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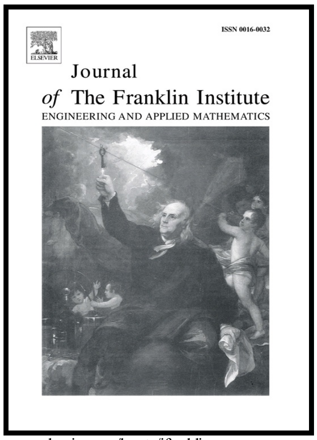


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PII: S0016-0032(16)30406-9
DOI: http://dx.doi.org/10.1016/j.jfranklin.2016.10.038
Reference: FI2781

To appear in: *Journal of the Franklin Institute*

Received date: 22 November 2015
Revised date: 6 September 2016
Accepted date: 30 October 2016

Cite this article as: Djekidel. Kamri and Romain. Bourdais, Periodic Solution versus Practical Switching Control for Sensorless Piecewise Affine System ( P W A ) , *Journal of the Franklin Institute* http://dx.doi.org/10.1016/j.jfranklin.2016.10.038

# Periodic Solutions versus Practical Switching Control for Sensorless Piecewise Affine Systems (PWA)

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SUMMARY

This work concerns the stabilization of general Piecewise Affine ( PWA) systems without common equilibrium; the main objective consists in proposing a characterization of periodic solutions, by determining the critical parameters values of the cyclic behaviors. The proposed approach is based on the expansion of previous results on practical stabilization by switching. Due to the non-convex nature of general PWA synthesis problems, we primarily present a BMI formulation of the practical stabilization that is used to generate periodic solutions. More precisely, we characterize ω-limit sets as periodic trajectories of the global PWA system in terms of special invariant sets of the practical stabilization method. This will avoid a posteriori subset inclusion checking, since the underlying set belongs to the admissible state space part. This approach generalizes previous results to obtain invariance conditions and the set ω-limit points. A methodology and algorithms to compute periodic trajectories parameters are provided. Two illustrative examples are used for simulation, in particular the third order of Goodwin oscillator model is investigated as a non-uniform oscillatory complex system.

KEY WORDS: Hybrid Systems; Invariant Sets; LMI; Periodic Solutions; PWA Systems; Practical Switching Stabilization; ω-Limits points.

## 1. INTRODUCTION

The piecewise affine (PWA) systems modeling framework is the most appropriate representation of general hybrid systems that results from diverse engineering fields. PWA systems are characterized by a collection of different affine dynamics, each one is activated in a continuous state space region. These systems have received growing interest [1-6] in the last decades since they can approximate most nonlinear behaviors with high accuracy and they are advanced in practice with the development of many various tools (PWA identification for example). Many analysis techniques and/or design methods proposed in the general context of hybrid and switched systems theory may be exploited in the investigation of PWA systems [7, 8]. However, most developed ideas do not deal with the general case of PWA systems without (or not common) equilibrium. Indeed, due to the affine term, the absence of common equilibrium is a natural characteristic of PWA systems, and as a consequence, the working point must be chosen among the equilibrium points of the average systems. As this equilibrium point is only virtual, asymptotic stabilization is no longer possible, but only practical stabilization. Consequently, the control is designed so that the trajectory of the closed-loop system can be derived to a small prescribed area enclosing the target point [9-15]. The practical stabilization has been widely investigated, and many important results have been