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Data-driven Economic NMPC using Reinforcement Learning

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Abstract

Model Predictive Control (MPC) is an advanced control technique able to deal with multivariable nonlinear models subject to constraints. The main idea of MPC is to use a mathematical model of the process to predict its future behavior and minimize a given performance index, subject to constraints capturing actuator limits and other operating constraints. The advantages of MPC are numerous, as it makes it relatively easy to handle various difficulties in control design, such as dealing with many inputs and outputs, input and output constraints, nonlinear and hybrid dynamics, delays, etc. One of the main drawbacks of MPC is that control performance is highly dependent on the predictive ability of the model.

Data-driven control approaches such as Reinforcement Learning (RL) mitigate the issue of model construction and tuning by learning directly the (optimal) control law from data. While stunning results have been obtained, differently from MPC, RL cannot provide stability nor safety guarantees. Additionally, partial information which is usually available, can be hard to include in RL.

In this seminar, we will discuss how RL and MPC can be combined with the aim of benefiting from the advantages of each while limiting the drawbacks of both. We will first introduce the two techniques and then present some recent theoretical results which support the use of MPC within an RL framework. Simulation results will also be presented to support the theoretical developments.

Biography

Mario Zanon received the Master's degree in Mechatronics from the University of Trento, and the Diplôme d'Ingénieur from the Ecole Centrale Paris, in 2010. After research stays at the KU Leuven, University of Bayreuth, Chalmers University, and the University of Freiburg he received the Ph.D. degree in Electrical Engineering from the KU Leuven in November 2015. He held a Post-Doc researcher position at Chalmers University until the end of 2017 and is now Assistant Professor at the IMT School for Advanced Studies Lucca. His research interests include numerical methods for optimization, economic MPC, reinforcement learning and optimal control and estimation of nonlinear dynamic systems, in particular for aerospace and automotive applications.