Local Stabilization of Switched Affine Systems: An Application to DC-DC Power Switching Systems

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Abstract

This technical report presents the results of applying a novel procedure to derive switching laws for switched affine systems. The procedure derives a discontinuous control law from a continuous one, , such that the controlled affine system is rendered asymptotically stable in a small neighborhood of the origin. This methodology is then applied to the control of a dc-dc converter.

1. Introduction

Switched linear systems are a category of hybrid systems. They have a switching rule that selects through an available list of subsystems in order to achieve global asymptotic stability. An affine system is a system that is linear in the input u, . A switched affine system is therefore a system of the form , where is the state, is the switching strategy and is the input, linearly related to . Not all switched affine systems can be stabilized globally. Until the paper of Hetel and Bernouau [4], if a switched affine system could not be stabilized globally, it could not be stabilized at all.

In their work [4], they show a way in which they stabilize a switched affine system in a region close to the origin even if the system cannot be stabilized globally. They show that if there exists a classical continuous feedback that renders a switched affine system locally or globally stable, then there also exists a local discontinuous stabilizer that selects subsystems from a set and renders the affine system locally stable.

In this report, the theory developed in [4] will be applied to control a power converter. These devices are widely used in power electronics. They are circuits controlled by transistors and diodes to adjust the electrical energy of a power source to meet the requirements of a load. They are controlled through Pulse Width Modulation technique and therefore these devices are good candidates to be modeled by non-linear switched systems.

The report gives further details about the problem in the Problem Statement section 2, gathers and analyses data from the literature in the Literature Review section 3, further expands the problem statement in section 4 and presents analysis and simulation results in sections 4 and 5, respectively.

1. Problem Statement
2. Literature Review

* Talk about Hetel and Bernouau paper
* Talk about other papers that control a dc-dc converter

1. Problem Formulation
2. Analysis
3. Simulation Results
4. Comparative Study
5. References

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1. Appendix