

## NUMERICAL SOLVING OF HYBRID DYNAMIC SWITCHING SYSTEM AND ITS APPLICATION

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**ABSTRACT.** *In this paper we propose a method of simulation and verification for a class of hybrid system. This kind of dynamic system integrates discrete and continuous parts according to the external control commands and internal evolution rules. In this case the system has character of chatting (oscillation or bifurcation) between the intersections of different regions. The switching surface is divided into two parts of sliding and crossing. The sliding mode on the switching surface is analyzed in detail; the conditions guiding the bifurcation between these two parts and the control formula to crossing or sliding are demonstrated. Furthermore the calculation algorithm is proposed to remove illegal crossing caused by the errors on this surface. Finally, we illustrate a successful application of solving an intake manifold model of an automobile engine with turbo charger for real time predictive control, in which the stability is improved greatly and the trajectory oscillation is reduced.*

**Keywords:** Hybrid system, Switching mode, Numerical method

1. **Introduction.** Technological innovation pushes towards the consideration of dynamical systems of a mixed continuous and discrete nature, which is called “hybrid systems”. The hybrid system [1] arises from the combination of an analog continuous time process and a digital time asynchronous controller. Many physical systems display hybrid behaviors: the description of multi-body dynamics depends crucially on the presence or absence of some contacts, models of friction phenomena distinguish between slip and stick phases and electrical circuits contain switching elements like diodes that can be blocking (open circuit) or conducting (short circuit).

In general, computation and simulation for hybrid system are difficult due to the difficulties of representing and propagating sets in discontinuous and continuous spaces [2-4]. In recent years, there has been some research focusing on this technical field by using approximations to make the problem reachable and tractable in various application areas. They include the use of linear hybrid automata [5], polyhedral representations [6],