Ecole Doctorale STIC

Sciences & Technologies de l'Information et de la Communication

ED STIC - Proposition de Sujets de Thèse

pour la campagne d'Allocation de thèses 2017

Axe Sophi@Stic :	SystèmesRéseaux|
Titre du sujet :	A Formal and Standard-compliant Co-simulation Framework for Cyber-Physical Systems
Mention de thèse :	Informatique
HDR Directeur de thèse inscrit à l'ED STIC :	Robert De simone

Co-encadrant de thèse éventuel :

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Description du sujet :

Context:

Large systems increasingly associate aspects from physical reality with digital ones, leading to the vocable of so-called Cyber-Physical Systems (CPS). The proper modeling of CPS thus requires an heterogeneous combination of distinct models, which we view each as concretely represented in a matching Domain Specific Language (DSL), which is tailored both syntactically and semantically to the part of the system under modeling.

However, this leads to a set of heterogeneous models and demands to correctly specify and understand the whole system. It is therefore mandatory to specify the interaction/coordination between these models [1]. This coordination must then take into account that different models require different simulation principles, both for accuracy

and efficiency of simulation. Then, the perceptive association of DSL simulators/solvers in co-simulation becomes more and more of an issue [2].
In this context, our objective is not to define new simulation practices in individual models, not even to define drastically new means to associate them in heterogeneous co-simulation, but to support properly the characterization of relevant features in modeling and scheduling of these individual DSLs, and the required constraints for their combination. Of course these "precise semantics simulation interfaces" should be designed in the view of allowing scheduler synthesis.
To provide a simplistic illustration, a low-power narrow-band IoT sensor sampling one environmental value and broadcasting it every hour should not be considered at the pace of (much faster) physical evolutions.
In broad terms, "physical" simulation may rely more on continuous models with differential equations and time-triggered simulation of discretized forms, where "cyber" models rely more on genuinely discrete models and event-driven simulation.

Objectives:
In previous exploratory works, realized during the GEMOC INS Project (http://gemoc.org/ins), a study on how to automatically coordinate behavioral models conforming to different languages has been proposed. This approach has successfully established the possibility to reason on the coordination of heterogeneous models ,when adequate interface is exposed. The main purpose of the PhD thesis proposal is to extend these results to the expressiveness of Cyber-Physical Systems, with both new proper formal definitions and practical realizations matching CPS demands.

Bilibliography:
[1] B. Combemale, J. Deantoni, B. Baudry, R. B. France, J.-M. Jézéquel, and J. Gray, “Globalizing Modeling Languages”; IEEE Computer, pp. 10-13, Jun. 2014. Available at https://hal.inria.fr/hal-00994551
[2] Gomes, C., Thule, C., Broman, D., Larsen, P. G., & Vangheluwe, H. (2017). Co-simulation: State of the art. arXiv preprint arXiv:1702.00686 .
https://arxiv.org/abs/1702.00686

URL : http://team.inria.fr/kairos/phd_kairos_ministry/

English version:

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