

AS-74.4340 Special Course in Control Engineering, summer 2013

Topic: Surface tension effects in microsystems, 2-3 ECTS

Lecturer: Prof. Pierre LAMBERT, Universite Libre de Bruxelles

Lecture room: TUAS building, AS3. First lecture: 20.08.2013 at 10:00.

Introduction

This course will be based on a new book to be published this summer.

Pierre LAMBERT, Surface Tension in Microsystems: Engineering Below the Capillary Length, Springer, ISBN 978-3-642-37551-4

<http://www.springer.com/materials/mechanics/book/978-3-642-37551-4>

- Summarizes most recent developments and research results in surface tension for emerging industrial products
- Provides an original and comprehensive study of surface tension forces and torques including modeling, simulation, experimental set ups
- Contains many case studies including gripping, actuation, capillary filling, sealing, self-assembly, adhesion for better understanding

This course describes how surface tension effects can be used by engineers to provide mechanical functions in miniaturized products (<1 mm). Even if precursors of this field such as Jurin or Laplace already date back to the 18th century, describing surface tension effects from a mechanical perspective is very recent.

It provides a comprehensive approach to various applications, such as capillary adhesion (axial force), centering force in packaging and micro-assembly (lateral force) and recent developments such as a capillary motor (torque).

It devises how surface tension can be used to provide mechanical functions such as actuation (bubble-actuated compliant table), sealing and tightness, energy harvesting, nanodispensing.

Content Level » Research

Keywords » axial capillary forces - bubble-actuated compliant table - capillary adhesion - capillary forces - capillary forces and adhesion - capillary micro motor - capillary torque - lateral capillary forces - modelling capillary forces - packaging of microdevices - surface tension book

Detailed content

20.08: 10:00-12:00 Surface tension effects and capillary forces I / Introduction and applications

Surface energy, surface tension, contact angle, Gibbs equation, curvature, Laplace equation, forces Handling and micromanipulation, self-assembly, capillary condensation, actuation, microfluidics, micro-optics

21.08: 10:00-12h00 Surface tension effects and capillary forces II / Models and measures

Energetic method (towards Surface Evolver), Laplace equation based models, geometrical models, lateral stiffness of menisci

22.08: 10:00-12:00 Surface tension effects and capillary forces III / Exercises

26.08: 14:00-16:00 Dimensional analysis I / PI-theorem and dimensional matrix

27.08: 10:00-12:00 Dimensional analysis I / Scaling laws and exercises

28.08: 10:00-12:00 Design of experiments I / Introduction (T-test, ANOVA, factorial designs)

29.08: 10:00-12:00 Design of experiments II / Exercises (paper exercises and/or design expert)

Home work (tentative):

- Write a Matlab code to compute meniscus shape and capillary forces between two parallel plates
- Write a personal report on surface tension effects in your research

Contact information:

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