Invited Open TRACK at 21th IFAC World Congress

Uncertainty Quantification in Control and Optimization – Tools, Methods and Applications

Organizers

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Scope and Aims

In many applications domains, such as process systems, manufacturing systems, and energy systems, available models are inherently uncertain and subject to stochastic process disturbances. Hence, recently there have been manifold efforts to account explicitly for uncertainties both in optimizing process performance and in designing control strategies. Concurrently, in the area of applied mathematics, Uncertainty Quantification (UQ) techniques have seen significant progress in terms of method development and in terms of available computational tools.

UQ concepts arise frequently in control and automation for example in context of stochastic MPC and stochastic optimization. At the core of any UQ approach to control problems is either the aspect for forward uncertainty propagation, e.g. the propagation of dynamics systems under (parametric) model uncertainty, or the aspect of inverse uncertainty quantification, e.g. Bayesian approaches.

Recently, different research groups have proposed to investigate polynomial chaos expansions as an efficient means of propagating parametric model uncertainties in the context of batch process optimization, in the context of MPC, and in the context of energy networks. At the same time, the extensive amount of research on stochastic MPC also encompasses issues such as the efficient reformulation of chance constraints, the propagation of uncertainties and stochastic stability and reachability problems.

The proposed track aims to bring together researchers working on different UQ methods, tools and applications. This way, it shall provide a platform for presenting theoretical and application-oriented contributions, and it shall foster discussions on new ideas regarding the development of tailored UQ schemes for uncertain process systems, energy systems and beyond.

The track welcomes contributions on theoretical, methodological, and applied aspects of UQ. Of specific interest are contributions presenting new computational tools.

Topics of interest include, but are not limited to:

- uncertainty quantification
- sensitivity analysis
- stochastic MPC
- process design under uncertainties
- chance constraints
- stochastic stability
- surrogate modelling
- optimal experimental design
- active fault detection
- energy systems, smart grids
- smart manufacturing
- hybrid modelling and big data
- Bayesian approaches