

Nonlinear Model Predictive Control based PID on Resource-Constrained Microcontrollers

Abstract

Nonlinear Model Predictive Control (NMPC) is a powerful approach for controlling highly dynamic robotic systems, as it accounts for system dynamics and optimizes control inputs at each step. However, its high computational complexity makes implementation on resource-constrained microcontrollers impractical. While recent studies have demonstrated the feasibility of Model Predictive Control (MPC) with linearized dynamics on microcontrollers, applying full NMPC remains a significant challenge. This work presents an efficient solution for generating and deploying NMPC on microcontrollers to control quadrotor UAVs. The proposed method optimizes computational efficiency while maintaining high control accuracy. Simulations in Gazebo/ROS and real-world experiments validate the effectiveness of the approach, demonstrating its capability to achieve high-frequency NMPC execution in real-time systems.