高壓直噴共軌柴油引擎多次噴油性能最佳化之研究

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摘 要

本研究之主旨為建立高壓直接噴射共軌式柴油引擎多次噴油系統性能控制最佳化之研究。 藉由引擎控制與輸出性能參數即時顯示之軟硬體，結合引擎控制參數多目標最佳化調校法則，由引擎測功計實驗加以驗證。 利用行車型態以及車輛參數轉換成引擎扭力與轉速之關鍵點油耗污染模擬，篩選出行車型態關鍵點，以實驗設計最佳化分析軟體將篩選出的關鍵點進行單噴與雙噴最佳化分析與調校。 建構引擎性能響應曲面方程式，以多目標達陣最佳化控制參數搜尋程式，預測及比較柴油引擎單噴及多次噴油之性能、油耗及污染，降低油耗廢氣排放量。 實驗驗證針對行車型態中三個不同之關鍵點加以測試，並找出對應雙噴四個控制參數分別為預噴與主噴正時及噴油間隔之最佳值。 此外研究亦透過燃燒分析儀與所建立之四行程直接噴射共軌式柴油引擎燃燒分析模組，由引擎量測之缸壓與曲軸角度之數據，進行單噴與雙噴燃燒分析比較，計算引擎燃燒之淨熱釋放率、淨熱釋放，以分析引擎燃燒特性供爾後直接噴射共軌式柴油引擎發展與控制之參考。

關鍵詞 : 高壓共軌柴油引擎多次噴油控制、柴油引擎多次噴油之性能油耗及污染最佳化、實驗設計多目標最佳化搜尋、柴油引擎燃燒分析

目錄

參考文獻

[1] G.E.Corcione, M. L. Rosa, M. Lavorgna, A. Giuffrida and R. Lanzafame ” Modeling and Control of a Common Rail System for Diesel Multiple Injections, ” SAE Paper No.2001-24-0014,2001.
[2] L. Zhang, “ A Study of Pilot Injection in a DI Diesel Engine, ” SAE Paper No. 1999-01-3493,1999.
[3] F. Yan and J. Wang, ” Common Rail Injection System On-Line Parameter Calibration for Precise Injection Quantity Control, ” American Control Conference No. 978-1-4244-7427-1/10, AACC, 2010.
[4] N. R. Abdullah, R. Mamat, P. Rounce, A. Tsolakis, M. L. Wyszynski and H. M. Xu, “ Effect of Injection Pressure with Split Injection in a V6 Diesel Engine ” SAE Paper No. 2009-24-0049,2009.
[5] N.A. Henein, M-C. Lai, I. P. Singh, L. Zhong and J. Han, “ Characteristics of a Common Rail Diesel Injection System under Pilot and Post Injection Modes, ” SAE Paper No. 2002-01-0218, 2002.
[6] C. Park, S. Kook and C. Bae, “ Effects of Multiple Injections in a HSDI Diesel Engine Equipped with Common Rail Injection System, ” SAE Paper No. 2004-01-0127, 2004.
[7] Y. Mingfa, W. Hu, Z. Zunqing and Y. Yan, “ Experimental Study of Multiple Injections and Coupling Effects of Multi-Injection and EGR in a HD Diesel Engine, ” SAE Paper No. 2009-01-2807, 2009.
[8] A. Shijie , C. Hanbao, X. Hongjun, “ Examinatal Study on Common Rail Diesel Engine for Multi-Injection strategies ” 978-0-7695-4077-1/10 , 2010 IEEE.
[9] F. E. Corcione, Bianca M.Vaglieco, G. E. Corcione, M. Lavorgna, “ Potential of Multiple Injection Strategy for Low Emission Diesel Engines, ” SAE Paper No. 2002-01-1150, 2002.
[10] W. D. Ojeda, P. Zoldak, R. Espinosa and R. Kumar, “ Development of a Fuel Injection Strategy for Diesel LTC, ” SAE Paper No. 2008-01-0057, 2008.
[11] A. Vanegas, H. Won, C. Felsch, M. Gauding and N. Peters, “ Experimental Investigation of the Effect of Multiple Injections on Pollutant Formation in a Common-Rail DI Diesel Engine, ” SAE Paper No. 2008-01-1191,2008.
[12] G. M. Bianchi, P. Pelloni, F. E. Corcione and F. Luppino, “ Numerical Analysis of Passenger Car HSDI Diesel Engines with the 2nd Generation of Common Rail Injection Systems: The Effect of Multiple Injections on Emissions, ” SAE Paper No. 2001-01-1068, 2001.
[13] S. Mendez and B. Thirouard, “ Using Multiple Injection Strategies in Diesel Combustion: Potential to Improve Emissions, Noise and Fuel Economy Trade-Off in Low CR Engines, ” SAE Paper No. 2008-01-1329, 2008.
[14] Y. Lu , W. Yu and W. Su, “ Using Multiple Injection Strategies in Diesel PCCI Combustion: Potential to Extend Engine Load, Improve Trade-off of Emissions and Efficiency, ” SAE Paper No. 2011-01-1396,2011.
[15] F. Mallamo, M. Badami and F. Millo, “ Analysis of Multiple Injection Strategies for the Reduction of Emissions, Noise and BSFC of a DI CR Small Displacement Non-Road Diesel Engine, ” SAE Paper No. 2002-01-2672, 2002.
[16] D. T. Montgomery and R. D. Reitz, “ Optimization of Heavy-Duty Diesel Engine Operating Parameters Using A Response Surface Method, ” SAE Paper No. 2000-01-1962, 2000.
[17] Y. L. and R. D. Reitz, “ Optimizing HSDI Diesel Combustion and Emissions Using Multiple Injection Strategies, ” SAE Paper No. 2005-01-0212, 2005.
[18] Z. Jingqiu,and G. Guangyao, “ Optimization Design of the Electronically Controlled Injector, ” 978-1-4244-2693-5/09,2009 IEEE.
[19] Q. J. Wen, C. H. Baol, and S L. Min, ” Optimization Design Injection System Parameters of Common Rail Diesel Engine Using Response Surface Methodology, ” 978-1-4 577-0246-4/11/$26.00,2011 IEEE.
[20] H. Hiroyasu, H. Miao, T. Hiroyasu, M. Miki, J. Kamiura, and S. Watanabe, “ Genetic Algorithms Optimization of Diesel Engine Emissions and Fuel Efficiency with Air Swirl, EGR, Injection Timing and Multiple Injections, ” SAE Paper No. 2003-01-1853,2003.
[21] Y. Sun, and R. D. Reitz, ” Modeling Diesel Engine NOx and Soot Reduction with Optimized Two-Stage Combustion, ” SAE Paper No. 2006-01-0027,2006.
[22] 陳榮俊, ” 智慧型車輛動力系統之動態模擬與分析, ” 大葉大學車輛工程學系碩士班碩士論文, 2002.
[23] 章文堯, “ 混合動力車輛反向性能模擬與分析, ” 大葉大學 車輛工程學系碩士班 碩士論文, 2003。
[24] 蘇筵壬, “ 直接噴射共軌式柴油引擎管理系統控制最佳化之研究, ” 大葉大學 機械與自動化工程學系碩士論文,2011.
[25] M. G.Daniel and P. D. Timothy, “ Engineering, Quality and Experimental Design, ” Longman Scientific & Technical. London, 1992.
[26] G. E. P. Box and J. S. Hunter, “ Multifactor Experimental Designs for Exploring Response Surfaces, ” Ann. Math. Stat. 28, pp.195-241. 1957.

[27] L. R. Foulds, “ Optimization Techniques An Introduction, ” Springer Verlag Inc., New York, 1981.
[28] R.H. Myers and D.C Montgomery, “ Response Surface Methodology, ” John Wiley & Sons Inc., 1995.
[29] G. Derringer and R. Suich, “ Simultaneous Optimization of Several Response Variables, ” J. of Quality Technology, Vol. 12, pp. 214-219, 1980.
[30] R. Stone原著、梁乃文譯, “ 內燃機(第二版) , ” p.527~p.532,文京圖書有限公司,1999