Post-Doc Opening - 2012

Symbolic Approaches to the Design of Cyber-Physical Systems

Starting:	September 2012
Duration :	12 months
Location :	Laboratoire Jean Kuntzmann, Univeristy of Grenoble, France
Supervisors :	Antoine Girard (`Antoine.Girard@imag.fr`), Gregor Goessler
Web :	`https://sites.google.com/site/antoinesgirard/`

Scientific Context

This position is opened within the SYMBAD project (*Symbolic Approaches to the Design of Cyber-Physical Systems*) funded by the University of Grenoble.

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.

Job Scope

The position deals with the development of sound approaches for the synthesis of discrete embedded controllers for cyber-physical systems. Recently, a new promising approach has been proposed, based on the use of symbolic abstractions that are approximately bisimilar to the continuous dynamics of the physical components of the system [3, 4]. More recently, the members of the SYMBAD project have proposed approaches, based on multiscale discrete abstractions defined on a hierarchy of embedded grids [2, 1], that are more efficient computationally.

The goal of the SYMBAD projects is double. The first goal is to develop the theory of controller synthesis using approximately bisimilar abstractions. Several challenging theoretical problems still need to be addressed: compositional synthesis; safe, robust and efficient controller refinement techniques; fine estimates of the precision of the symbolic models... The second goal is to continue the development of a toolbox for controller synthesis that has been initiated within the VEDECY project[1]. Depending on his profile, the successful candidate will work on one or several of the aspects of the SYMBAD project.

Candidate Profile

The successful candidate should have a Ph.D. or a Master in Computer Science, Applied Mathematics or Control. Knowledge of at last one of the domains of formal methods in computer science, scientific computing, or control is required.

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

[1] http://sites.google.com/site/vedecy/

References

[1] J. Camara, A. Girard, and G. Goessler. Safety controller synthesis for switched systems using multi-scale symbolic models. In *Joint IEEE Conference on Decision and Control and European Control Conference*, 2011.

[2] 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.

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

[4] 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.