Fakultät II *Informatik, Wirtschafts- und*
Rechtswissenschaften
Department für Informatik

Internes Kolloquium

Am **Montag, dem 11. Mai 2009,** um **16:15** Uhr hält

Dipl.-Inform. Jens Oehlerking
Universität Oldenburg

im Rahmen seiner beabsichtigten Dissertation einen Vortrag mit dem Titel

Decomposition of Stability Proofs for Hybrid Systems

Der Vortrag findet im OFFIS, Escherweg 2, Konferenzraum F02 statt.

Zusammenfassung:

The verification of hybrid systems, encompassing both discrete-time and continuous-time behavior is a problem of rising importance. For instance, hybrid behavior occurs in the fields of embedded systems (plane autopilot systems), sensor networks (energy consumption models) or industrial control (switched feedback control of chemical processes). Due to the hybrid nature of these systems, neither methods from the discrete domain (like model checking), nor methods from the continuous domain (like frequency domain analysis) can be applied without modification. To verify properties of hybrid systems, it is necessary to employ methods from both domains, if one wants to arrive at algorithms that are also efficiently automatable.

One desired property of hybrid systems, stemming from the control domain, is stability. A stable system is able to recover from transient faults on its own accord, returning to a desirable state after a certain time. Stability proofs are usually conducted with the help of so-called Lyapunov functions, which act as generalized energy functions of the system. A Lyapunov function maps each of the (usually infinitely many) possible system states onto an energy value, such that the energy decreases as the system evolves. The existence of such a function serves as a proof of stability. Furthermore, there exists numerical methods to conduct the computation of such functions, allowing for automated verification. While these methods work well for small-scale systems, they do, however, not scale up well to systems with large discrete state spaces that appear in many real-world applications. Therefore, it is desirable to conduct these computations in a decompositional manner, solving many small-scale problems instead of one large-scale problem.

This thesis will contribute to bridging this gap by introducing an automatable framework that works on hybrid automaton models. A hybrid automaton is viewed as a graph structure and decomposed into sub- components, for which the numerical algorithms are run individually. The results of these computations are then lued back together to yield a Lyapunov function, and therefore a stability proof, for the entire system. These local proofs are not only more lightweight than the monolithical (and possibly intractable) standard proof, but also allow for the location of problem states if the computation fails, and the compositional construction of complex stable hybrid automata. Furthermore, the results can be extended to the domain of probabilistic hybrid automata, which are a combination of hybrid systems and Markov chains. Probabilistic hybrid automata allow for the exploitation of statistical information about the environment, guaranteeing stabilization with a certain probability. The decompositional results are generalized to this setting, to allow for qualitative and quantitative automatable stability proofs for probabilistic systems. For both non-probabilistic and probabilistic systems, the decompositional approach can also be exploited to yield a set of rules for the structured construction of stable hybrid systems with complex discrete behavior.

Betreuer: Prof. Dr.-Ing. Oliver Theel

Weitere Kolloquiumstermine sind im WWW abrufbar.