Control Systems Society
Italy Chapter

Systems Modeling and Control Seminar

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"Adaptive Model Predictive Control: Robustness, Performance Enhancement and Parameter Estimation"

December 3, 2019 - 14:30 Sala Riunioni – IEIIT CNR

Abstract. Control algorithms that combine online model identification with optimization of predicted performance have been a focus of research since the origins of Model Predictive Control (MPC) 40 years ago. However few control strategies based on MPC with online model identification provide guarantees of robust performance and constraint satisfaction. Recent developments in robust predictive control, set-based identification and convex optimization have led to a resurgence of interest in this direction.

The talk will discuss recent work on computationally tractable robust adaptive MPC formulations for systems with uncertain models, additive disturbances, and state and control constraints. The approach has the potential to overcome a fundamental limitation of MPC, namely that optimization-based control strategies rely on accurate system models, but these can be prohibitively expensive and disruptive to obtain through dedicated model identification experiments. By explicitly optimizing predicted control signals and system responses, adaptive MPC is an ideal framework within which to consider simultaneous optimization of regulation performance and model excitation for parameter identification.

We will explore conditions for parameter convergence and implications for the cost of model identification. Connections with safety and robustness in machine learning and a framework applicable to nonlinear model classes will be discussed. The talk will also consider how to balance the potentially conflicting requirements for achieving good tracking performance and improving parameter estimates by introducing convex constraints that ensure persistency of excitation.

Biographical Sketch. Mark Cannon obtained the degrees of MEng and DPhil from Oxford University in 1993 and 1998, and SM from Massachusetts Institute of Technology in 1995. Since 2002 he has been a Lecturer (now Associate Professor) in the Engineering Science Department and a Fellow of St John's College, University of Oxford. He is a member of the Oxford Control Group.