

EINLADUNG

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(Seminarraum Informatik 1)

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Titel: Emergent Models in the Theory of Hybrid Systems

Abstract:

Using system dimensions, a term coined from aspect engineering, hybrid systems (HS) can be defined as a mixture of two dimensions: mixture of continuous and discrete dynamics.⁰¹ In the modern research for HS, there are many other dimensions that are considered simultaneously: concurrency, probability, mobility, hierarchical control, architectural views (UML), and so on. This rich dimension integration is necessary for accurately modeling phenomena in technology, biology, physical environment and society. The formidable modeling power achieved in this way pays back in complexity of formal verification. In this talk, the author research on finding a balance between modeling and verification in the area of hybrid systems will be presented. In a basic classification of hybrid systems, proposed by the author, HS split in two classes: Universal models: The model is obtained through algebraic operations from formal models of each dimension. Emergent models: The model results by considering emerging properties resulted from the interaction between different system dimensions.

The models in the first class have been investigated using formal tools from abstract algebra. Their main advantage resides from compositionality which allows the extension of existing verification methods. For the models in the second class, the main advantage comes from the possibility to define subtle and flexible relationships in modeling, and the disadvantage is that new verification methods must be designed from scratches.

A typical example for emergent models are the stochastic hybrid systems. These models result from a deep interaction of traditional academic disciplines like computing, mathematics and control engineering. An example of emerging properties is the stochastic dependence between the probabilities associated with different dimensions. Moreover, the emerging properties can have an impact on system analysis that makes necessary a new classification, proposed by the author: transitional and behavioral models. Behavioral modeling and verification constitute newly introduced computational paradigms that will be presented in the talk. Examples include Hilbertian formal methods, stochastic reachability and functional abstractions. In the end, possible applications in emergent and ubiquitous computing will be discussed.