Data-Enabled Predictive Control: In the Shallows of the DeePC

Prof. Florian Dörfler
ETH Zurich
Date: Wednesday, April 10, 2019
Time: 11:30 pm
Location: ECAD 109
There will be Pizza, Drinks, and Coffee

Abstract: We consider the problem of optimal and constrained control for unknown systems. A novel data-enabled predictive control (DeePC) algorithm is presented that computes optimal and safe control policies using real-time feedback driving the unknown system along a desired trajectory while satisfying system constraints. Using a finite number of data samples from the unknown system, our proposed algorithm uses a behavioral systems theory approach to learn a non-parametric system model used to predict future trajectories. We show that, in the case of deterministic linear time-invariant systems, the DeePC algorithm is equivalent to the widely adopted Model Predictive Control (MPC), but it generally outperforms subsequent system identification and model-based control. To cope with nonlinear and stochastic systems, we propose salient regularizations to the DeePC algorithm. Using techniques from distributionally robust stochastic optimization, we prove that these regularization indeed robustify DeePC against corrupted data. We illustrate our results with nonlinear and noisy simulation case studies from aerial robotics, power electronics, and power systems.

Bio: Florian Dörfler is an Assistant Professor at the Automatic Control Laboratory at ETH Zürich. He received his Ph.D. degree in Mechanical Engineering from the University of California at Santa Barbara in 2013, and a Diplom degree in Engineering Cybernetics from the University of Stuttgart in 2008. From 2013 to 2014 he was an Assistant Professor at the University of California Los Angeles. His students were winners or finalists for Best Student Paper awards at the 2013 European Control Conference, the 2016 American Control Conference, and the 2017 PES PowerTech Conference. His articles received the 2010 ACC Student Best Paper Award, the 2011 O. Hugo Schuck Best Paper Award, the 2012-2014 Automatica Best Paper Award, and the 2016 IEEE Circuits and Systems Guillemin-Cauer Best Paper Award. He is a recipient of the 2009 Regents Special International Fellowship, the 2011 Peter J. Frenkel Foundation Fellowship, and the 2015 UCSB ME Best PhD award.