IFAC World Congress 2020

Open Invited Track:

Numerical Methods for Predictive Control

Model Predictive Control (MPC) is a modern control design paradigm that formulates the control problem as a constrained mathematical optimization problem, parametric in the most recent state measurements. The solution of this problem is a finite time input sequence/trajectory which optimizes some performance metric of the predicted system evolution. If implemented as a closed-loop controller, the solution of the classical MPC problem must be recomputed at every subsequent sample time using the most recent state measurements.

Both the complexity of the resulting numerical optimal control problem and the time available to find a solution depend on the system under consideration. The availability of efficient numerical optimization methods is essential for the real-time application of MPC to complex systems. Existing algorithms have applied iterative numerical methods such as interior point, active-set, or gradient-based methods to solve MPC problems.

Much existing work has focused on exploiting the particular structure of the MPC problem. Tailor-made algorithms have allowed for a significant reduction in the computational complexity and improved scalability. For example, with structure-exploiting interior point methods the computational time required scales linearly with the horizon length, instead of cubically.

Alternatively, instead of speeding up convergence to optimality, other lines of work have proposed MPC schemes which do not require convergence to optimality at each time step. Many of these algorithms utilize early termination criteria, sup-optimal solutions, lower-order control updates to previously computed trajectories, or real-time iteration schemes to provide control inputs at a faster rate. These methods trade off the optimization of closed-loop performance with the computation of stabilizing control inputs for a fast systems.

In this invited track, technical and scientific contributions in the following areas are encouraged:

- Novel numerical methods to solve MPC optimization problems.
- Improvements to performance, robustness, or applicability of existing methods.
- MPC on embedded processors.
- Sub-optimal MPC.
- Real-time schemes.
- Hardware or software implementations for real-time MPC.