A COMPARATIVE STUDY OF MODEL PREDICTIVE CONTROL AND THE STANLEY METHOD FOR VEHICLE PATH TRACKING APPLICATIONS

A Master's Thesis Defense in Mechanical Engineering
California Polytechnic State University, San Luis Obispo

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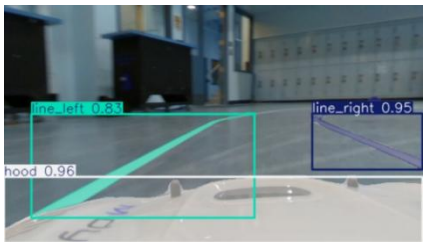

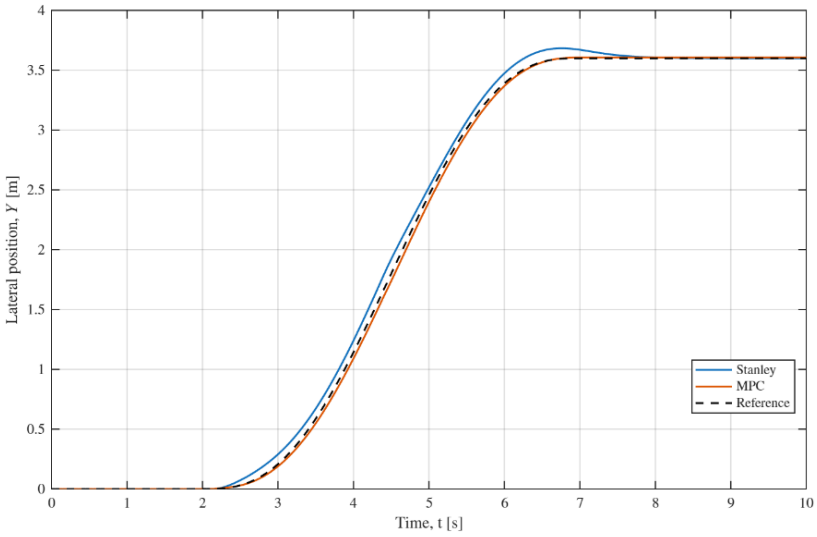

Vehicle path tracking is a fundamental challenge in autonomous driving, requiring steering controllers that balance tracking performance, computational cost, and robustness under real-world sensing conditions. This research compares a model predictive controller (MPC) and a lateral Stanley controller for autonomous vehicle path tracking. Controllers were first evaluated in simulation using a nonlinear dynamic bicycle plant model executing prescribed lane change maneuvers, then implemented within a perception-driven steering-control pipeline using replayed ROS2 bagfile data collected from manual vehicle operation on the MXcarkit 1/8th-scale autonomous vehicle platform by MdynamiX. Results showed that MPC provided improved tracking performance during aggressive simulated maneuvers but required greater steering activity and computational effort. Under perception-driven replay evaluation, both controllers demonstrated similar agreement with recorded manual steering behavior, suggesting that the shared perception and roadway-estimation pipeline may limit observable differences between controller architectures.

Friday, June 5, 2026 | 9:10 a.m. PDT | Building 13, Room 124B

Zoom Meeting ID: 720 963 6451 | https://calpoly.zoom.us/j/7209636451