Fakultät für Elektrotechnik und Informationstechnik
Technische Universität München

Einladung zur Fortsetzung des Habilitationsverfahrens von

Herrn Dr. Johannes Russer

Akademischer Vortrag im Rahmen der Schlussbewertung

(Dauer: 45 Min., Vortragssprache: Englisch)

am Freitag, den 11. November 2016, 12.00 Uhr (s. t.)

im Nordgelände der TUM, Gebäude N1, 1. Stock, Raum N1135

„Multiphysics Modeling in Nanoelectronics “

Abstract:

The term nanoelectronics comprises all electronic devices and systems with nanoscale dimensions, i.e. dimensions under 100 nm. Nanoelectronics not only influences the development of semiconductor electronics towards higher integration densities and higher frequencies of operation, but also yields novel nanoelectronic materials and devices, such as carbon nanotubes, graphene nanoribbons, spin flip electronic devices, and superconducting quantum interference devices. These developments are not only based on new technologies but also on novel theoretical concepts, requiring multiphysics simulation including transport effects, elasticity theory, electromagnetics, and quantum mechanics.
Multiphysics modeling deals with the modeling of physical or technical systems on the basis of consideration of multiple interacting physical systems and phenomena. Such systems are typically governed by various physical laws as for example Maxwell's theory for electrodynamic phenomena, elasticity theory for vibrations in solids, transport theory for electrons in solids, diffusion theory for thermal conduction, and statistical mechanics for thermodynamics. Due to the low signal power levels in nanoelectronic systems, the accurate modeling of stochastic signals and fields, and of electromagnetic interference plays an important role. Hence, it is an important issue to expand all modeling techniques to handle stochastic variables. With continuing reduction of dimensions, quantum effects yield an increasing role and quantum mechanical laws have to be considered for describing the physical phenomena. Classical systems are replaced by quantum systems and classical statistical systems by quantum statistical systems.
The analytic description of multiphysics systems is performed by coupled systems of partial differential equations. Numerical modeling of nanoelectronic systems requires discretization at various levels based on classical physical as well as quantum mechanical models, comprising deterministic as well as stochastic approaches. The introduction of network models for multiphysics systems either via space-time discretization or by applying Method of Moments is discussed. For the network models Foster or Brune equivalent circuits are established applying system identification methods. Lossless quantum mechanical systems are described by systems of coupled harmonic oscillators - a quantum mechanical correspondence to the classical Foster multiport equivalent circuits. Losses in quantum mechanical systems are modeled on the basis of the Langevin equations. Correlation dyadic methods for the modeling

of noisy fields and the treatment of noise by correlation matrix methods in network models are discussed. The Correlation dyadic method for stationary noisy electromagnetic fields is expanded to cyclostationary noisy electromagnetic fields. The description of noisy fields by correlation matrices can be treated in a memory efficient way using principal component analysis.

Der Vortrag ist **hochschulöffentlich**.

Dekan Prof. Dr. Paolo Lugli

München, den 21. Oktober 2016

Verteiler:
Fachmentorat, Präsident der TUM, Dekane der TUM, Fakultätsrat, Professorenkollegium