



**DANISH CENTER FOR APPLIED
MATHEMATICS AND MECHANICS**

Ph.D.-course

ADVANCED MECHANICS OF MECHANICAL SYSTEMS

- Organizer :** Shaoping Bai, e-mail: shb@m-tech.aau.dk;
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- Lecturers :** Aki Mikkola, Professor, Lappeenranta University of Technology, Finland;
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Michael Skipper Andersen, Assistant Professor, Aalborg University
- ECTS :** 3.0
- Time :** 18, 19, 21 Sept 2012
- Place :** Aalborg University
- Registration and
Deadline :** <http://phdcourse.aau.dk/index.php?list=29582>, before 28-08-2012
(there is a link to registration right after course description)
- Max. No. of participants:** 30

Description:

An increasing demand for designing reliable and high-performance mechanical systems such as hydraulic cranes, wind turbines or robotic systems requires in-depth understanding of dynamic behavior of the systems, which can be achieved by modeling and simulation at the system level.

The course is aimed to provide basic concepts of mechanics of multibody mechanical systems for the purpose of modeling and simulation. The course deals with the formulation and solutions of dynamic equations of multibody systems. Both rigid and flexible systems in planar and spatial movements will be considered.

The topics will include kinematic analysis with constraints, analytical dynamics, and numerical integration of the equation of motion. The dynamic modeling of flexible multibody systems and nonlinear gear dynamics will be introduced. Dynamic modeling with MSC Adams is demonstrated.

Prerequisites:

Knowledge of linear algebra, rigid body kinematic and dynamics, ordinary differential equations

Lectures

The course consists of three full-day lectures:

Day 1 Kinematic description of rigid bodies

- Open and closed-loop mechanisms
- Constraint equations
- Rigid body orientation and rotation matrix
- Position, velocity and acceleration analysis
- Other kinds of kinematic analysis

Day 2 Dynamic modeling of rigid multibody systems and gear dynamics

- Analytical background
- Formulation of unconstrained equation of motion
- Formulation of constrained equation of motion
- Friction modeling in multibody systems
- Nonlinear dynamics of gear systems
- Dynamic modeling with MSC Adams

Day 3: Introduction of flexible system dynamics

- Kinematics of flexible body
- Description of deformation
- Constraint equations and governing equations of motion
- Modeling of flexible multibody systems
- Numerical example