Study of Hardware-In-Loop Fuzzy Logic Control Intelligent Vehicle Anti-Roll System

張晁誠、張一屏
E-mail: 343894@mail.dyu.edu.tw

Abstract

The objective for this study is to establish an intelligent vehicle anti-roll fuzzy control system in the Hardware-in-Loop (HIL) environment. Different vehicle operating conditions were simulated to compare the vehicle anti-roll performance and effects of body center of gravity height and suspension active force variation with the vehicle speed to the roll rate were assessed. In order to achieve steady-state anti-roll stability of the body control purposes, different control systems were used to compare and validate with fuzzy control system output performance. In this study, object-oriented models and fuzzy control module were established to simulate the intelligent vehicle roll motion. Simulation includes the steering control and stability control, braking force distribution control, tire dynamic model, roll model and fuzzy control models. Different speeds and operating conditions were simulated to calculate the roll angles and its rate of intelligent vehicle anti-roll system to analysis the effects of control and design parameters. Anti-roll performance and control strategic planning of the fuzzy controller were validated and compared with previous PI controller results. Intelligent vehicle center of gravity and suspension active force control calculated from the fuzzy controller varied with different speed and steering input conditions which changes in according to path movement, can thus be more accurately corrected to ensure vehicle roll stability to meet the design requirements for driving conditions. The analysis method used in this study can quickly assess the anti-roll stability system of vehicles which are required for the performance evaluation in domestic production vehicles business. This study also enhances R&D capabilities of the domestic vehicles and technology in the active vehicle anti-roll stability system and body stability control system, which helps related engineers to improve performance and shorten the development time for domestic related industries to enter the ranks of advanced technology.

Keywords: Rollover、Roll-Stability Indicator、Vehicle Real-Time Dynamic Stability Control System、Dynamic Performance Hardware-in-Loop Simulation
REFERENCES


P. Gaspar, Z. Szabo, and J. Bokor, 「Brake control combined with prediction to prevent the rollover vehicles,」 IFAC World Congress, Praha. 2005.


J. Wang, G. Yu, Z. Li, W. Zhang, N. Ding, 「Real-time roll state estimation and rollover prediction for light SUVs,」 School of Transportation Science and Engineering, Beihang University, Beijing 100191, China.


A. Y. Lee, 「Coordinated control of steering and anti-roll bars to alter vehicle rollover tendencies,」 ASME International Mechanical Engineering Conference and Exhibition, 2002.


Reference:


[63] 賴耿陽, 車輛驅動及控制, 復漢出版社印行, 1993。

[64] 郭仲軒「後輪操控對抑止車輛翻覆之影響分析」國立臺灣大學工學院機械工程學系碩士論文, 2007。

[65] 黃俊儒「多缸汽油引擎噴油控制器設計與研究」大葉大學車輛工程研究所碩士論文, 2005。


[69] 張一屏, 「四行程機車氣冷式汽車引擎管理系統參數最佳化分析」中國機械工程學會第十五屆學術研討會(臺南市 " "準備中)

[70] 張一屏, 蘭真, 「四行程汽車引擎管理系統參數實驗設計最佳化分析」陸軍官校87年機械基礎學術研討會(高雄縣鳳山市 " "準備中)

[71] 張一屏, 蘭真, 「汽車引擎於全負荷之性能參數最佳化設計與實驗分析」中國機械工程學會第十五屆學術研討會(臺南市 " "準備中)

[72] 張一屏, 蘭真, "智慧型車輛引擎定轉速控制參數多目標性能最佳化分析", 「民航學會/航太學會/燃燒學會」學術聯合會議論文集(高雄市 " "準備中)

[73] 陳榮俊「智慧型車輛動力系統之動態模擬與分析」大葉大學車輛工程研究所碩士論文, 2002。

[74] 許益誠「積極滾動控制之車輛半主動式懸吊系統之研發」國立臺北科技大學製造科技研究所碩士學位論文, 2002。

[75] 鄧肇鴻「車輛行駛軌跡及抑止車輛翻覆之差動式輪胎力矩控制系統」國立交通大學機械工程學系碩士論文, 2002。

[76] 鄧肇鴻「線傳車輛前房鈴電控系統模擬與測試分析之研究」大葉大學機械與自動化工程學系碩士論文, 2002。

[77] 洪秉賢「可變重心車輛運動穩定性之模擬與控制研究」大葉大學機械與自動化工程學系碩士論文, 2002。