汽油引擎噴油控制器設計與製作之研究

林冠宇、張一屏

E-mail: 9606907@mail.dyu.edu.tw

摘 要

本研究之主旨為建立汽油引擎噴油控制器設計與製作，運用物件導向程式，針對汽油引擎噴油控制系統，建立動態模擬技術與控制參數設定評估系統性能之圖控程式。並使用模糊邏輯噴油控制器模型，修正噴油量以保持空燃比維持在設定之目標值。 本研究將針對一汽油引擎進行噴油控制器開發，模擬控制汽油引擎之噴油量，使其空燃比不因負載與轉速改變，維持在設定之空燃比附近，以降低油耗與排放之廢氣污染。另以適當模糊邏輯控制器，依據含氧感知器所輸出之排氣中含氧濃度或狀態變數加以修正，以構成一閉迴路系統之回饋控制。 利用所建立之汽油引擎空燃比預測模型，配合控制器之環境中，修改模糊邏輯控制器之參數，達到所需的性能，再將控制器利用硬體實現，搭配汽油引擎使用。在定轉速、三種不同的節氣門開度下測試，其模擬與實際硬體輸出之空燃比能控制在合理的誤差範圍內，燃油噴射量降低5%~15%，且引擎輸出扭力不因空燃比變化而下降。 本研究所建立的引擎空燃比預測模型，於開發汽油引擎噴油控制器時，可將所需參數設定後輸入模型中執行，產生一組適合的噴油策略，快速將噴油控制器成型，使相關研究人員縮短研發時間與成本。

關鍵詞 : 汽油引擎噴油控制 ; 模糊邏輯控制器 ; 空燃比控制

目錄

參考文獻

[1] 黃靖雄，“現代汽車原理”，全華出版社，1993。

[2] W. W. Yuen and H. Servati,“A Mathematic Engine Model Including the Effect of Engine Emissions,”SAE Paper No. 840036, 1986.

[3] R. D. Fruechte, and A. Kade,“Transfer Function Modeling of a Gasoline Engine and Engine Actuators,”GMR Memorandum 53-46, April 10, 1978.

[4] R. D. Fruechte and A. Kade,“Design of an Idle Speed Control System Using a Perturbation Engine Model,”GMR Report EG-150, August 30, 1978.

[5] J. F. Cassidy,“A State Variable Model for Engine Control Studies,”GMR Report ET-180, December 7, 1978.

[6] J. F. Cassidy,“On the Design of Electronic Automotive Engine Controls Using Linear Quadratic Control Theory,”GMR Report ET-181, December 5, 1981.

[7] J. A. Tennant,“Engine Characterization and Control, APE Project No. 2238 an overview,”GM Engineering Staff APER-262, June 23, 1976.

[8] J. A. Tennant et.,“Development and Validation of Engine Model Via Automated Dynamometer Tests,”SAE Paper No. 790178, February, 1979.

[9] D. J. Dobner,“A Mathematical Engine Model for Development of Dynamic Engine Control,”GMR Report EG-159, April 30, 1979.

[10] D. J. Dobner,“ Engine Characteristics for the Dynamic Engine Model, ” GMR Report EG-177, May 30, 1980.
[11] D. J. Dobner,“ Introducing the Effect of Exhaust Gas Backflow in Dynamic Engine Models, ” GMR Report EG-190, May 8, 1981.
[12] R. G. DeLosh et al.,“ Dynamic Computer Simulation of a Vehicle with Electronic Engine Control, ” SAE Paper No. 810447, February, 1981.
[13] R. Nishiyama, S. Ohkubo and S. Washino,“ An Analysis of Controlled Factors Improving Transient A/F Control Characteristics, ” SAE Paper No.890761, 1989.
[14] M. Nasu, et.,“ Model-Based Fuel Injection Control System for SI Engines, ” SAE Paper No.961188, 1996.
[15] J. Gehring and S. Herbert,“ A Hardware-in-the-Loop Test Bench for the Validation of Complex ECU Networks ”, SAE technical paper series No. 2002-01-0801, 2002.
[16] F. A. Caraceni,“ Benefits of Using a Real-Time Engine Model During Engine ECU Development, ” SAE technical paper series No. 2003-01-1049, 2003.
[17] Powell,“ Hardware-in-the-loop Simulation for the Design and Testing of Engine-Control Systems, ” SDOS, 1998.
[18] H. Hanselmann,“ Hardware-in-the-Loop Simulation Testing and Its Interation into A CACSD Toolset, ” IEEE, 1996.
[19] G. R. Babbitt, J. J. Moskwa,“ Implementation Details and Test Results for A Transient Engine Dynamometer and Hardware in the Loop Vehicle Model, ” Computer Aided Control System Design, 1999.
[20] N. Noomwongs, et al,“ Study on Handling and Stability Using Tirehardware-in-the-Loop Simulator, ” SDOS JSAE Review, 2003.
[21] J. H. Kim and J. B. Song,“ Control Logic for an Electric Power Steering System Using Assist Motor, ” SDOS Mechatronics, 2002.
[22] N. P. Fekete, U. Nester, I. Gruden and J. D. Powell,“ Model-Based Air-Fuel Ratio Control of a Lean Multi-Cylinder Engine, ” SAE technical paper series No.950846, 1995.
[23] T. C. Tseng and W. K. Cheng,“ An Adaptive Air/Fuel Ratio Controller for SI Engine Throttle Transients, ” SAE technical paper series No. 1999-01-0552, 1999.
[24] D. G. Copp, K. J. Burnham, F. P. Lockett,“ Model Comparison for Feedforward Air/fuel Ratio Control, ” Control '98.UKACC International Conference on (Conf. Publ. No. 455), 1998.
[25] G. Corde, Y. Bianco and Y. Lecluse,“ Air Mass Flow Rate Observer Applied to SI AFR Control, ” SAE technical paper series No. 952460, 1995.
[26] R. Schoknecht, and M. Riedmiller,“ Using Reinforcement Learning for Engine Control, ” Artificial Neural Networks,Ninth International Conference on (Conf. Publ. No. 470), 1999.
[27] K.S. Al-Olimat , A.A. Ghandakly and M.M. Jamali,“ Adaptive Air-Fuel Ratio Control of an SI Engine Using Fuzzy Logic Parameters Evaluation, ” SAE Paper No. 2000-01-1246, 2000.
[28] A. Kimura and I. Maeda,“ Development of engine control system using real time simulator, ” Computer-Aided Control System Design, IEEE International Symposium on, 1996.
[29] G. Kaiser, M. Zechnall and G. Plapp,“ Closed Loop Control at Engine Management System MOTRONIC, ” SAE, 1988.
[30] C. Cao, D. Shull and E. Himes,“ A Model-based Environment for Production Engine Management System (EMS) Development, ” SAE Paper No. 2001-01-0554, March 5-8, 2001.
[31] M. M. Steven,“ Engine Control - What Does It Take ? , ” Automotive Microcontrollers, pp.351~ 354, 1989.
[32] M. Baleani, et al,“ HW/SW Codesign of an Engine Management System, ” Design, Automation and Test in Europe Conference and Exhibition 2000, Proceedings, IEEE, pp.203-212, 2000.
[33] 林宜謀，“ 多缸汽油引擎管理系統最佳化設計與製作之研究 ”，大葉大學車輛工程研究所碩士論文，2004。
[34] A. Kimura, I. Maeda,“ Development of Engine Control System using Real Time Simulator, ” IEEE International Symposium on Computer Aided Control System Design, Dearborn, Michigan, September 15-18, pp.157-163 , 1996.
[35] M. H. Smith,“ Towards a More Efficient Approach to Automotive Embedded Control System Development, ” IEEE International Symposium on Computer Aided Control System Design, Kohala Coast-Island of Hawaii, Hawaii, August 22-27, pp. 219-224, 1999.
[36] 童元鋮，“ 車輛嵌入式控制系統設計---應用Model-Based設計工具 ”，機械工業雜誌，第105-118頁，2001。
[37] http://www.thvs.tp.edu.tw/5/ENGINE2/1/1/index.html [38] 藤尺英也等人，賴耿陽編譯，“ 電子控制式汽油噴射技術 ”，台灣復文興業出版，1995。
[39] K. J. Ronald,“ Automotive Microcontrollers, ” Society of Automotive Engineers, Inc, 1998.
[40] D. H. James and E. E. Herbert,“ Automotive Engines, ” Prentice Hall, 1997.
[41] J. J. Moskwa,“ Automotive Engine Modeling Real Time Control, ” M.I.T. Ph.D. thesis, May, 1988.
[42] J. J. Moskwa and W. W. Robert,“ Automotive Engine Modeling Real Time Control Using MATLAB/SIMULINK, ” SAE Paper No. 950417, 1995.
[43] K.S. Al-Olimat , A.A. Ghandakly and M.M. Jamali,“ Adaptive Air-Fuel Ratio Control of an SI Engine Using Fuzzy Logic Parameters Evaluation, ” SAE Paper No. 2000-01-1246, 2000.
[44] 莊辛富，“ 引擎噴油與點火控制微電腦之快速成型技術研究 ”，國立台北科技大學車輛工程研究所碩士論文，2003。

[45] M.G. Daniel and P.D. Timothy, “ Engineering, Quality and Experimental Design, ” Longman Scientific & Technical. London, 1992.
[46] G.P. Roger., “ Design and Analysis of Experiments, ” Marcel Dekker Inc. New York,1985.
[47] G. E. P.Box, and J. S. Hunter, “ Multifactor Experimental Designs for Exploring Response Surfaces, ” Ann. Math. Stat. 28, pp.195-241. (1957).
[48] G. E. P.Box, and K. B. Wilson, “ On the Experimental Attainment of Optimum Conditions, ” J. R. Stat. Soc. B 13, pp. 1-45, 1951.
[49] R. H. Myers, “ Response Surface Methodology, ” Allyn & Bacon, Boston, 1971.