Real-time Tire Parameters Observer for Vehicle Dynamics Stability Control

LI Liang*, LI Hongzhi, ZHANG Xiaolong, HE Lin, and SONG Jian

State Key Laboratory of Automotive Safety and Energy, Tsinghua University, Beijing 100084, China

Received December 15, 2009; revised August 2, 2010; accepted August , 2010; published electronically August , 2010

Abstract: The performance of the vehicle dynamics stability control system(DSC) is dominated by the accurate estimation of tire forces in real-time. The characteristics of tire forces are determined by tire dynamic states and parameters, which vary in an obviously large scope along with different working conditions. Currently, there have been many methods based on the nonlinear observer to estimate the tire force and dynamic parameters, but they were only used in off-line analysis because of the computation complexity and the dynamics differences of four tires in the steering maneuver conditions were not considered properly. This paper develops a novel algorithm to observe tire parameters in real-time controller for DSC. The algorithm is based on the sensor-fusion technology with the signals of DSC sensors, and the tire parameters are estimated during a set of maneuver courses. The calibrated tire parameters in the control cycle are treated as the elementary states for vehicle dynamics observation, in which the errors between the calculated and the measured vehicle dynamics are used as the correcting factors for the tire parameter observing process. The test process with a given acceleration following a straight line is used to validate the estimation method of the longitudinal stiffness; while the test process with a given steering angle is used to validate the estimated value of the cornering stiffness. The ground test result shows that the proposed algorithm can estimate the tire stiffness accurately with an acceptable computation cost for real-time controller only using DSC sensor signal. The proposed algorithm can be an efficient algorithm for estimating the tire dynamic parameters in vehicle dynamics stability control system, and can be used to improve the robustness of the DSC controller.

Key words: tire, longitudinal stiffness, cornering stiffness, vehicle dynamics stability

---

*Corresponding author. E-mail: liangl@tsinghual.edu.cn
This project is supported by National Natural Science Foundation of China (Grant No. 50905092)

E-mail: cjme@mail.machineinfo.gov.cn **http:** // www.cjmenet.com.cn