Abstract

This talk is about a novel control scheme, named self-reflective model predictive control, which takes its own limitations in the presence of process noise and measurement errors into account. In contrast to existing output-feedback MPC and persistently exciting MPC controllers, self-reflective MPC controllers do not only propagate a matrix-valued state forward in time in order to predict the variance of future state-estimates, but they also propagate a matrix-valued adjoint state backward in time. This adjoint state is used by the controller to compute and minimize a second order approximation of its own expected loss of control performance in the presence of random process noise and inexact state estimates. A second part of the talk introduces a real-time algorithm, which can exploit the particular structure of the self-reflective MPC problems in order to speed-up the online computation time. It is shown that, in contrast to generic state-of-the-art optimal control problem solvers, the proposed algorithm can solve the self-reflective optimization problems with reasonable additional computational effort compared to standard MPC. The advantages of the proposed real-time scheme are illustrated by applying it to a benchmark predator-prey-feeding control problem.

Biographical Information

Boris Houska is an assistant professor at the School of Information Science and Technology at ShanghaiTech University. He received a diploma in Mathematics from the University of Heidelberg in 2007, and a PhD in Electrical Engineering from KU Leuven in 2011. From 2012 to 2013 he was a post-doctoral researcher at the Centre for Process Systems Engineering at Imperial College London. During 2013–2014 he worked as faculty member at the Department of Automation at Shanghai Jiao Tong University and as a guest professor at the Institute for Microsystems Engineering at the University of Freiburg. His research interests include numerical optimization and optimal control, robust and global optimization, as well as fast model predictive control algorithms.