Model predictive path following controller for multirotor UAVs

Abstract:
There is strong interest in Micro Aerial Vehicle (MAV) control architectures which are able to systematically respect physical limitations of the plant. Nonlinear Model Predictive Control (NMPC) inherits the required constraint handling abilities and is easy to reconfigure in case of plant degradation. This work presents a promising cascaded control architecture for multirotors for the task to follow a geometric path. In contrast to existing NMPC implementations for path following, three times continuously differentiable reference trajectories are required due to the underactuated nature of multirotor vehicles. This is achieved by defining a path by a quartic spline and employ fourth order path dynamics. The proposed controller considers the dynamics of the inner acceleration loop explicitly so that the assumption of time-scale separation between the controller cascades can be dropped. The presented implementation allows for online adaptation of plant and control parameters as a first step towards application in a fault-tolerant setup. High fidelity simulation results demonstrate the favorable performance.
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