Study of series connected lithium-ion batteries balance management system for electric motorcycle / 曾建銘 撰 .- 彰化縣

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ABSTRACT

This study describes the characteristics of lithium batteries used in electric motorcycle. There are many factors resulting in unbalanced battries, such as the battery charge and discharge characteristics, degree of aging. The unbalanced batteries may be resulting in over-charging or over-discharge of battery, or even shorten the battery life, as well as influence the estimated state of charge(SOC) accurately. In order to improve battery life and the estimated state of charge(SOC) accurately, this study is divided into two research directions as follows: 1. Lithium battery performance testing platform for different discharge conditions, ambient temperature. These experimental data of battery charge and discharge test that used to construct lithium-iron battery performance database. 2. Using the four lithium-iron batteries in series to form a balanced circuit module. The above four modules strung together to form sixteen lithium iron battery cells. By battery balanced technologies, the each modules of batteries pack can be obtained the same capacity. Finally, a series of experimental results are presented to demonstrate the feasibility of the proposed method.

Keywords : Electric motorcycle、Lithium battery、State of charge、Series-connected batteries balance

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目錄

REFERENCES

[1]鄭勝文，“電動車輛專輯”，機械月刊，pp.354-405，1999年。
[2]C. C. Chan and K. T. Chau,“An Overview of Electric Vehicles – Challenges andOpportunities,” Proceedings of the IEEE IECON 22nd International Conference,Vol. 1, pp. 1-6, August 1996.
[3]H. Oman,“Battery Developments that will make Electric Vehicles Practical,” IEEEAerospace & Electronics Systems Magazine, Vol. 1, No. 8, pp. 11-21, August 2000.
[4]H. Oman,“Making Batteries Last Longer,” IEEE Aerospace & Electronics Systems Magazine, Vol. 14, No. 9, pp. 19-21, September 1999.
[5]T.B. Gage,“Lead-Acid Batteries: Key to Electric Vehicle Commercialization – Experience with Design, Manufacture, and Use of EVs,” 15th Battery Conference on Applications and Advances, pp .217-222, January 2000.
[6]B. Dickinson and J. Gill,“Issues and Benefits with Fast Charging Industrial Batteries,” 15th Battery Conference on Applications and Advances,pp. 223-229, January 2000.
[7]C.C. Chan,“An Overview of Electric Vehicle Technology,” Proceedings of the IEEE, Vol. 81, No. 9, pp. 1202-1213, September 1993.
[8]P. T. Krein and R. S. Balog,“Life Extension Through Charge Equalization of Lead-Acid Batteries,” 24th International Telecommunications Energy Conference INTELEC 2002, pp. 516-523, September/October 2002.
[9]P. T. Krein, S. West, and C. Papenfuss,“Equalization Requirements for Series VRLA Batteries,” The 6th Annual Battery Conference on Applications and Advances, pp. 125-130, January 2001.
[10]S. West and P. T. Krein,“Equalization of Valve-Regulated Lead-Acid Batteries: Issues and Life Test Results,” 22nd International Telecommunications Energy Conference INTELEC 2000, pp. 439-446, September 2000.
[11]H. Schmidt and C. Siedle,“The Charge Equalizer – A New System to Extend Battery Lifetime in Photovoltaic Systems, U.P.S. and Electric Vehicles,” 15th International Telecommunications Energy Conference INTELEC 1993, Vol. 2, pp. 146-151, September 1993.
[12]H. Shibata, S. Taniguchi, K. Adachi, K. Yamasaki, G. Ariyoshi, K. Kawata, K. Nishijima, and K. Harada,“Management of Serially-Connected Battery System Using Multiple Switches,” 4th International Conference on Power Electronics and Drive Systems PEDS 2001, Vol. 2, pp. 508-511, October 2001.
[13]S. Duryea, S. Islam, and W. Lawrance,“A Battery Management System for Stand Alone Photovoltaic Energy System,” Applications Magazine, IEEE, Vol.7, pp.67-72, 2002.

[14]林威佐，“電池電容量檢測技術之研究”，國立台灣大學電機所碩士論文，2002年。
[15]P. Ramadass, B. Haran, R. White, and B. Popov,“ Mathematical Modeling of the Capacity Fade of Li-ion Cells, ” Journal of Power Sources, Vol.123, pp.230-240, 2003.
[16]何文隆，“電動車輛變動負載之電池殘電量研究”，大葉大學車研所碩士論文，2004年。
[17]賴世榮，“智慧型鋰離子電池殘存電量估測之研究”，中山大學電機工程所碩士論文，2004年。
[18]何昌佑，“鋰電池管理晶片之設計與應用分析”，電子月刊，第13卷，第9期，2007年。
[19]吳坤德、林頂立、周弘亮、吳晉昌、孫禹華，“類神經網路應用於鉛酸電池殘電量偵測之應用”，電機月刊，第17卷，第7期，2007年。
[20]G. Li, H. Wang, and Z. Yu,“ New Method for Estimation Modeling of SOC of Battery, ” IEEE, Software Engineering, Vol.2, pp.387-390, 2009.
[21]L. Wang, L. Wang, and J. Liu,“ Sigma-point Kalman Filter Application on Estimating Battery SOC, ” IEEE, Vehicle Power and Propulsion Conference, pp.1592-1595, 2009.
[22]B. X. Sun and L. Wang,“ The SOC Estimation of NIMH Battery Pack for HEV Based on BP Neural Network, ” IEEE, Intelligent Systems and Applications, pp.1-4, 2009.
[23]L. Wang, L. Wang, and C. Liao,“ Research on Improved EKF Algorithm Applied on Estimate EV Battery SOC, ” IEEE, Power and Energy Engineering Conference (APPEEC), pp.1-4, 2010.
[24]V. Spath, A. Jossen, H. Doring, and J. Garche,“ The Detection of the State of Health of Lead-Acid Batteries, ” IEEE, International Energy Conference, Vol.19, No.23, pp.681-686, 1997.
[25]C. C. O ’Gorman, D. Ingersoll, R. G. Jungst, and T. L. Paez,“ Artificial Neural Network Simulation of Battery Performance System Sciences, ” Kohala Coast, HI, USA: Proceedings of the Thirty First Hawaii International Conference, pp.115-121, 1998.
[26]W. X. Shen, C. C. Chan, E. W. C. Lo, and K. T. Chau,“ Adaptive Neuro Fuzzy Modeling of Battery Residual Capacity for Electric Vehicles, ” IEEE Trans. Ind. Electron, Vol.49, No.3, pp.677-684, 2002.
[27]中央研究院資訊科學研究所自動化實驗室，“電動機車整車管理系統之研發”，國家地理頻道之台灣熱門科學，2002年。
[28]Y. S. Lee, T. Y. Kuo, and W. Y. Wang,“ Fuzzy Neural Network Genetic Approach to Design the SOC Estimator for Battery Powered Electric Scooter, ” 35th Annunl IEEE Power Electronics Specialists Conference, pp.2759-2765, Aachen, Germany, 2004.
[29]黃廣順，“電池電源模組之並聯運轉”，中山大學電機所碩士論文，2004年。
[30]C. R. Chen, K. H. Huang, and H. C. Teng,“ The Estimation of the Capacity of Lead-Acid Storage Battery Using Artificial Neural Networks, ” IEEE Conferenceon Systems, Man, and Cybernetics, pp.8-11, 2006.
[31]謝秉勳、謝登存，“鋰離子電池加速測試方法及壽命預估模式介紹”，工業材料雜誌，第236期，2006年。
[32]李建興、陳瑋凱、洪建平，“類神經網路應用於鉛酸電池放電時間之估測”，第28屆電力工程研討會，2007年。
[33]C. Barlak and Y. Ozkazan,“ A Classification Based Methodology for Estimation of State-of-health of Rechargeable Batteries, ” IEEE, Electrical and Electronics Engineering, pp.101-105, 2009.
[34]D. Haifeng, W. Xuezhe, and S. Zechang,“ A New SOH Prediction Concept for the Power Lithium-ion Battery Used on HEVs, ” IEEE, Vehicle Power and Propulsion Conference, pp.1649-1653, 2009.
[35]陳文智，“電池內串聯電槽之工作特性與探討”，中山大學電機工程學系研究所碩士論文，2006年。
[36]歐陽文億，“串聯電池組雙向電量平衡電路”，中山大學電機工程學系研究所碩士論文，2005年。
[37]江承億，“雙向式轉換器應用於均勻充電之研製”，聖約翰技術學院自動化及機電整合研究所碩士論文，2005年。
[38]蔡志明，“串並聯電池組均壓充電及放電管理之研究”，大同大學電機工程研究所碩士論文，2002年。
[39]周文雄，“智慧型均等化電池充電器”，高雄應用科技大學電子與資訊工程研究所碩士論文，2007年。
[40]柯易斌，“ 微控制晶片於鋰離子串接電池等化之應用”，天主教輔仁大學電子工程學系碩士論文，2006年。
[41]J. W. Kimball, B. T. Kuhn, and P.T. Krein,“ Increased Performance of Battery Packs by Active Equalization, ” IEEE, Vehicle Power and Propulsion Conference, pp.323-327, 2007.
[42]A. Baughman and M. Ferdowsi,“ Analysis of the Double-Tiered Three-Battery Switched Capacitor Battery Balancing System, ” IEEE, Power Electronics and Motor Drives Laboratory, 2007.
[43]X. Wei and B. Zhu,“ The Research of Vehicle Power Li-ion Battery Pack Balancing Metho, ” IEEE, Electronic Measurement & Instruments, pp.2-498-2-502, 2009.
[44]L. Wang, L. Wang, C. Liao, and J. Liu,“ Research on Battery Balance System Applied on HEV, ” IEEE, Vehicle Power and Propulsion Conference, pp.1788-2-1791, 2009.
[45]統振公司，“ LiPOD Specification”，2006 年。
[46] http://www.a123systems.com/products-cells-26650-cylindrical-cell.htm