Control Strategy for Safe Driving of four in-Wheel Motor Vehicles

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Abstract

In this study, we presents a comprehensive control strategy for in-wheel motor independent drive electric vehicles (full 4-IWM EV). The primary objectives of our control strategy encompass three key aspects: accurate tracking of desired speed, precise following of reference paths, and enhanced energy efficiency.

The control architecture consists of upper and lower controllers. The upper controller focuses on determining longitudinal forces and yaw moments using model predictive control (MPC). To obtain the yaw moment, desired yaw rate is calculated from the bicycle model. In order to determine the longitudinal force, the velocity error with respect to target value and a feedforward term to minimize the effect of disturbance will be considered.

The lower controller is responsible for individual wheel torque allocation and can exactly follow the commands of the upper controller. To achieve these goals, we develop a cost function that addresses both reduced engine power consumption and improved wheel stability. By carefully balancing these factors, we aim to achieve the optimal trade-off between energy efficiency and vehicle performance. Additionally, We will formulate a control strategy that aims to optimize energy by minimizing rolling resistances associated with wheel slip angle and carry out our mission of performing stable driving on rough roads. Respond to road undulation pattern, analysis of the suspension model was carried out in order to fulfill the specified constraints.

Through simulation and analysis. We verify the effectiveness of control strategies to achieve the proposed goals. This result indicates successful coordination between the upper and lower controllers, leading to better tracking accuracy and better energy-saving capabilities. This study will contribute to an efficient torque distribution method for full 4-IWM EV.
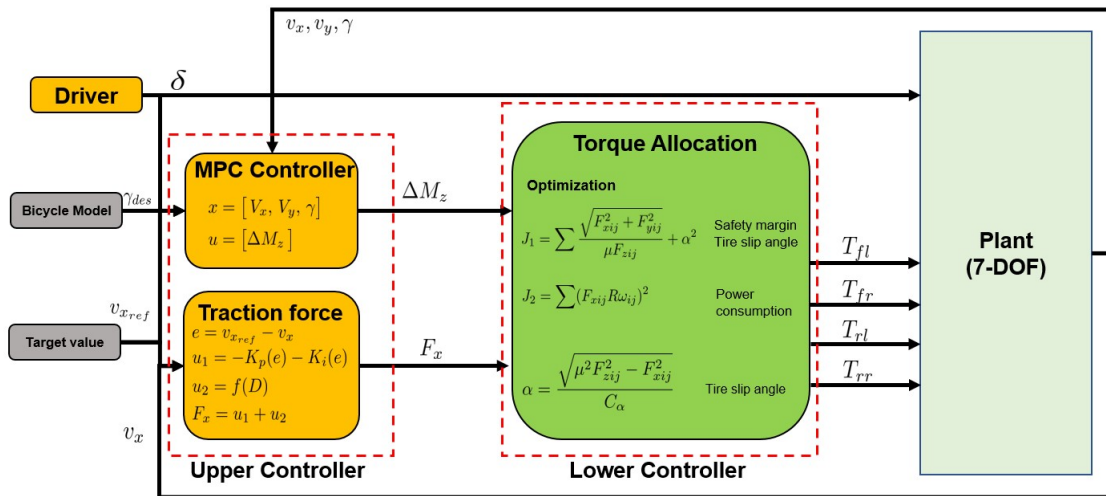
Figure 1: Overall structure