新型並聯式複合電動重型機車之一體式馬達/發電機驅動器與控制器研製

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摘 要

近年來隨著環保意識抬頭與全球暖化的危機浮現，如何減緩對環境的汙染已成為當前迫切的議題。在大眾運輸方面，傳統內燃機雖然排氣污染較嚴重，但結合內燃機之優點與電動馬達的特性之複合電動車(Hybrid Electric Vehicle，HEV)是目前省能且低污染具環保概念車輛的主流。 基於複合電動車輛的重要，本論文發展一種新型並聯式複合電動型機車之一體式馬達/發電機驅動器與控制器研製，在電控系統中，使用數位訊號處理器（DSP）作為各元件訊號溝通與處理整個系統的完整運作。本論文的理論分析是藉由線性矩陣不等式(LMI)方法應用在非匹配不確定輸出回授可變結構系統(VSS)，經由此理論推導之控制器，能有效減少非匹配不確定成份的不良影響，確保系統穩定而且性能良好。 本論文根據實際系統建構車輛在各種路面及負載狀況下運轉特性，並藉由實驗平台的系統零組件配置及行車模式的測試操控，實際驗證此種新型並聯式複合電動型機車之單一動力輸出與雙動力整合之功能與成效。 本論文也實際建構一台原型車，此原型車並也於今年四月的台北國際車用電子展中展示。

關鍵詞 : 複合電動車 ; 一體式馬達/發電機 ; 數位訊號處理器 ; 線性矩陣不等式 ; 可變結構系統

目錄

參考文獻

[1] S. Onoda, S. M. Lukic, A. Nasiri and A. Emadi,“ A PSIM-based modeling tool for conventional, electric, and hybrid-electric vehicles studies, ” In: Vehicular Technology Conference, VTC 2002-Fall IEEE, vol. 3, pp. 1676-1680, 2002.

[2] K. T. Chau and Y. S. Wong,“ Overview of power management in hybridelectric vehicles, ” Energy Conversion and Management, vol. 43, No. 15, pp. 1953-1968, 2002.

[3] H. Xiaoling, J. W. Hodgson,“ Modeling and simulation for hybrid-electric vehicles. Intelligent Transportation Systems, ” IEEE Trans. on Intelligent Transportation System, vol. 3, No. 4, pp. 235-243, 2002.

[4] H. Xiaoling, J. W. Hodgson,“ Modeling and simulation for hybrid-electric vehicles. II. Modeling. Intelligent Transportation Systems, ” IEEE Trans. on Intelligent Transportation System, vol. 3, No. 4, pp. 244-251, 2002.

[5] N. J. Schouten, M. A. Salman and N. A. Kheir,“ Energy management strategies for parallel hybrid-vehicles using fuzzy logic, ” Control

Engineering Practice, vol. 11, pp.171-177, 2003.
[6] Hybrid Synergy Drive. 2007. Toyota Motor Corporation. 15 Jun. 2007 http://www.hybridsynergydrive.com/.
[7] Z. L. Fan, " Study of Dynamic Simulation and Control of a New Parallel Hybrid Electric Power System, " Department of Mechanical and Automation Engineering College of Engineering Dayeh university, 2005.
[8] H. Y. Su, " Study of a New Parallel Hybrid Electric Power System, " Department of Mechanical and Automation Engineering College of Engineering Dayeh university, 2005.
[9] I. J. Nagrath and M. Gopal " Control Systems Engineering, " CENTRAL BOOK COMPANY, 1985.
[10] K. David Huang, Y. W. Tsai, S. C. Chang, C. Y. Wua, C. C. Lub. " Study of System Energy Management of Parallel Hybrid Electric Heavy Motorcycle, " AVEC, 2006.
[11] S.C. Tzeng, K.D. Huang and C.C. Chen, " Optimization of the Dual Energy Integration Mechanism in a Parallel-type Hybrid Vehicle, " Applied Energy, vol. 80, Issue 3, pp. 225-245, 2005.
[12] C. S. Lin, " On the Study of the Transmission Mechanism System of the Parallel Hybrid Power Motorcycle and Its Dynamic Characteristics ", Department of Mechanical and Automation Engineering College of Engineering DAYEH UNIVERSITY, 2005.
[13] R. W. Erickson and D. Maksimovic, " Fundamentals of power electronics, " Kluwer Academic Publishers, 2nd ed., 2001.
[14] C. H. Yang, " Electrical Control System and Li-ion Battery Management System of Parallel Hybrid Electric Heavy Motorcycle, " Department of Mechanical and Automation Engineering College of Engineering Da-Yeh University, 2006.
[15] International Rectifier – The Power Management Leader. 2007. International Rectifier. 15 Aug. 2005 http://www.irf.com/indexsw.html
[16] Y. T. Hsueh, " A Study of Smart IGBTs Desgin, " Department of Electrical Engineering College of Engineering Da-Yeh University, 2003.
[17] J. Zeng, P. A. Mawby, M. S. Towers, K. Board, " Effect of carrier lifetimes on forward characteristics of MOS-controlled thyristors, " Circuits, Devices and Systems, IEE Pro., vol. 142, 1995.
[18] J. W. Dixon and I. A. Leal, " Current Control Strategy for Brushless DC Motors Based on a Common DC Signal, " IEEE Trans. on Industrial Electronics, pp. 232-240, 2002.
[19] H. H. Choi, " An explicit formula of linear sliding surfaces for a class of uncertain dynamic systems with mismatched uncertainties " Automatica, vol. 34, pp. 1015-1020, 1998.
[20] H. H. Choi, " On the existence of linear sliding surfaces for a class of uncertain dynamic system with mismatched uncertainties, " Automatica, vol. 35, pp. 1707-1715, 1999.
[21] S. H. Zak, and S. Hui, " On variable structure output feedback controllers for uncertain dynamic systems, " IEEE Transactions on Automation Control, vol. 38, pp. 1509-1512, 1993.
[22] C. M. Kwan, " On variable structure output feedback controllers, " IEEE Trans. on Automation Control, " vol. 41, pp. 1691-1693, 1996.
[23] P. P. Khargonekar, I. R. Petersen and K. Zhou, " Robust stabilization of uncertain linear systems: quadratic stabilizability and control theory, " IEEE Trans. on Automation Control, vol. 35, pp. 356-361, 1990.
[24] K. K. Shyu and J. C. Hung, " Totally invariant variable structure control systems, " Proceedings of the IECON ' 97, vol. 3, New Orleans, pp. 1119-1123, 1997.
[25] Y. W. Tsai and K. H. Mai, " Output feedback variable structure controller with totally invariance property, " Proceedings of the 2004 Automatic Control Conference, R. O. C., pp. 290-293, 2004.
[26] K. K. Shyu, Y. W. Tsai and C. K. Lai, " A dynamic output feedback controllers for mismatched uncertain variable structure systems, " Automatica, vol. 37, pp. 775-779, 2001.
[27] Taiwan Trade Centre Ltd., " Taipei International Automobile Electronics Show, " Auto Tronics Taipei 2007. Apr, pp. 25-28, 2007.