Development of electrical control system and performance analysis for a new ParalleHybrid electric heavy motorcyle

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ABSTRACT

With growing concerns over environmental protection and energy conservation, the hybrid electric vehicle (HEV) has taken center stage. The electric vehicle is a transportation implement of zero emission; however, its performance and driving distance are not acceptable in most cases. Thus the electric vehicle is not accepted extensively. On the other hand, the hybrid electric vehicle (HEV) not only achieves minimum fuel consumption and minimum emissions but also reduce pollution. The hybrid electric heavy motorcycle would have the merits of energy-saving. In this study investigates a new parallel hybrid electric heavy motorcycle, the aim of research is integral performance analysis and electrical control system. Its includes：(1) The simulation and performance analysis of integral systems: to simulate and analyze situations which the vehicle operate under variations of vehicle load； (2) Electrical control system: the major controller of the systems used by Digital Signal Processor (DSP) and control the vehicle under variations of driving pattern. In order to achieves minimum fuel consumption and minimum emissions, the internal combustion engine always operates at the sweet spot. The linear matrix inequality (LMI) method is applied in the design of dynamic output feedback controller for mismatched uncertain variable structure system (VSS). Using this new LMI theory based output feedback variable structure control (VSC), the mismatched variable structure systems is asymptotically stable with better performance. The electric control system and major controller of the hybrid electric vehicle have been achieved on the experimental platform. The prototype of hybrid vehicle is also established. The performances of the new hybrid electric vehicle are proved by experiment and operate actuality.

Keywords : Hybrid electric heavy motorcycle (HEV) ; Sliding mode ; Variable Structure Control (VSC)

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REFERENCES

[1] Onoda S, Lukic SM, Asiri AN, Emadi A. A PSIM-based modeling tool for conventional, electric, and hybrid-electric vehicles studies. In: Vehicular Technology Conference, VTC 2002-Fall IEEE, vol. 3, 2002, pp. 1676-80.

[2] Chau KT, Wong YS. Overview of power management in hybrid-electric vehicles.-Energy Conversion Manage 2002, pp:1953-68.

[3] Xiaoling H, Hodgson JW. Modeling and simulation for hybrid-electric vehicles. Intelligent Transportation Systems, IEEE Trans 2002, pp:235-43.

[4] Xiaoling H, Hodgson JW. Modeling and simulation for hybrid-electric vehicles. II. Modeling. Intelligent Transportation Systems, IEEE Trans 2002, pp:244-51.
[5] Schouten NJ, Salman MA, Kheir NA. Energy management strategies for parallel hybrid-vehicles using fuzzy logic. Control Eng Practice 2003, pp:171 – 7.
[6] Ron Hodkinson and John Fenton ”Lightweight electric/hybrid vehicle design” Butterworth-Heinemann,2001.
[7] Fan zhen lin, ” 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] Su hong yi, ” Study of a New Parallel Hybrid Electric Power System”, Department of Mechanical and Automation Engineering College of Engineering Dayeh university,2005.
[9] H. H. Choi, “An explicit formula of linear sliding surfaces for a class of uncertain dynamic systems with mismatched uncertainties,” Automatica, Vol. 34, No. 8, pp. 1015-1020, 1998.
[10] A. Packard, K. Zhou, P. Pandey and G. Becker, “A collection of robust control problems leading to LMIs,” IEEE Conf. on Decision and Control, pp. 1245-1250, 1991.
[11] S. Boyd, L. E. Ghaoui, E. Feron and V. Balakrishnan, “Linear Matrix Inequalitiesin System and Control Theory,” SIAM, Philadelphia, 1994.
[12] P. P. Khargonekar, I. R. Petersen and K. Zhou, “Robust stabilization of uncertain linear systems: quadratic stabilizability and control theory, ” IEEE Trans. Automat. Control, Vol. 35, pp. 356-361, 1990.
[13] El-Ghezawi. O. M. E, Zinober. A. S. I and Billings. S. A, “Analysis and design of variable structure systems using a geometric approach,” International Journal of control, Vol. 38, pp. 657-671, 1983.
[14] S. H. Zak, and S. Hui, “On variable structure output feedback controllers for uncertain dynamic systems,” IEEE Transactions on Automation Control, AC-38, pp. 1509-1512, 1993.
[15] K. K. Shyu, Y. W. Tsai, and C. K. Lai, “A dynamic output controllers for mismatched uncertain variable structure systems,” Automatica, Vol. 37, pp. 775-779, 2000.
[16] M. L Chan, C. W. Tao and T. T. Lee, “Sliding mode controller for linear systems with mismatched time-varying uncertainties,” Journal of The Franklin Institute, 337, pp. 105-115, 2000.
[17] J. C. Shen, “Designing stabilizing controllers and observers for uncertain linear systems with time-varying delay,” IEE Proc, D144(4), pp. 331-334, 1997.
[18] Nagrath and Gopal “Control Systems Engineering”, 中央圖書出版社,1985.
[19] K. David Huang, Yao-Wen Tsai, Shun-Chang Chang, Chen-YangWua, Che-Chuan Lub. Study of System Energy Management of Parallel Hybrid Electric Heavy Motorcycle. AVEC 2006 [20] 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, Feb. 2005. (EI) [21] Yao-Wen Tsai, Shun-Chang Chang, K. David Huang, Ching-Huang Chang “Development of Real-Time Monitor system of Test Bench for the Parallel Hybrid Electric Heavy Motorcle”, 2006 Procedings of AVEC, pp.20-24.
[22] Kuo-Kai Shyu, Yung Yu, Kuang-Chiung Chang “Dynamic Output Feedback Sliding Mode Design for Linear Unmatched Uncertain Systems”, International Journal of Control 2000.