Post-doc or Research Engineer Opening - 2011

Controller Synthesis for Continuous Systems
Using Multiscale Symbolic Abstractions

Starting: As soon as possible
Duration: 12 months
Location: POPART Project, INRIA Rhône-Alpes, Grenoble, France
Web: http://www.inrialpes.fr/
Supervisors: Gregor Goessler (Gregor.Goessler.inria.fr), Antoine Girard (Antoine.Girard@imag.fr)

Scientific Context

This post-doc position is opened within the VEDECY project (Verification and Design of Cyber-Physical Systems) funded by the ANR. This projects brings together hybrid systems and formal methods experts from INRIA and the Laboratories Jean Kuntzmann and Verimag.

Cyber-physical systems are integrations of computation with physical processes: embedded computers control physical processes which in return affect computations through feedback loops. They are ubiquitous in current technology and their impact on lives of citizens is meant to grow in the future (autonomous vehicles, robotic surgery, “intelligent” energy efficient buildings...). Cyber-physical systems applications are often safety critical and therefore reliability is a major requirement. To provide assurance of reliability, model based approaches and formal methods are appealing. Models of cyber-physical systems are heterogeneous by nature: discrete dynamic systems for computations and continuous differential equations for physical processes.

The candidate will be co-supervised by Gregor Goessler at INRIA and Antoine Girard at the Laboratory Jean Kuntzmann and will have the opportunity to interact with the other members of the VEDECY project.

Job Scope

The post-doc position deals with the development of sound approaches for the synthesis of discrete embedded controllers for switched systems. Recently, a new promising approach based on the use of approximately bisimilar symbolic abstractions has been proposed. The main idea is to relax the requirement of exact equivalence [2] in order to be able to handle more general classes of systems [3]. The current techniques relies on a uniform discretization of the continuous state space and thus suffers from the state explosion problem.

Depending on the control objectives, it might be useful to compute a discrete abstraction that is very accurate in some parts of the state space and less in other parts. For that purpose, we propose to consider multiscale discrete abstractions defined on a hierarchy of embedded grids. We consider simple safety or reachability properties. In order to ensure these properties, discrete controller synthesis is performed on a discrete abstraction of the continuous system. Whenever safety cannot be ensured at the coarser level at the abstraction, we intend to locally and incrementally refine the level of abstraction in order to synthesize an admissible controller. As the discrete abstractions can be computed on the fly, this synthesis technique should avoid exploring too many states and therefore increase the efficiency of our approach. Preliminary results have been developed by the members of the Vedecy project [1]. The purpose of the job is to propose efficient data-structures...
and algorithms for controller synthesis using multi-scale discrete abstractions and to implement them in a toolbox.

**Candidate Profile**

Candidates must have a Ph.D. in Computer Science, Control, or Applied Mathematics. Significant programming experience is required. Knowledge of the domain of formal methods in computer science and control is a plus.

Please send your application file (including CV, references) by email to Gregor.Goessler.inria.fr and Antoine.Girard@imag.fr.

**References**

