Adaptronics

Module-No./Abbreviation	Credits	Workload	Term	Frequency	Duration
CE-WP03/**ADAP**	5 CP	150 h	2nd Sem.	Summer term	1 Semester
Courses			**Contact hours**	**Self-Study**	**Group Size:**
Adaptronics			3 SWS (45 h)	105 h	No Restrictions

Prerequisites

Basic knowledge in Structural Mechanics, Control Theory and Active Mechanical Structures is of advantage.

Learning goals / Competences

Acquiring knowledge in fundamental control methods, structural mechanics and modeling and their application to the active control of mechanical structures.

After successfully completing the module, the students

- have basic knowledge in behavior and modeling of piezoelectric materials for adaptronic structures and systems,
- have knowledge in model development of mechanical structures for the control system design (linear time invariant systems in state space and transfer function form),
- are able to perform the model based system analysis in time and frequency domain,
- are able to design basic control structures with compensator and feedback gain systems,
- are able to independently simulate control systems (PID and pole placement controller),
- have knowledge in discrete-time control systems,
- are able to use Matlab/Simulink software and Toolboxes for the control system analysis, design and simulation.

Content

An overall insight of the modeling and control of active structures is given within the course. The terms and definitions as well as potential fields of application are introduced. For the purpose of the controller design for active structural control, the basics of the control theory are introduced: development of linear time invariant models, representation of linear differential equations systems in the state-space form, controllability, observability and stability conditions of control systems. The parallel description of the modeling methods in structural mechanics enables the students to understand the application of control approaches. For actuation/sensing purposes multifunctional active materials (piezo ceramics) are introduced as well as the basics of the numerical model development for structures with active materials. Control methods include time-continuous and discrete-time controllers in the state space for multiple-input multiple-output systems, as well as methods of the classical control theory for single-input single output systems. Differences and analogies between continuous and discrete time control systems are specified and highlighted on the basis of a pole placement method. Closed-loop controller design for active structures is explained. Different application examples and problem solutions show the feasibility and importance of the control methods for structural development. Within this course the students learn computer aided controller design and simulation using Matlab/Simulink software. Students will implement the acquired knowledge in the framework of a seminar paper related to the controller design supported by Matlab Software.

Teaching methods / Language

Lectures with exercises and Tutorials (3h / week) / English

Mode of assessment Written examination (90 min, 100%) / Seminar paper (Workload for the Seminar paper 30 hours, deadlines will be announced at the beginning of the semester)
Requirement for the award of credit points Passed final module examination and passed Seminar paper
Module applicability MSc. Computational Engineering
Weight of the mark for the final score 5 %
Module coordinator and lecturer(s) Prof. Dr.-Ing. T. Nestorović, Assistants
Further information