Année 2019 / 2020	**Master** ☑ **Option :** electrical engineering or control engineering **PFE** ☑ **Commentaire :** …….

Titre : Control of switched systems : application to power electronic systems

Contexte/ Context :

Laplace/CODIASE research group (Control and Diagnostic of Electric Systems) has a large experience in energy management and modelling of energy conversion systems. Researches on Power Electonics control and Multisource smart energy management are conduced mixing electrical engineering and control theory implemented in real time controller.

Présentation du Sujet/ Subject details :

Switching is ubiquitous in numerous application fields. They can be connected to the physical nature of the system: power electronic converters, micro-grids, mechanical systems with dry frictions, aerospace, etc. They can also be introduced intentionally in the feedback loop in order to ensure desirable performances such as in sliding mode control, relay, or adaptive control. In recent control theory, it has been shown that neglecting the switching behavior in analysis and control design can lead to unstable systems.

The main objective of this internship is control design and implementation for power electronic systems while taking into account their switching dynamics. More precisely, we are particularly interested in the design and real-time implementation of controllers for a power management system. Usually, super-capacitors (two converters parallel structure, for example) are used in order to manage the regulation of the DC-bus that relies different power sources. This super-capacitors present switching elements that should be taken into account in the analysis and control design. Thus, the first step in this internship consists in modeling the systems under study us switched systems. This class of systems describes the behavior of continuous processes exhibiting different operation modes modeled by different differential equations (evolution of the current, voltage, etc.) and a logical law indicating which mode is active (switch "on" or switch "off"). The second objective of this internship consists of switching control design for systems under study. Several methods based on Lyapunov theory and passivity property have been proposed in the automatic control community for different classes of switched systems in order to tackle the stability and stabilization problems. However, most of the proposed approaches consider time-continuous switched systems with continuous time switching controllers. Moreover, the attempts to implement the existing methods have shown that sampling has a real impact on the performances of controlled systems. Thus, a comparative study of different control methods should be done. In addition, simulations will be performed in order to analyze the effect of the sampled controllers on the closed-loop systems. Finally, experimental implementations of the designed controllers will be realized. A simple DC/DC converter circuit will be considered, in the first time, before dealing with the more complex energy management systems (DC-bus stabilization).

Profil recherché / Skills requested:

Student must be enrolled as a full-time student in a degree granting program. Relevant M.S. in electrical engineering or control engineering.

Connaissances requises / knowledge background:

Ideal candidates will have good modeling and simulation experience. Experience with MATLAB/Simulink, and real-time simulation platforms and software are preferred.

Responsable(s) :
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Lieu du stage et conditions particulières :

Lieu : CODIASE group, Laplace Laboratory, 2 Rue Charles Camichel, 31000, Toulouse, France.

Conditions particulières/ Particular conditions : Possibility to pursue a PhD.