基于主动制动的车辆稳定性系统最优控制策略 Optimal Yaw-moment Control Based on Active Braking

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关键词： 车辆 分层控制 横摆力矩控制 滑移率控制 模型跟踪

摘 要： 引入分层控制概念设计了横摆力矩控制和滑移率控制相结合的车辆稳定性控制系统。建立了侧偏角和横摆角速度具有最佳输出响应的车辆理想模型，采用前馈与反馈控制相结合跟踪理想模型的控制策略，基于最优控制理论设计横摆力矩控制器。通过设计理想滑移率分配模块确定下层滑移率控制器理想值，基于模糊控制理论设计滑移率控制器。在Matlab/Simulink平台上建立8自由度非线性车辆模型，分别在低附着和高附着路面条件下进行了仿真分析。结果表明：采用分层控制可以很好地实现车辆所需横摆力矩，有效地控制车辆质心侧偏角和横摆角速度跟踪理想模型，瞬态及稳态响应良好，改善了车辆操纵稳定性。The cascade structure of control system consisting of yaw-moment controller and wheel slip controller was adopted to develop vehicle stability control (VSC). An ideal model with the best performance of side-slip angle and yaw-rate was established. The strategy of both the forward-feed control and back-feed control of tracking the desired model was employed. The linear quadratic regulator (LQR) theory was exploited for yaw-moment controller. Ideal slip assignment model was proposed to determine the ideal value for slip controller from the yaw moment acquired from the yaw-moment controller. The fuzzy logic control theory was applied to slip controller. An 8-DOF nonlinear vehicle model was constructed based on Matlab/Simulink platform, and then simulation was performed under low friction and high friction road condition respectively. The results show that the proposed control algorithm can achieve the desired yaw-moment, the side-slip angle and yaw-rate can track the ideal model effectively. It can achieve good transient and steady response, and improve vehicle handling stability.

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