Course Package

Biorobotics

MODULE	1A + 1B	15.0 EC
Biorobotics	First semester	

Required preliminary knowledge: *Not fully available yet.* Bachelor's degree in Biomedical Engineering, Industrial Design & Engineering, or Mechanical Engineering, Basic knowledge in Mechanics, Multi-body Kinematics and Dynamics, General Physics, General Mathematics, Principles of Signal Processing.

201400040 **Dynamics and Control (1A + 1B)**
The analysis of nonlinear dynamic mechanical systems, and techniques for controlling such systems, play important roles in nowadays engineering research and applications. Typical examples are helicopter blades, robotic manipulators, and unfolding solar panels for satellites. In this course the theoretical framework is outlined for the kinematic and dynamic description of such multibody systems. The analysis involves both rigid systems as well as systems with elastic components. The relevance of inverse kinematic and dynamic relations is addressed for the realisation of specified motion profiles. The use of feedback and feedforward control is presented for mechatronic systems. In this context issues regarding stability and accuracy are addressed.

201400286 **Clinical Research Methods (1A)**
Clinical research is the systematic process of examining clinical conditions and outcomes, in order to establish relationships among clinical phenomena and to generate evidence for decision making toward improved clinical practice. As a Biomedical Engineer, you will continuously encounter clinical research, either by performing a clinical study yourself or by using the results of clinical research for development or validation of new technologies or medical devices. Furthermore, you will frequently be working with professionals for whom clinical research is a main source of knowledge toward theory building and clinical innovation - c.f., evidence based medicine. This course will provide the foundations of clinical research by addressing key aspects of theory building, concepts of measurements, study design, interpretation of data. Students will assess and interpret clinical methods and results and use clinical results for developing new concepts or for assessment or validation of new technology. The course consists of lectures disclosing the structure of the subject material, explaining approaches and concepts and providing illustrative examples from the clinical research practice. During the course, students will build a portfolio based on assignments for application of the theory on a specific clinical research topic of interest and participate in peer groups for providing mutual feedback and receiving feedback from a tutor. This feedback is processed into the final version of the portfolio, which is graded at the end of the course. The final assignment in the portfolio will be a brief research proposal, to be presented to fellow students.

201400285 **Biostatistics (1A)**
Central concepts of probability theory like (conditional) probability, expectation and variance are treated. Also, the calculation of expectations and variances of linear functions of the observations is a topic of the course and this topic ends with principal components. The principles of statistical testing theory are explained considering the case of one sample (discrete and continuous data). Statistical tests are focused towards: the comparison of two samples, regression, analysis of variances (including repeated measures)

The modules are tentative and subject to change. Please check the website regularly.

and logistic regression. Within analysis of variance we spend some time on multiple comparison / post hoc analysis / simultaneous confidence intervals.

Each week you have to do an assignment. You have to deliver a written report for the first three assignments and the last assignment. You need to use SPSS (or another statistical package if the student prefers that) for the last 5 assignments and these last 5 assignments have to be discussed individually, except for the last one.

+ Modern Robotics (1A)
As an alternative to Dynamics and control. Both can courses can be followed but this is not recommended (similar topic, although different approach)

201300004 **Robotics for Medical Applications (1B)**
This course provides an introduction to robotics with emphasis on the mathematical tools for describing the kinematics and control of robotic manipulators. In addition, selected topics concerning modeling of soft biological tissues and haptics, are also discussed. During minimally invasive surgery, instruments are often teleoperated by the clinician. Principles from robotics are used to describe this manipulation and navigation of instruments. Clinical insight and applications to medical robotics are also covered in this course. In addition to classroom lecture, there is a weekly lab where experiments are conducted using a haptic device.

191150390 **Biomechanics (1B)**
The Biomechanics course applies subjects and techniques from mechanics to biological structures. These are in general characterized by strong non-linear and time-dependent behavior (e.g. growth). Among the subjects are the remodeling behavior of bone, viscous-elastic properties of soft tissue, dynamics of biological fluids, lung mechanics and the mechanics of human movement, applied to gait, flight and scaling rules. The students will be informed about common techniques to tackle these areas. This will be applied in 2 written assignments.