The study and implementation on force feedback hardware in the loop for ...

陳清山、林海平

E-mail: 9806426@mail.dyu.edu.tw

ABSTRACT

Steering-by-Wire system (SBW) is the core research for steer system of the advanced vehicle in the near future. This investigation focuses on force feedback system in Steering-By-Wire system. We used the Steering-By-Wire model developed by the previous researcher and modified some parameters to simulate road feeling. Further move, the road feeling for the force feedback system was designed to achieve the goal that the vehicle can be operated easily at low speed and the road feeling can be accurate at high speed. In this study, the controller of the feedback system is designed combining the output of gear reduction and angle sensor, the hardware in the Loop for the platform is build. In force feedback system we choose a DC motor as force feedback motor. The Pulse-Width-Modulate (PWM) signal for the motor is decided via the angle sensor and the vehicle speed. Then we can compare the result with the simulation results.

Keywords : Steering-By-Wire system , force feedback , Road feeling ,Pulse-Width-Modulate

Table of Contents

博碩士論文暨電子檔案上網授權書..... iii 中文摘要.....iv ABSTRACT .....v 誌謝.....vi 目錄.....vii 圖目錄.....x 表目錄.....xiii 符號說明.....xiv 第一章 緒論.....1 1.1 前言.....1 1.2 文獻回顧.....2 1.3 研究目的.....10 第二章 硬體迴路平台與實驗架構.....12 2.1 實驗架構.....12 2.2 實驗儀器與設備與軟體.....13 2.2.1 方向盤操舵力角計.....13 2.2.2 CAN-Bus 系統之方向盤轉角感知器.....14 2.2.3 應變資料擷取系統.....15 2.2.4 力回饋馬達.....16 2.2.5 力回饋馬達減速機.....17 2.2.6 軟體介紹.....18 2.2.7 車輛線控轉向系統方向盤停止機構.....19 第三章 力回饋硬體迴路模擬.....22 3.1 輪胎模型[13] .....23 3.2 轉向系統動力學模型[13] .....26 3.3 力回饋馬達模型[13] .....28 第四章 力回饋硬體迴路之控制器設計及平台建立與實驗.....30 4.1 力回饋主控制器設計.....31 4.1.1 主控制器之微處理器.....31 4.1.2 PCA82C251 功能與接腳.....33 4.2 力回饋直流馬達驅動電路.....34 4.2.1 邏輯控制電路.....35 4.2.2 MOSFET 驅動電路.....35 4.2.3 H 橋直流馬達驅動電路.....37 4.2.4 直流馬達驅動電路硬體建立.....38 4.3 力回饋系統軟體模組設計.....39 4.3.1 力回饋系統軟體控制主流程.....39 4.3.2 感知器訊號接收與轉換.....40 4.3.2.1 轉角感知器接收與轉換.....41 4.3.2.2 車速訊號接收與轉換.....42 4.3.3 邏輯運算設計建立.....43 4.3.4 PWM 輸出模組.....46 4.3.5 輸出訊號之控制.....47 4.3.6 力回饋硬體迴路之控制器建立.....49 4.4 力回饋硬體迴路平台建立與實驗結果.....50 4.4.1 力回饋硬體迴路平台建立.....50 4.4.2 力回饋硬體迴路平台實驗與結果.....50 4.4.2.1 控制器實驗與結果.....50 4.4.2.2 力回饋系統硬體回路實驗與結果.....51 第五章 結論與建議.....54 5.1 結論.....54 5.2 建議事項與未來研究項目.....54 參考文獻.....57 附錄.....60

REFERENCES

[1] P. Green, T. Gillespie, S. Reifeis, L. Wei-Haas and D. Ottens, “ SUBJECTIVE EVALUATION OF STEERING EFFORT LEVELS, ”

UMHU-84-39, 1984.
[2] 車輛線控轉向系統, http://www.csi-auto.nl/carshopping/0013/.
[3] P. Gary Bertollini and M. Robert Hogan, “ Applying Driving Simulation to Quantify Steering Effort Preference as a Function of Vehicle Speed, ” SAE Paper, 1999.
[4] Douglas Cesiel, C. Michael Gaunt and Brian Daugherty, “ Development of a Steer-by-Wire System for the GM Sequel, ” SAE Paper, 2006.
[5] 卓桂榮, “ 四輪驅動電動汽車關鍵技術研究, ” 上海同濟大學博士學位論文, 2004 [6] 日本精工的線控轉向系統, http://big5.nikkeibp.co.jp/china/news/news/200711/auto200711070126.html.
[7] H. Ryouhei, N. Katsutoshi, N. Shirou and K. Kazuhiro, “ The Vehicle Stability Control Responsibility Improvement Using Steerby-Wire, ” IEEE Intelligent Vehicles Symposium, 2000.
[8] NISSAN 汽車EA2 線控轉向系統 http://carscoop.blogspot.com/2008/04/nissan-murano-ea2-drive-bywire-concept.html [9] Sanket Amberkar, Farhad Boloumhi, D. Jon Demerly, A. Scott Millsap, “ A Control System Methodology for Steer by Wire Systems, ” SAE, 2004.
[10] D. Odenthal, T. Bunte, H.-D. Heitzer and C. Eicker, “ How to make steer-by-wire feel like power steering ” In Proc. 15th IFAC World Congress on Automatic Control, 2002.
[11] 羅石, 商高高, 蘇清祖, “ 線控轉向系統轉向盤力回饋控制模型的研究, ” 汽車工程, 2006。
[12] 林海平, 張舜長, 徐榮傑, “ 車輛線控轉向系統方向盤停止機構, “ 中華民國專利, 2007。
[13] 林立璿 , “ 車輛線控轉向系統研究與實作, ” 私立大葉大學車輛工程研究所碩士論文, 2008。
[14] E. Bakker, L. Nyborg and H.B. Pacejka, “ Tyre Modelling for Use in Vehicle Dynamics Studies, “ SAE Paper, 1987.
[15] 郭孔輝, “ 汽車操縱動力學, ” 長春吉林科學技術出版社, 1991。
[16] 阮堅忠, “ 電動輔助轉向系統之模擬與控制, ”, 私立大葉大學車輛工程研究所碩士論文 ”, 2008。
[17] 王文沖, “ 線控轉向系統總體方案及控制方法研究, ” 南京理工大學車輛工程研究所碩士論文, 2007。
[18] 枕海燕, “ 基于無刷直流電動機的電動助力轉向系統的研究, ” 山東理工大學, 2008。
[19] 董勝源, “ 單晶片MCS-51 與C 語言入門實習, ” 宏友圖書開發股份有限公司, 2002。
[20] 龔永融, “ 線控轉向系統建模與性能分析, ” 同濟大學中德學院車輛工程研究所論文, 2007。