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PERFORMANCE ANALYSIS OF PREDICTIVE FUNCTIONAL CONTROL FOR AUTOMOBILE ADAPTIVE CRUISE CONTROL SYSTEM

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Abstract

This paper presents the performance analysis of Predictive Functional Control (PFC) for Adaptive Cruise Control (ACC) application. To cope with multiple driving objectives of modern ACC systems such as passenger comfort, safe distancing, and fast time response, an advanced optimal controller such as Model Predictive Control (MPC) is often used. Nevertheless, MPC requires a high computation load due to its complex formulation and may overload the processing power of a microcontroller. Thus, the prime objective of this work is to propose a PFC algorithm as an alternative controller, while providing a formal comparison between MPC and the traditional Proportional Integral (PI) controller. A standard kinematic model for vehicle longitudinal dynamics was modelled and used to derive the control law of

PFC. Since the open-loop dynamic of the derived transfer function is not stable, the second objective is to propose a pre-stabilized loop or cascade PFC structure for the system. A complete tuning procedure and analysis were presented. The simulation result shows that although MPC performance is the best for the ACC application with Root Mean Square Error (RMSE) of 1.4873, PFC has shown a promising response with RMSE of 1.5501, which is better compared to the PI controller with RMSE of 1.6219. All the imposed driving constraints such as maximum acceleration, maximum deceleration and safe distance were satisfied in the car following application. Thus, the findings from this work can become a good initial motivation to further explore the capability of the PFC algorithm for future ACC development.

Author keywords

adaptive cruise control; model predictive control; PID; predictive functional control

SciVal Topics

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