microforces or to provide kinematics in precision mechanics and MEMS applications
- Surface tension effects and capillary forces enhancing adhesion, sealing, actuation, or self-centering in microsystems

Additionally, two methodologies are also introduced:

- Scaling laws in micro-engineering (dimensional analysis, similitude laws)
- Design of experiments, to organize experimental campaigns in many parameters problems

Objectifs (et/ou acquis d'apprentissages spécifiques)

The goal of the course is to give an overview of the ongoing research in the field, to offer student the opportunity to become familiar with the scientific literature, and to apply one of the course topics in their own master thesis or in one of the research questions of the department

Pré-requis et co-requis

Connaissances et compétences pré-requises

Mechanics, materials strength, kinematics and dynamics of machines...

Méthodes d'enseignement et activités d'apprentissages

- 24h theory: theoretical course and seminars based on ongoing research in the department
- 24h practical work: introduction to the software Design Expert used in design of experiments, exercises on scaling laws, and individual work applying the course to your master thesis or to a research question of the department. Examples of past works: design of an electrostatic actuator (coupling of electrostatics and compliant mechanisms), design and assembly of a lateral capillary forces [http://www.springerlink.com/content/j85q5h5576nr3164/?MUD=MP] test bed, to characterize industrial micro-assembly processes, design and assembly of a forces measurement device to characterize granular adhesion in soil mechanics, characterization of silicone-ethanol actuators...
- 12h personal work

Références, bibliographie et lectures recommandées

- T. Szirtes, Applied Dimensional Analysis and Modelling [http://www.amazon.com/Applied-Dimensional-Analysis-Modeling-Edition/dp/0123706203]
- N. Chaillet, M. Hafez and P. Lambert, Actuators for Microrobotics, in Microrobotics for Micromanipulation [http://www.amazon.com/Microrobotics-Micromanipulation-ISTE-Nicolas-Chaillet/dp/1848211864]
- L. Howell, Compliant mechanisms [http://books.google.be/books/about/Compliant_Mechanisms.html?id=tiiSOuhslfgC&redir_esc=y]
- S. Henein, Conception des guidages flexibles [http://books.google.be/books/about/Conception_des_guidages_flexibles.html?id=0z9pu7uC8MAC&redir_esc=y]
- M.P. Koster, Constructieprincipes [http://www.bol.com/nl/p/constructieprincipes/1001004005902416]
- P. Lambert, Capillary Forces in Microassembly [http://www.amazon.com/Capillary-Forces-Microassembly-Experiments-Microtechnology/dp/0387710884]
- D. Montgomery, Design and Analysis of Experiments [https://www.wiley.com/en-us/Design+and+Analysis+of+Experiments%2C+10th+Edition-p-9781119492443]
- H. Koshima, Mechanically Responsive Materials for Soft Robotics [https://onlinelibrary.wiley.com/doi/book/10.1002/9783527822201]

Support(s) de cours

Université virtuelle

Autres renseignements

Lieu(x) d'enseignement

Solbosch

Contact(s)

Pierre LAMBERT, TIPs, http://plambert.ulb.be

Méthode(s) d'évaluation

Autre

Méthode(s) d'évaluation (complément)

Examen oral en juin et rapport de projet

Construction de la note (en ce compris, la pondération des notes partielles)

- Examen oral: 75%
- Rapport de projet: 25%

Langue(s) d'évaluation principale(s)

Anglais et Français

Autre(s) langue(s) d'évaluation éventuelle(s)

Français

Programmes

Programmes proposant ce cours à l'école polytechnique de Bruxelles

MA-IRCB | Master : ingénieur civil biomédical | finalité Spécialisée/bloc 2, MA-IREM | Master : ingénieur civil électromécanicien | finalité Spécialisée/bloc 2 et MS-NATE | Master de spécialisation en nanotechnologie | bloc U