東京大学 大学院新領域創成科学研究科
基盤科学研究系 先端エネルギー工学専攻
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半制御コンバータを用いた電気自動車のスーパーキャパシタ・電池ハイブリッドエネルギー貯蔵システム～電力マネジメント戦略とスラインディグモード制御を用いた新しい制御手法～

学生証番号 47116058 氏名 ABREU CURTI, JOAO MARCUS
（指導教員 堀 洋一 教授）
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Electric Vehicles (EV), is one of the solutions for environmental issues due to zero emissions of Greenhouse gases. However, the widely used energy storage system based on batteries (NiMH, Lead-Acid, Lithium-ion, e.g.) has some disadvantages such as high cost, long charging time and relatively short lifetime. One solution for this problem, other than improving the storage device, is the use of Hybrid Energy Storage Systems (HESS).

The HESS combines at least two energy storage devices in order to achieve an improved storage system with additional features. Herein, it is analyzed a well-known system with Supercapacitor (SC) and battery. Actually, this combination is now a trend in HESS research, since SCs are able of providing high charge/discharge rate, long lifetime in comparison to batteries and capability of supporting high stress. However, a dc-dc converter is necessary for controlling a power flow strategy between the two energy storage devices.

In the present study, the Half-Controlled Converter (HCC) is used due to their low cost and similar efficiency in comparison to the most used types of converters. Firstly, a linear control approach based on feedback and feed-forward is used to generate a pulse-width modulation for driving the switches. Then, a power distribution strategy based on current control and filter decoupling is attached to the HESS in order to control the power flow between SC and battery. The applied strategy overtakes other approaches, such as fuzzy control or neural network, in terms of a faster and less complex implementation.

At last, a new control based in a non-linear approach, namely Sliding Mode Control (SMC), is proposed for the HCC control. The results demonstrate that SMC can be used to achieve a more robust output voltage control even under wide input voltage and load variations.