INVITATION TO A GUEST LECTURE

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Simulation of Distributed Parameter Systems by Transfer Function Models

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Abstract: Most real-world systems are distributed parameter systems, the dynamics of which depend not only on their temporal, but also on their spatial behavior. An abstraction of the real world delivers a comprehensive mathematical description of distributed parameter systems in terms of initial-boundary value problems. The analysis of natural existing as well as the design of synthetic distributed parameter systems are very important tools. Therefore, it is indispensable to obtain suitable models to simulate the spatio-temporal dynamics of such systems. In literature, a considerable number of modeling techniques is found. They may be roughly divided into two different categories: numerical methods and analytical methods. Most numerical methods lead to powerful simulation algorithms. However, these methods often have a very high computational complexity and provide only little insight into the influence of parameters on the output signal. In contrast to that, analytical methods try to find an explicit solution of an initial-boundary value problem before a discrete algorithm is established. A modeling approach from the class of analytical methods is based on a representation in terms of multidimensional transfer functions. Finally, the model of a distributed parameter system can be formulated in terms of a multidimensional state space description. This formulation exhibits several advantages: it constitutes a unified solution and allows its analysis and modification by concepts from control and systems theory. By adapting concepts from control theory the system models are extended by suitable feedback structures to incorporate complex boundary behavior and other desired physical effects. Furthermore, the concept allows to model interconnected systems, which builds the basis for a block-based modeling approach of interconnected distributed parameter systems.

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Bio

Maximilian Schäfer studied Electrical Engineering at the University of Erlangen-Nuremberg, Germany. He received the degree "Doktor-Ingenieur" in electrical engineering from the University Erlangen-Nuremberg, Germany. He worked with the chair of Multimedia Communication and Signal Processing, and now as a Postdoctoral Researcher at the Institute for Digital Communications at the University of Erlangen-Nuremberg, Germany. His research is focused on multidimensional systems theory and the modeling of distributed parameter systems with applications in sound synthesis and molecular communications.

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