**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;
Michael Skipper Andersen, e-mail: msa@m-tech.aau.dk

Lecturers :   Aki Mikkola, Professor, Lappeenranta University of Technology,
Finland;
Shaoping Bai, Associate Professor, Aalborg University
Michael Skipper Andersen, Associate Professor, Aalborg
University
Fredrik Sjögren, MSC.Software Sweden AB

ECTS :   3.0

Time :

07-10 Oct 2014

Place :   Aalborg University, Aalborg, Denmark

**Registration and
Deadline :**   http://phdcourse.aau.dk/index.php , before 19-09-2014

Course participation is free for Ph.D. students and university
staff. Participants from industry will be charged DKK 7,500 (DKK
2,500 pr. ECTS).

**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 will be introduced. Dynamic modeling with MSC Adams is demonstrated with their applications in industry in the workshop.

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

Lectures

The course consists of three full-day lectures and a half-day workshop:

Day 1 (07/10) 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 (08/10) Dynamic modeling of rigid multibody systems
- Newton-Euler equation
- Lagrange equations
- Numerical implementation
- Formulations with improved performance

Day 3 (09/10): Workshop on dynamic modeling with MSc.Adams
- Overview of MSC Software
- Introduction to Adams
- Overview of the capabilities of Adams with examples
- Follow-along hands-on exercise

Day 4 (10/10) 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 examples