Robotics and Autonomous Systems Thesis Defense

Model-Predictive Control Enhanced Energy Management and Analysis of Dual-Motor Electric Vehicles

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Abstract

Electric vehicles (EVs) have emerged as a promising solution to reduce greenhouse gas emissions and dependency on fossil fuels in the transportation sector. However, limited battery capacity remains a significant challenge, impacting range and overall performance. This thesis explores the application of Nonlinear Model Predictive Control (NMPC) techniques to optimize energy management in EVs. The study begins with a comprehensive review of existing literature on EV energy optimization strategies and NMPC methodologies. Subsequently, a detailed model of the EV's dynamics, including the battery, motor, and vehicle dynamics, is developed to formulate the optimization problem. The NMPC controller is designed to dynamically adjust the power distribution among different vehicle components, such as the motor, battery, and regenerative braking system, while considering constraints such as battery state-of-charge, vehicle speed, and road conditions. Simulation studies are conducted to evaluate the performance of the proposed NMPC-based energy optimization strategy under various driving scenarios and compare it with conventional control strategies. The results demonstrate that NMPC offers superior performance in terms of energy efficiency, range extension, and overall vehicle dynamics. The findings of this research contribute to the advancement of energy optimization techniques for EVs, paving the way for more efficient and sustainable transportation systems in the future.

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