Coupling Control of Sideslip and Yaw Rate for Distributed Drive Vehicles Via Torque Vector Control㊀

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Abstract: Distributed drive vehicles are typical over-actuated systems, and taking full advantage of the four-wheel independent drive capability can enhance the maneuverability and safety of the vehicle. In this study, a new torque vector control algorithm is proposed to maximize the use of the tire force of each wheel and realize the coupling control of sideslip angle and yaw rate. Firstly, based on the analysis of vehicle steering hysteresis characteristics, a critical yaw rate is proposed to establish a reliable yaw rate stability boundary, while a phase portrait analysis method is used to determine the sideslip angle stability boundary and calculate the target value to complete the reference target setting of the torque vector control algorithm. Secondly, a torque vector controller with hierarchical architecture is designed, consisting of three parts: the first one is the longitudinal force distribution layer, with the control objective of reaching the road adhesion limit simultaneously for the front and rear axles of the vehicle as much as possible, the second one is the additional yaw moment control layer, which generates the additional yaw moment of the vehicle based on model predictive control, the third one is the wheel torque regulation layer, which combines the additional yaw moment and longitudinal drive force distribution requirements and other constraints to complete the four-wheel wheel torque distribution based on the optimal tire adhesion rate. Finally, the effectiveness of the torque vector control algorithm is verified through a typical experiment scenario.

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