Speaker: Alessandro Abate, Oxford University

Title: Data-driven and model-based quantitative verification and correct-by-design synthesis of CPS

Abstract:
I discuss a new and formal, measurement-driven and model-based automated verification and synthesis technique, to be applied on quantitative properties over systems with partly unknown dynamics. I focus on physical systems (with spatially continuous variables, possibly noisy), driven by external inputs and accessed under noisy measurements, and suggest that the approach can be as well generalized over CPS. I formulate this new setup as a data-driven Bayesian model inference problem, formally embedded within a formal, model-based verification procedure.

While emphasizing the generality of the approach over a number of diverse model classes, this talk zooms in on systems represented via stochastic hybrid models (SHS), which are probabilistic models with heterogeneous dynamics (continuous/discrete, i.e. hybrid, as well as nonlinear) - as such, SHS are quite a natural framework for CPS. With focus on model-based verification procedures, I provide the characterization of general temporal specifications based on Bellman's dynamic programming.

The computation of such properties and the synthesis of related control architectures optimizing properties of interest is attained via the development of abstraction techniques based on quantitative approximations. This abstraction approach employs methods and concepts from the formal verification area, such as that of (approximate probabilistic) bisimulation, over models and problems known in the field of systems and control.

Theory is complemented by algorithms, all packaged in a software tool (FAUST^2) that is freely available to users.