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PolyMPC: an efficient and extensible tool for real-time nonlinear model predictive tracking and path following for fast mechatronic systems. (English) Zbl 1467.93094

Summary: This paper presents PolyMPC, an open-source C++ library for pseudospectral-based real-time predictive control of nonlinear systems. It provides a necessary background on the computational aspects of the pseudospectral approximation of optimal control problems and explains how various model predictive control and parameter estimation algorithms can be implemented using the software. We discuss the key algorithmic modules and architectural features of the PolyMPC library. The workflow of a path following controller design for a highly nonlinear mechatronic system is demonstrated in a tutorial example. Another example illustrates how the core functionality might be used to approximate and solve a custom optimal control problem.

MSC:
93B45 Model predictive control
93C10 Nonlinear systems in control theory
93-08 Computational methods for problems pertaining to systems and control theory

Keywords:
Chebyshev polynomials; nonlinear model predictive control; optimal control; pseudospectral collocation

Software:
GPOPS; qpOASES; ROS; DIRCOL; PolyMPC; CppAD; CasADi; Matlab; SNOPT

Full Text: DOI