

Li-ion Battery Modelling and Implementation with Variable Structure Control

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ABSTRACT

The purpose of this study was to build a new li-ion battery model, based on state-space identification. Another aim was to design a controller for the lithium iron phosphate (LiFePO₄) battery ' s discharging and charging process, based on reference models and variable structure control (VSC). State-space equations were used to describe the discharging and charging process of a LiFePO₄ battery, and these processes were simulated by MATLAB/Simulink. Curve-fitting methods were applied to obtain the parameters for the battery by using curve-fitting tool in MATLAB Toolbox. The simulation results of the study were close to the experiment/practical results. The proposed battery modelling is suitable for describing the li-ion battery ' s characteristics and adequate for implementation with modern control theory. The modelling also provided a unity in using the same parameters for both charging and discharging processes. The results revealed that the method used has a potential in modelling not only for LiFePO₄ battery, but also for any kind of battery, by examining its characteristics, defining parameters, doing experiments and using curve-fitting methods with simulations iteratively. This study has contributed to literature a new battery modelling with feasibility on simulating some various types of battery, even a series of batteries. It offered an easy way to implement modern control theory, especially VSC. It also showed the process of designing a variable structure controller for battery control.

Keywords : lithium iron phosphate (LiFePO₄), li-ion, battery modelling, state-space, variable structure control (VSC)

Table of Contents

Inside Front Cover	Signature Page	Chinese Abstract...	iii	English Abstract...	iv	Acknowledgement...	v	Table of Contents...	vi	Table of Figures...	ix	List of Abbreviations...	xii	Chapter 1 Introduction...	1	1.1 The Li-ion batteries...	1	1.2 LiFePO ₄ batteries ' characteristics...	4	1.3 Battery State of Charge...	5	1.4 Motivation...	6	1.5 Methodology...	7	1.6 Thesis outline...	9	Chapter 2 Mathematical Modelling of a Battery...	10	2.1 General Modelling...	10	2.1.1 ADVISOR Models...	10	2.1.2 The battery model in MATLAB Help...	10	2.1.3 The Rint Model...	12	2.1.4 The RC Model...	13	2.1.5 The Thevenin Model...	14	2.1.6 The DP Model...	15	2.2 Conventional Modelling...	16	2.2.1 The RC1C2 model...	17	2.2.2 The RLC model...	23	2.3 Introduction to PWM concept...	30	Chapter 3 New battery state-space modelling...	33	3.1 New battery modelling...	33	3.2 Basic parameters...	35	3.2.1 From manufacturer...	35	3.2.2 Calculation...	35	3.3 Development of State-Space Equations...	38	3.3.1 Discharge model...	38	3.3.1.1 Simple discharge circuit for a single battery...	38	3.3.1.2 Detailed battery discharging model...	40	3.3.2 Charge model...	47	3.3.2.1 Simple charge model for a single battery...	47	3.3.2.2 Detailed battery charging model...	49	3.4 Comparison of simulation and practical results...	53	3.4.1 Discharging process...	55	3.4.2 Charging process...	56	Chapter 4 Variable Structure Controller for single battery...	58	4.1 Objectives...	58	4.2 Introduction to reference model and the controller...	58	4.2.1 Reference model...	59	4.2.2 Variable structure control...	61	4.3 Derivation of equations...	62	4.2.1 Equations for discharging process...	63	4.2.2 Equations for charging process...	71	4.4 Large-scale batteries with balancing techniques...	74	4.4.1 Conventional SOC balancing technique...	75	4.4.2 Novel SOC balancing technique...	76	Chapter 5 Conclusion...	77	5.1 Contributions...	77	5.2 Recommendations...	78	References...	80	Appendix...	85
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