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 :	POP ART team, INRIA Grenoble – Rhône-Alpes, France
Web :	`http://pop-art.inrialpes.fr/`
Supervisors :	Gregor Goessler (`firstname.lastname@inria.fr`), Antoine Girard (`Antoine.Girard@imag.fr`)

Scientific Context

This position is opened within the VEDECY project (*Verification and Design of Cyber-Physical Systems*) funded by the ANR:

`http://sites.google.com/site/vedecy/`

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 work with 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 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]. Most of the current techniques relies on a uniform discretization of the continuous state space and thus suffers from the state explosion problem.

The members of the VEDECY project have proposed new approaches based on multiscale discrete abstractions defined on a hierarchy of embedded grids [1]. 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 accurate in other parts. Whenever the specification cannot be ensured at the coarser level, the abstraction is locally and incrementally refined in order to synthesize an admissible

controller. As the discrete abstractions can be computed on the fly, this synthesis techniques avoid exploring too many states and therefore increase the efficiency of our approach.

The purpose of the job is the development of a toolbox for controller synthesis using multi-scale discrete abstractions. This includes the choice of efficient data structures, high-quality implementation of existing algorithms and development of new techniques in collaboration with members of the VEDECY project.

Candidate Profile

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

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

References

[1] J. Camara, A. Girard, and G. Goessler. Synthesis of switching controllers using approximately bisimilar multiscale abstractions. In *Hybrid Systems: Computation and Control, HSCC'11*, 2011. to appear.

[2] A. Girard and G.J. Pappas. Approximation metrics for discrete and continuous systems. *IEEE Trans. Automatic Control*, 52(5):782–798, 2007.

[3] A. Girard, G. Pola, and P. Tabuada. Approximately bisimilar symbolic abstractions for incrementally stable switched systems. In *Hybrid Systems: Computation and Control, HSCC'08*, volume 4981 of *LNCS*, pages 201–214. Springer, 2008.