

# The Research and Development of Saving-Energy Control Technology of Fuel Cut System for Motorcycle

黃崧林、張舜長

E-mail: 9419917@mail.dyu.edu.tw

## ABSTRACT

The main purpose of this study is to develop the saving-energy devices. The concept of this design is to apply the device of the by-pass air valve. When engine is running under middle or high speed and the throttle valve is closing state, then solenoid is energized and the vacuum of intake-manifold is leaked. The air movement can not produce a partial vacuum in the venturi, therefore the by-pass air system cuts off the normal fuel circuit at this stage. When engine speed decreases closely idle speed, then the solenoid is de-energized. Because of the throttle position and engine speed are simultaneously received by the ECU. The ECU can process signals and estimate the fuel-cut timing. This thesis utilized the single chip AT89c52 as the main centre of controller, cooperates with peripheral hardware, compile with C-programming language and planning the strategies of the fuel-cut to build up fuel-cut control system. We also used the Lambda Meter to monitor the variation of engine 's air/fuel ratio, manifold absolute pressure, engine speed and throttle position to judge that the fuel-cut system acting. This study adopt self-built driving cycle to control the throttle opening by the electronic motor under some conditions, such as the same time, duty cycle and load, etc. And to measure the throttle valve opening under the different angles before and after the engine installed the fuel-cut system, and measured the fuel consumption difference of system, in order to prove that the fuel-cut system 's feasibility and practicability. The focus of this study is to improve the defects of carburetor engine and adopt the advantages of fuel cut control for computer control engine. The characteristics of this study were simple system structure and did not require many sensors and actuators, such as fuel pump, injectors, O2 sensor, temperature sensor, pressure sensor and so on. The final goal of this study was to improve the fuel consumption while throttle valve is closed in a moment, because the vacuum of intake-manifold is raise with the result that waste of unnecessary fuel supplied. We also want to estimate the feasibility of fuel-cut system and make the environment much better.

Keywords : Fuel-Cut System, Carburetor

## Table of Contents

第一章 緒論.....	1	1.1 研究背景.....	1	1.2 研究動機與目的.....	2	1.3 文獻回顧.....	3	1.4 研究步驟.....	6	1.5 論文架構.....	9																																						
第二章 系統概述.....	10	2.1 系統元件特性.....	10	2.1.1 化油器原理.....	10	2.1.2 節氣門位置感知器.....	11	2.1.3 歧管絕對壓力感知器.....	12	2.1.4 含氧感知器.....	13	2.1.5 旁通空氣控制閥.....	14	2.1.6 電磁閥.....	15	2.2 燃油切斷系統控制策略規劃.....	19	2.2.1 建立控制策略.....	20	2.2.1.1 高速燃油切斷.....	22	2.2.1.2 減速燃油切斷.....	22	2.2.1.3 回復供油時機.....	22	2.2.2 建立判斷式.....	23	2.3 控制器硬體設計製作.....	24	2.3.1 電源供應.....	25	2.3.2 主控制器.....	27	2.3.3 輸入與輸出訊號.....	28	2.3.4 訊號處理.....	29	2.3.5 控制器硬體配置.....	38	2.4 實驗相關設備.....	41								
第三章 結果與討論.....	49	3.1 控制器模擬測試.....	49	3.2 控制器實車測試.....	53	3.3 控制器驗證.....	56	3.3.1 實車量測.....	56	3.3.2 量測型態的訂定.....	64	3.3.3 節氣門開度控制.....	66	3.3.4 自訂量測型態測試.....	69	3.3.4.1 無燃油切斷系統量測.....	71	3.3.4.2 加裝燃油切斷系統量測.....	76	3.3.5 測試結果與分析.....	82	第四章 結論與建議.....	87	4.1 結論.....	87	4.2 建議事項與未來研究項目.....	89	參考文獻.....	91	附錄(A) 電磁閥規格表.....	96	附錄(B) AT89C52.....	98	附錄(C) IRF640N.....	99	附錄(D) ADC0804.....	100	附錄(E) ADC0804 連續轉換模式.....	101	附錄(F) LM324.....	102	附錄(G) PC817.....	103	附錄(H) CB-68LP 端子座I/O 腳位圖.....	104	附錄(I) 燃油切斷控制器之程式.....	105	附錄(J) 燃油切斷控制器電路圖.....	110

## REFERENCES

- [1] J. Cassidy, M. Athans and W.H. Lee, " On the Design of Electronic Automotive Engine Controls Using Linear Quadratic Control Theory, " Automatic Control, IEEE Transactions, Vol. 25, Issue. 5, pp.901-912, 1980.
- [2] H. Inagaki, A. Ohata and T. Inoue, " An Adaptive Fuel Injection Control with Internal Model in Automotive Engines, " Industrial Electronics Society, IECON '90, 16th Annual Conference of IEEE, Vol. 1, pp.78-83, 1990.
- [3] R. Pfiffner, F. Webber, A. Amstutz and L. Guzzella, " Modeling and Model-based Control of Supercharged SI-Engines for Cars with Minimal Fuel Consumption, " Proceeding of the American Control Conference, pp.304-308, 1997.
- [4] J. K. Pieper and R. Mehrotra, " Air/fuel Ratio Control Using Sliding Mode Methods, " Proceeding of the American Control Conference, Vol. 2, pp.1027-1031, 1999.
- [5] M. Abu-Qudais, K.R. Asfar and R. Al-Azzam, " Engine Performance Using Vaporizing Carburetor, " Energy Conversion and Management, Vol. 42, Issue. 6, pp.755-761, 2001.
- [6] R. Isermann and N. Muller, " Design of Computer Controlled Combustion Engines, " Mechatronics, Vol. 13, Issue. 10, pp.1067-1089, 2003.
- [7] T. Villa, H. Wong-Toi, A. Balluchi, J. Preussig, A.L. Sangiovanni-Vincentelli and Y. Watanabe, " Formal Verification of An Automotive Engine Controller in Cutoff Mode, " Decision and Control, Proceedings of the 37th IEEE Conference, Vol. 4, pp.4271-4276, 1998.
- [8] 張朝剛, " 如何減少化油器式汽車排放污染 ", 中國內燃機期刊, No. 3, 2002 年。
- [9] 陳昌巨, 嚴志勇, 周芳, " 採用電控夾氣噴射方法降低內燃機排放研究 ", 中國華南科技大學學報自然科學版, Vol. 31, No. 4, 2003。
- [10] 李美娟, 王世震, " 實用摩托車發動機電控系統的開發設計 ", 中國小型內燃機與摩托車期刊, Vol. 32, No. 3, 2003 年。
- [11] 王剛, 劉少軍, 姚亞夫, 楊鶯, " 汽油發動機空燃比模糊控制及其實驗研究 ", 中國中南工業大學學報自然科學版, Vol. 34, No. 5, 2003 年。
- [12] 閻偉, 李國祥, 徐秀蘭, " 車用汽油機電控補氣裝置試驗分析 ", 中國內燃機工程期刊, Vol. 24, No. 1, 2003 年。
- [13] 陶國良, 郭連, " 電子節氣門技術的發展現狀及趨勢 ", 中國車用發動機, No. 4, 2003 年。
- [14] S. B. Choi, M. Won and J. K. Hedrick, " Fuel-Injection Control of SI Engines, " Decision and Control, Proceedings of the 33rd IEEE Conference on, Vol. 2, pp.1609- 1614, 1994.
- [15] 龔金科, 楊河洲, 劉作榮, 譚凱, 周立迎, " NA20S 化油器式汽油機電噴改造的研究 ", 中國湖南大學學報自然科學版, 第30 卷, 第2 期, 4 月, 2004 年。
- [16] 顏伏伍, 鄒斌, 侯獻軍, 杜傳進, 阮傑, 段功清, 彭輔明, " 摩托車發動機電控燃油噴射系統的設計 ", 中國武漢理工大學學報資訊與管理工程版, 第25 卷, 第1 期, 2 月, 2003 年。
- [17] 蔡樟, " 視窗51 模擬實務 C 語言篇 ", 知行文化出版社, 2000 年。
- [18] 董勝源, " 單晶片MSC-51 與C 語言入門實習 ", 宏友出版社, 2003 年。
- [19] 蔡朝洋, " 電工實習(4) ", 全華出版社, 1995 年。
- [20] 賴麒文, " C 與8051 單晶片軟體設計-基礎篇 ", 文魁資訊, 2002 年。
- [21] 鐘富昭, " 8051/8052 系列原理介紹與產品設計 ", 全華出版社, 2001 年。
- [22] 陳明燦, " 單晶片8051 實作入門 ", 文魁出版社, 2002 年。
- [23] 蔡朝洋, " 單晶片微電腦8051/8751 原理與應用 ", 全華出版社, 1996 年。
- [24] Y. Hacoheh and E. Sher, " Fuel Consumption and Emission of SI Engine Fueled with H<sub>2</sub>-Enriched Gasoline, " Energy Conversion Engineering Conference, IECEC '89, Proceedings of the 24th Intersociety, Vol. 5, pp.2485-2490, 1989.
- [25] D. Knowles, " Classroom Manual for Automotive Computer Systems, " Delmar Publishers, 1996.
- [26] F. Zhang, Y. Ge, Y. Huang, F. Liu, Y. Sun and S. Wu, " A Micro-Processor Based Adaptive Ignition Control System, " Vehicle Electronics Conference, Proceedings of the IEEE International, pp.34-37, 1999.
- [27] S. Hwang, " Simulation of Advance Ignition System for a Four Stroke and Single Cylinder Engine Using Photo Sensor and 8751H Microcontroller, " Control Applications, First IEEE Conference, Vol. 2, pp.907-908, 1992.
- [28] 楊明豐, " 8051 單晶片設計實務 ", 碁峰資訊, 1998 年。
- [29] 李永振, 梁季倉, 韓強生, " 電子學 ", 全華出版社, 6 月, 1991 年。
- [30] F.S. Lee, S.C. Tseng, C.C. Tsen and J.C. Wang, " Fuel Injection Motorcycle Engine Model Development, " Networking, Sensing and Control, IEEE International Conference, Vol. 2, pp.1259 – 1264, 2004.
- [31] 劉益, 羅挺, 嚴慶福, " 摩托車微電子數控點火器基本結構及原理 ", 中國小型內燃機與摩托車期刊, 第32 卷, 第2 期, 2003 年。
- [32] <http://www.epa.gov.tw>, 行政院環保署。
- [33] 王朝森, " 車輛定速線傳控制與硬體迴路模擬設計技術整合之研究 ", 大葉大學車輛工程研究所碩士班碩士論文, 2005。
- [34] 李宜達, 麥焜燦 編譯, " MATLAB 在工程上的應用 ", 麥格羅希爾, 2000。
- [35] 鈦思科技股份有限公司, " 視覺化建模環境Simulink 入門與進階 ", 鈦思科技, 2001。
- [36] 賴耿陽 編譯, " 汽車行駛性能與測試法 ", 台灣復文興業, 2001 年。

[37] P. Willard W., "Engineering Fundamentals of the Internal Combustion Engine," Prentice-Hall Inc., 1997.