Symbolic Approaches to Control via Approximate Bisimulations

Antoine Girard

Laboratoire Jean Kuntzmann, Université Joseph Fourier, Grenoble, France

Antoine Girard is an Assistant Professor in Applied Mathematics at the Université Joseph Fourier, Grenoble, France. He received the diplôme d’ingénieur from the Ecole Nationale Supérieure d’Informatique et de Mathématiques Appliquées de Grenoble (ENSIMAG) in 2001 and the Ph.D. in Applied Mathematics from the Institut National Polytechnique de Grenoble in 2004. He was a postdoctoral researcher in the Department of Electrical and Systems Engineering of University of Pennsylvania, Philadelphia, USA, from October 2004 to December 2005, and in the Verimag Laboratory, Grenoble, France, from January to August 2006. He joined the faculty of the Université Joseph Fourier in September 2006. He received the 2009 George S. Axelby Outstanding Paper Award of the IEEE Control Systems Society. His research interests deal with the algorithmic analysis and design of hybrid control systems with an emphasis on verification and reachability analysis of hybrid systems, abstraction techniques, hierarchical control, symbolic control, distributed control...

Abstract

Advances in control systems technology demand that we make constant progresses in the design of controllers achieving always more complex specifications such as safety and reachability requirements, sequencing of tasks, fault-tolerance, etc... Symbolic control approaches offer the possibility to deal with such specifications by abstracting the continuous dynamics of the control system under consideration. In this talk, we will present an approach based on the notion of approximate bisimulation [1], that applies to incrementally stable switched control systems. More precisely, we will show that under the assumption of incremental stability, it is possible to compute discrete dynamic systems, called symbolic models, that are accurate descriptions of the original system [2]. These symbolic models can be used for controller synthesis and enable to leverage all the control techniques of discrete dynamic systems theory. Refinements of these discrete controllers can then be used to control the original system. Moreover, by carefully handling the discrete synthesis, these refined controllers can be certified correct by design. In this talk, we will focus on the synthesis of safety [3] and reachability [4] controllers.

References


