

Modules semester 1

Module 1 – Cyber Physical Systems

M11 – Structures and Functions of Cyber Physical Systems (4 SWS, 4 CP)

This subject illustrates essential structures and functions of cyber physical systems (short: CPS) and establishes the link to mechatronic systems.

- correlation / differentiation CPS – IoT
- CPS in automatization and production
- basic technologies of networked systems
 - sensor technology, actuator technology
 - communications systems (IPv4, IPv6, OPC-UA...)
 - cloud-systems
 - production planning and control software (THD – example Proleis)
 - ubiquitous computing

Literature:

- Geisberger Eva, Broy Manfred (Hrsg.): agenda CPS, acatech Studie, Springer Verlag , 2012
- Broy, Manfred (Hrsg.): Cyber-Physical Systems, aca tech DISKUTIERT, Springer Verlag, 2010

M12 – Business Models for CPS (2 SWS, 2 CP)

“A Business Modell is an exemplary representation of the logical correlation how an organization respectively an enterprise generates addition value for the customers and secures earnings for the organization.” (based on Gabler Wirtschaftslexikon)

Following this definition typical business models which are in direct relationship with the application of cyber physical systems will be presented and discussed. Examples are:

- new supplier- / costumer relationships using WEB2.0
- individualization of produtcs
- system networking to support maintenance, service, etc. of technical systems
- automation approaches regarding production control

Module 2 – Cooperative and autonomous systems

M21 – Advanced Robotics

In the course of the lecture „Advanced Robotics“ solid knowledge regarding significant topics of autonomous robot systems will be acquired. Paramount are assistance-, service- and

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mobile robots. In this context guidelines and standards will be presented – in particular safety aspects of collaborative robots. Further topics of this lecture will be robot system architectures, localization and mapping as well as navigation and path planning.

M22 – Autonomous Systems

The lecture „Autonomous Systems“ deepens the understanding of mobile and collaborative robotic.

Thereby 3D obstacle- / object recognition and real-time image processing play key roles. Cognitive systems, machine learning and artificial intelligence are also subjects of the lecture.

M23 – Case Study Cooperative and Autonomous Systems

With a selected application example the students are expected to develop and work on a topic by literature research and – where appropriate – smaller independent subtasks. Within the introductory part of the lecture the overall topic will be explained and the subtasks defined.

Example autonomous driving:

- characteristics of the necessary networked systems
- aspects of functional safety for autonomous vehicles
- sensor and actuator technology of the vehicle control system
- autonomous driving and mobility concepts
- (legal / operational framework)
- ...

Module 3 – Advanced Simulation Systems

M31 – Advanced Modeling and Simulation

Basic knowledge of modelling and simulation will be broadened by these and possibly further topics:

- approaches in theoretical modelling of extensive mechanical / electrical / thermal / ... systems, for example energy approach by Lagrange, further approaches of network analysis, finite elements, ...
- techniques for experimental system analysis / modelling: parameter identification, parameter estimation
- presentation and discussion of different procedures of the numeric simulation
- Comparison of causal and non causal simulation systems

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M32 – Case Study Mechatronic System Simulation

With a selected application example the students shall work independent on a connected modelling – and simulation task or on a specific subtopic in the field of modelling / simulation. Contributions from experts from the industry can deepen the understanding of specific topics.

Case studies are so-called “Prüfungsstudienarbeit” (student research projects), there will be no classic exam at the end of the semester.

Modules semester 2 and 3

Module 4 Human Machine Interfaces

Module 5 – Additive Manufacturing

Module 7 – Functional Safety