Direct Data-Driven Design of Linear Control Systems with Constraints

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Abstract

In many nonlinear control problems, the plant can be accurately described by a linear model whose operating point depends on some measurable variables, called scheduling signals. When such a linear parameter-varying (LPV) model of the plant needs to be derived from a set of data, several issues arise in terms of parameterization, estimation and model validation. Moreover, the way modeling errors affect the closed-loop performance is still largely unknown. In this talk, a direct data-driven control method is proposed to design linear controllers directly from data without deriving a model of the nonlinear plant. The main idea of the approach is to use a hierarchical control architecture, where the inner controller is designed to match a simple and a-priori specified closed-loop behavior. Then, an outer reference governor is synthesized from data to handle input/output constraints and to enhance the performance of the inner loop. The effectiveness of the approach is illustrated by means of simulation and experimental examples. Practical implementation issues are also discussed.

Biographical Information

Simone Formentin was born in Legnano, Italy, in 1984. He received the B.Sc. and M.Sc. degrees cum laude in automation engineering from Politecnico di Milano, Italy, respectively in 2006 and 2008, and the Ph.D. degree cum laude in information technology within a joint program between Politecnico di Milano and Johannes Kepler University Linz, Austria, in 2012. He held postdoctoral appointments at EPFL Lausanne, Switzerland, and University of Bergamo, Italy. Since 2014, he has been an Assistant Professor at Politecnico di Milano. His research interests include system identification, machine learning and automotive control. Dr. Formentin is a member of the IEEE CSS TC on System Identification and Adaptive Control, IFAC TC on Modelling, Identification and Signal Processing and IFAC TC on Robust Control. He is a member of the Editorial Board of the IEEE CSS.