Ruhr Master School
of Applied Sciences

Dieses Wahlpflichtmodul ist ein Angebot der:

Fachhochschule Dortmund
University of Applied Sciences and Arts

Master Embedded Systems for Mechatronics

Signals & Control Systems 1

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STIFTUNG MERCATOR

Signals & Control Systems 1 (MOD2-04)

Code Number	Workload	Credits	Semester	Frequency	Duration
10240/41	180 h	6	Sem. 2	annually	1 Semester

1	Course Title	Contact hours	Self-Study	Planned Group Size
	Signals & Control Systems 1	4 SWS / 60 h	120 h	25 students

2 Course Description

Cyber-physical systems (CPS) interact with the physical world by making use of sensors and actuators. Their main source of information is a variety of signals. The analysis, processing and understanding of signals and the inherent information is a central topic for the development of mechatronic systems. This module delivers the theoretical foundations for the understanding of signal processing and control engineering problems and algorithms.

The description of sensors and actuators by linear time-invariant systems is a powerful tool for the description of the dynamic behavior of mechatronic systems. The corresponding concepts are dealt with in the first block of this course.

Control systems are the connection between the mechanical/physical world and the control task performed by the embedded system. The goal of this module is to enable students to interact with control system experts and to integrate their results into embedded and mechatronic systems by learning the basic principles of feedback and control engineering.

Embedded signal processing and control systems are based upon time-discrete calculations. Thus a major focus of this course is to deal with time discrete signals and systems and the transformation from continuous time to discrete time.

Filters play a major role in the processing of data and they are widely used in signal processing and control engineering tasks. The analysis starts with continuous time filters and then introduces canonical structures for FIR and IIR filters.

An additional goal is to teach the use of advanced tools for signal processing and control system design.

3 Course Structure

1. Linear time-invariant systems
2. State variable models
3. Linear feedback and control systems
4. Sampling theorem and discrete Fourier-transform
5. Structures for discrete time systems
6. Continuous time and discrete time filters (FIR/IIR filter)
7. Applications of the above
8. Signal processing and control engineering with Matlab/Simulink

4 Parameters

- Course characteristics: compulsory
- Course frequency: every year - winter semester
- Capacity: 25 students

	• Course admittance prerequisites: higher mathematics • Skills trained in this course: theoretical and methodological skills • Assessment of the course: Written Exam (90 min) at the end of the course (100%) • Teaching staff: Prof. Dr. Andreas Becker, (Prof. Dr. Jörg Thiem)
5	**Learning outcomes** 5.1 Knowledge • Knows relevant theoretical foundations of signal processing and control theory • Knows mathematical background of linear feedback controllers • Is aware of critical limitations of discrete time signals and the impact of sampling • Knows basic analogue and digital filters 5.2 Skills • Can analyze systems and signals • Can model linear feedback controllers for mechatronic systems • Can apply and design digital filters 5.3 Competence - attitude • Can discuss control system design for mechatronic systems with experts • Can lead cross domain design of control systems • Understands control system experts and translates between different domains
6	**Teaching and training methods** • Lectures & Exercises, Matlab/Simulink labs • e-learning modules on mathematics and control theory, tool tutorials
7	**Course mapping** Input for: • MOD-E04 - Signals and Systems for Automated Driving • MOD-E06 – Computer Vision • MOD-E07 – Signals & Control Systems 2 Requires: • MOD1-01 - Mathematics for Signals & Controls
8	**References** R. Bishop, R. Dorf: Modern Control Systems, Pearson Education, 2010 Oppenheim, Willsky, Nawab, Signals and Systems, Pearson Education, 2013