Systems and Control Seminar
Fujita and Hatanaka Group
Tokyo Institute of Technology

Model Predictive Control of Stochastic Nonlinear Systems

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Dipl. –Inform. Christof Chlebek
Institute of Anthropomatics and Robotics
Department of Informatics
Karlsruhe Institute of Technology

Abstract

In Model Predictive Control (MPC), the main objective is to compute and apply control inputs such that the behavior of a system quantified by means of a cost function is optimized over a certain control horizon. Modeling errors or disturbances affecting the system can be considered in a stochastic fashion leading thereby to stochastic MPC (SMPC). The optimal solution, or strictly speaking the closed-loop optimal solution, is given by the Bellman equation, which unfortunately is only computable in few special cases, such as the linear-quadratic-Gaussian (LQG) control problem or the control of systems with a finite number of states, possible measurements, and control inputs. This is mostly due to the curse of dimensionality and the fact that separation of estimation and control does not hold in the case of stochastic nonlinear systems.

In literature, this problem is mainly considered by two research fields, namely Partially Observable Markov Decision Problems (POMDPs) and Optimal Control. Historically arisen from different domains, we are now confronted with two sets of notations. In this talk, we give a unified overview of the resulting problem of the control of stochastic nonlinear systems with imperfect state information in the context of model predictive control. We show how growing measurement feedback history can be represented compactly by Bayesian estimation theory. Finally, we compare the spirit of the POMDP and Optimal Control research communities in the context of two methods considering the stated problem.