Space Vector PWM Control for 3kW Brushless Motor Driver Design and Application for Novel Parallel Hybrid Electric Vehicl

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ABSTRACT

In recent years, owing to the environmental protection concept has risen and global warming, it is important to reduce the environmental pollution. If the merits of both internal combustion engine and permanent magnet synchronous motor (PMSM) can be integrated to become a hybrid electric vehicle, it must have ultra-low pollution and energy-saving but still keeping high performance. For this reason, the central purpose of this thesis is to develop a novel parallel hybrid electric vehicle system driver and controller. Electronic motor control systems used by extremely versatile digital signal processor (DSP). The important space vector pulse-width-modulation (SVPWM) technology is applied to the PMSM control to provide more efficiency of the hybrid electric vehicle. The SVPWM technology is also guarantees the system to be stable with better performance. Subsequently, by way of experiment results have proved the SVPWM technology provides more and more performance of the PMSM and the SVPWM technology have been applied in hybrid electric vehicle with high efficiency. Finally, a prototype of the hybrid electric heavy-duty motorcycle has been established and it has been exhibit on the " Taipei international automobile electronics show" at the Taipei world trade center in 2007.

Keywords: Hybrid electric vehicle; digital signal processor; space vector pulse-width-modulation; permanent magnet synchronous motor

Table of Contents

REFERENCES

[1] K.D. Huang, C.C. Chen, S.C. Tzeng, and T.M. Jeng, November 2004, "Study of the Parallel Hybrid Electric System with Internal Combustion Engine Running at the Optimal State," 9th Vehicular Engineering Conference, Tashi, Taiwan.

[2] [3] [4] Zki Yang Pan and Fang Lin Luo, " S Novel Soft-Switching Inverter for Brushless DC Motor Variable Speed Drive System," IEEE Trans. on Power Electronics, vol. 19, No.2, pp. 280-288, 2004. J. R. Jhan, " An Experimental Study of a DC Brushless Motor Driving System" Department of Mechanical and Electrical Engineering College of Engineering Da-Yeh University, 2003. Hong-xing Wu, Shu-kang Cheng, and

Shu-mei Cui, "A Controller of Brushless DC Motor for Electric Vehicle," IEEE TRANSACTIONS ON MAGNETICS, vol. 41, No. 1, pp. JANUARY 2005.

[5] [6] B. H. Lin, "DSP-Based Permanent Magnet Synchronous Motor Driving System Design and Implementation Using Variable Structure Control Theory" Department of Mechanical and Automation Engineering College of Engineering Da-Yeh University, 2006. Texas Instruments, "Field Orientated Control of 3-Phase AC-Motors" Inc., Texas Instruments Europe, 1998.

[7] J. M. Jhan, "Novel Brushless Motor Driver and the Application of Electric Motorcycles" Department of Mechanical and Automation Engineering College of Engineering Da-Yeh University, 2006.

[8] Texas Instruments "TMS320LF2407A-EP DSP CONTROLLERS" Texas Instruments Inc., 2002.

[9] [10] Texas Instruments "TMS320LF2407, TMS320LF2406, TMS320LF2402 DSP CONTROLLERS" Texas Instruments Inc., 1999. Parker Hannifin Corporation "Hall Effect Sensors" Parker Hannifin Co. pp. 107-118.

[11] "About Optical Isolation" Patton Electronic Co. 28 Oct. 1994. http://www.patton.com/technotes [12] Harada. K and Sakamoto. H, "SWITCHED SNUBBER FOR HIGH FREQUENCY SWITCHING," IEEE Trans. on Industrial Electronics, pp. 181-188, 1990.

[13] Texas Instruments, "Space-Vector PWM With TMS320C24x/F24x Using Hardware and Software Determined Switching Patterns" Inc., 1999.

[14] 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.

[15] 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.

[16] [17] [18] [19] Taiwan Trade Centre Ltd., "Taipei International Automobile Electronics Show," Auto Tronics Taipei 2007. Apr, pp. 25-28, 2007. 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) Hyung-Min Ryu, Jang-Hwan Kim and Seung-Ki Sul, "Analysis of multiphase space vector pulse-width modulation based on multiple d-q spaces concept," IEEE Trans. on Power Electronics, vol. 20, No. 6, pp. 1364-1371, 2005. P.F. Seixus, M.A. Severo Mendes, P. Donoso-garcia, and A.M.M. Lima, "A space vector PWM method for three-level voltage source inverter, 2000.