19/03 & 21/03

SEMINAR TOPIC'S

A Unified Interval Approach for Parameter Identification, State Estimation and Robust Control of Spatially Distributed Heating Systems with Uncertainty

Abstract:

Offline parameter identification as well as online estimation of state variables are common tasks for a large variety of control applications. These tasks become especially challenging if parameters are not known with absolute accuracy. Then, interval representations can be used to describe worst-case bounds of uncertain parameters and to compute guaranteed enclosures of the trajectories of all state variables. In this series of talks, an interval-based parameter identification procedure is presented, extended to an observer approach, and validated experimentally for a finite volume representation of a distributed heating system. Moreover, linear matrix inequality techniques are derived and validated experimentally for a robust, cooperativity preserving synthesis of feedback controllers. The unified benchmark application for all subtasks is a distributed heating system with Peltier elements serving as cooling and/or heating devices available at the Chair of Mechatronics at the university of Rostock. In all design phases for parameter identification, state estimation, and control synthesis, the structural system property of cooperativity is exploited which allows for constructing two independent sets of state equations describing guaranteed lower and upper bounds of all system states.

Speakers short bio:

Andreas RAUH received his diploma degree in electrical engineering and information technology from the Technische Universität München, Munich, Germany, in 2001 and his PhD degree (Dr.-Ing.) from the University of Ulm, Germany, in 2008. He completed his habilitation at the Faculty of Mechanical Engineering and Marine Technology at the University of Rostock in 2017 (equivalent to the venia legendi). He has published more than 120 articles and chapters in edited books, international conferences and peer-reviewed journals. His research interests are: state and parameter estimation for stochastic and set-valued uncertainties, verified simulation of nonlinear uncertain systems, nonlinear, robust, and optimal control, interval methods for ordinary differential equations as well as differential-algebraic systems. Dr. Rauh is currently with the Chair of Mechatronics, University of Rostock, Germany, as post-doctoral researcher. Among others, he has been a member of the IEEE 1788 Working Group for the Standardization of Interval Arithmetic since 2008.

****

Julia KERSTEN got her Master of Science in Mechanical Engineering from the University of Rostock in 2014. Since then, the PhD student is working as a researcher at the Chair of Mechatronics. Her research deals mainly with the optimization of efficiency and reliability of energy systems based on robust interval-based control under consideration of uncertainties and nonlinearities.