Dynamics of Continuous, Discrete and Impulsive Systems
Series **A:** *Mathematical Analysis* **25 (2018)** 1-14

DWELL TIME FOR SWITCHED SYSTEMS WITH MULTIPLE EQUILIBRIA ON A FINITE TIME-INTERVAL

Oleg Makarenkov and Anthony Phung

Department of Mathematical Sciences
University of Texas at Dallas, Richardson, TX 75080, USA

Abstract. We describe the behavior of solutions of switched systems with multiple globally exponentially stable equilibria. We introduce an ideal attractor and show that the solutions of the switched system stay in any given ε-inflation of the ideal attractor if the frequency of switchings is slower than a suitable dwell time T. In addition, we give conditions to ensure that the ε-inflation is a global attractor. Finally, we investigate the effect of the increase of the number of switchings on the total time that the solutions need to go from one region to another.

Keywords. Switched system, dwell-time, global exponential stability, ideal attractor.

AMS (MOS) subject classification: 93C30; 34D23

1 Introduction

Dwell time is the lower bound on the time between successive switchings of the switched system

$$\dot{x} = f_{u(t)}(x), \qquad u(t) \text{ is a piecewise constant function, } x \in \mathbb{R}^n, \tag{1}$$

which ensures a required dynamic behavior under the assumption that each of the subsystems

$$\dot{x} = f_u(x), \qquad u \in \mathbb{R},\ x \in \mathbb{R}^n, \tag{2}$$

possess a globally stable equilibrium x_u. When all the equilibria $\{x_{u(t)}\}_{t\ge t_0}$ coincide, the dwell time $T > 0$ which gives global exponential stability of the common equilibrium x_0 is computed e.g. in Liberzon [5, §3.2.1]. Specifically, the result of [5, §3.2.1] gives a formula for T which makes x_0 globally exponentially stable for any piecewise constant function $u(t)$ whose discontinuities $t_1, t_2, \ldots$ verify

$$|t_i - t_{i-1}| \ge T. \tag{3}$$

The case where the equilibria are distinct is covered in Alpcan-Basar [1], who offered a dwell time T that ensures global exponential stability of a suitable set $A \supset \{x_{u(t)}\}_{t\ge t_0}$ for any $u(t)$ whose discontinuities verify (3). The