ME-475

Multi-body simulation

Sakar Selman

Cursus	Sem.	Type
Mechanical engineering	MA2, MA4	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

The objective of this course is to introduce to the student the basic concepts, models, algorithms and methods for the kinematic and dynamic analysis of multi-body systems, specifically designed for mobility.

Content

This course reviews and reinforces the student's understanding of kinematics and dynamics of multibody systems. We are going to explore the mechanical machinery that generates motion in biological and engineered systems, from the tiniest microorganisms to airplanes. The emphasis will be on design rules, scaling laws, constitutive equations, computational modeling, and numerical analysis.

Keywords

Constrained multi-body simulation, principles of locomotion, multiphysics, design of machinery, bioinspired engineering

Learning Prerequisites

Important concepts to start the course

Rigid Body Kinematics and Dynamics
Numerical Analysis
Basic programming skills in MATLAB

Learning Outcomes

By the end of the course, the student must be able to:

- Apply the concepts of rigid and deformable body mechanics and of continuum mechanics to model and analytically solve problems of statics, structural stress analysis or simple mechanisms, S1
- Apply the principle of statics and structural mechanics to analyse and design assemblies of simple mechanical elements in the framework of statics, buckling, S2
- Be able to compare the range of validity of different constitutive laws, B7
- Define, describe and apply the basic flow equations, such as the Navier-Stokes equations, AH17

Transversal skills

- Communicate effectively, being understood, including across different languages and cultures.
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Summarize an article or a technical report.

- Use both general and domain specific IT resources and tools

Teaching methods

The course is organised in theoretical sessions and multi-body dynamics modelling to be realised in projects.

Expected student activities

Classroom participation, reading assignments, exercises on theoretical concepts, and mini-projects on computational modeling and analysis

Assessment methods

Mini-project assignments during the semester (75%) and final written exam (25%).

Supervision

Office hours	No
Assistants	Yes
Forum	No

Resources

Bibliography

Advanced Dynamics. Reza N. Jazar. Wiley 2011.
Design of Machinery, 5th edition. Robert L. Norton. Mcgraw-Hill 2012.
Dynamics of Multibody Systems, 4th edition. Ahmed A. Shabana. Cambridge Uni Press 2013.

Ressources en bibliothèque

- Design of Machinery / Norton
- Dynamics of Multibody Systems / Shabana