Chapter 1

Introductionx

1.1 Motivation and Context

Switched systems are widely used in engineering applications and its importance has grown up considerably these last years, because of their ease of implementation for controlling cyber-physical systems. A switched systems is a set of dynamical systems, each with its own dynamical behaviour controlled by a parameter mode u whose values are in a finite set U(See Liberzon (2003)). However, due to the composition of many switched systems together, the global switched systems has a number of modes and dynamics which increases exponentially. Switched systems have numerous applications in control of mechanical systems, the automotive industry, and many other fields.

1.2 Problem Statement

Nowadays, there is a large number of methods to solve switched systems; however, it does not have guarantee in safety. For that reason, we propose a new approach to solve switched systems.

1.3 Objectives

General Objective

Our main objective is to propose a pipeline to solve switched systems guarantee safety and optimal synthesis controllers.

Specific Objectives

To achieve our main objective, we have the following specific objectives:

- Define a case of study and get its mathematical model.
- Implement a safety controller for switched systems.
- Optimize the switched systems using model checking techniques.
- Evaluate each step of the pipeline and compare with traditional approaches.

1.4 Contributions

This thesis proposes a novel approach to solve switched systems guaranteeing safety and optimal controller synthesis. This procedure to consider stochastic variables as an input for the system. Our contributions are related to each part and are detailed below.

- Define
  - We propose a method to guarantee safe controller. This methods consider three regions to have reachability and safety in the system.
  - We also demonstrate the utility of the proposed method comparing with traditional methods.
- Analyze the stability for our case of study study.
  - analyze the zeros and poles for the system.

1.5 Outline

Bibliography

Liberzon, D. (2003). *Switching in systems and control*. Springer Science & Business Media.