TECHNISCHE UNIVERSITÄT KAISERSLAUTERN

Module Handbook

TUK MODHB Homapage

Notes on the module handbook of the department Mechanical and Process Engineering

Die hier dargestellten veröffentlichten Studiengang-, Modul- und Kursdaten des Fachbereichs Maschinenbau und Verfahrenstechnik ersetzen die Modulbeschreibungen im KIS und wuden mit Ausnahme folgender Studiengänge am 28.10.2020, bzw. am 13.01.2021 verabschiedet.

Ausnahmen:

- BEd. Lehramt Metalltechnik (Stand WS 19/20): https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MHB_Bachelor_Lehramt_Metalltechnik.pdf
- MEd. Lehramt Metalltechnik Werkstoffe und Fertigung (Stand WS 19/20): https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MHB_Master_Lehramt_Metalltechnik_-_Werkstoffe_und_Fertigung.pdf
- MEd. Lehramt Metalltechnik Maschinen- und Fahrzeugtechnik (Stand WS 19/20): https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MHB_Master_Lehramt_Metalltechnik_-_Fahrzeugtechnik.pdf
- MEd. Lehramt Metalltechnik Verfahrenstechnik (Stand WS 19/20): https://www.mv.uni-kl.de/fileadmin/mv/Studium_Lehre/Modulhandbuecher/MHB_Master_Lehramt_Metalltechnik_-_Verfahrenstechnik.pdf

Course MV-MEC-86679-K-7

Learning-based Control (2V, 3.0 LP)

Course Type

SWS	Type	Course Form	CP (Effort)	Presence-Time / Self-Study	
2	V	Lecture	3.0 CP	28 h	62 h
(2V)			3.0 CP	28 h	62 h

Basedata

SWS	2**V**
CP, Effort	3.0 CP = 90 h
Position of the semester	1 Sem. in WiSe
Level	[7] Master (Advanced)
Language	[EN] English
Lecturers	Ahmed, Saeed, Dr. (WMA | DEPT: MV)
Area of study	[MV-MEC] Mechatronics in Mechanical and Automotive Engineering
Additional informations	Informations about the course
Livecycle-State	[NORM] Active

Contents

Overview of Learning-Based Control, Linear System Identification (Eigensystem Realization Algorithm, Observer Kalman Filter Identification, Dynamic Mode Decomposition), Genetic Programming Control, Extremum Seeking Control, Iterative Learning Control, Robust Data-Driven State-Feedback Design, An H-infinity approach to data-driven simultaneous fault detection and control, Data-Driven Model Predictive Control with Stability and Robustness Guarantees, Data-Driven Economic Model Predictive Control, Reinforcement Learning for Control, Extended Kalman Filter Design for Detection and Tracking of Vehicles Using Radar and Lidar Sensors.

Competencies / intended learning achievements

Learning-based or data-driven techniques are currently revolutionizing how we model, predict, and control complex systems. The most pressing scientific and engineering problems of the modern era are not amenable to empirical models or derivations based on first-principles. Increasingly, researchers are turning to learning-based approaches for a diverse range of complex systems, such as turbulence, the brain, climate, epidemiology, finance, robotics, and autonomy. These systems are typically nonlinear, dynamic, multi-scale in space and time, high-dimensional, with dominant underlying patterns that should be characterized and modeled for the eventual goal of sensing, prediction, estimation, and control. With modern mathematical methods, enabled by the unprecedented availability of data and computational resources, we are now able to tackle previously unattainable challenge problems. In this course, we focus on a mix of established and emerging methods that are driving current developments. In particular, we will focus on the key challenges of discovering dynamics from data and finding data-driven representations that make nonlinear systems amenable to linear analysis. There will be several programming demonstrations on MATLAB.

Literature

- Brunton, Steven L., and J. Nathan Kutz. Data-driven science and engineering: Machine learning, dynamical systems, and control. Cambridge University Press, 2019.
- Buşoniu, Lucian, Tim de Bruin, Domagoj Tolić, Jens Kober, and Ivana Palunko. "Reinforcement learning for control: Performance, stability, and deep approximators." Annual Reviews in Control 46 (2018): 8-28.

Materials

Online, blackboard, powerpoint. For further information and course materials please consider the corresponding OLAT-course.

Requirements for attendance (informal)

Recommended:

Modules:

- [MV-MEC-M155-M-7] Control Theory (M, 5.0 LP)

- [MV-MEC-M193-M-7] Machine Learning (M, 5.0 LP)

Requirements for attendance (formal)

None

References to Course [MV-MEC-86679-K-7]

Module	Name	Context	
[MV-MEC-M222-M-7]	Learning-based Control	P: Obligatory	2V, 3.0 LP