DATA-DRIVEN MODELING AND CONTROL WITH GUARANTEES

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ABSTRACT: Classical control approaches are often based on physical dynamic models, which are required to describe the true underlying system behavior in a sufficiently accurate fashion. For complex dynamical systems, however, such descriptions are often extremely hard to obtain, or even nonexistent, hence data-driven approaches have to be employed. Data-driven models are based on observations and measurements of the true system and only require a minimum amount of prior knowledge of the system. However, they require new control approaches since classic analysis and synthesis tools are not suitable for models of probabilistic nature.

This talk focuses on Gaussian process models, which are very generally applicable and have shown to be successful in many control scenarios. We show how to analyze the control-relevant properties of Gaussian process models. Furthermore, we present new control algorithms, which not only improve the overall performance but also guarantee the stability of the closed-loop system. Finally, the approaches are tested and validated in simulations and robotic experiments.