PICS MBSAR
(Model-Based Security Analysis at Runtime)
http://gemoc.org/mbsar
2013-2015
Responsable scientifique : Benoit Combemale, IRISA, CNRS UMR 6074

RAPPORT D'ACTIVITÉ 2015

Point-clés de l'année 2015 :
- ✓ 1 doctorant de l'IRISA en visite à CSU
- ✓ Visite d'un professeur de MSU (USA)
- ✓ Visite d'un professeur de Swansea Univ. (UK)
- ✓ Organisation de 2 workshops internationaux et édition des actes associés
- ✓ Publication d'un livre chez Springer (http://www.springer.com/gp/book/9783319261713), d'1 article de journal (JOT) et d'un article de conférence (Modularity'15).
- ✓ Décès du Professeur Robert France, PI du projet PICS MBSAR pour CSU (cf. http://people.irisa.fr/Benoit.Combemale/tribute-robert-france)

Suite à la dernière visite à l'IRISA du Professeur Robert France en octobre et novembre 2014, nous avons eu la douleur d'apprendre son décès le 15 février 2015. Lors de cette année 2015, avec l'ensemble de ses collègues internationaux et ses doctorants à CSU, nous nous sommes attaché à finaliser les travaux initiés avec Robert France. Ainsi, nous avons finalisé la publication de certains ouvrables, et organisé différents évènements que nous avions initié avec lui.

A. MOBILITE TRANSNATIONALE

Workshop Sustainability 2015 (http://sustainability15.inria.fr) :

1st international workshop on Next Generation of Modularity Approaches for Multiple Dimensions of Sustainability (Sustainability'15), March 17, 2015, CSU, Fort Colins, CO, USA. Co-localisé avec la conférence Modularity 2015.

Organisateurs:
- Ana Moreira, Universidade Nova de Lisboa, Portugal
- Betty H.C. Cheng, Michigan State University, USA
- Benoit Combemale, Inria and University of Rennes, France
- Jean-Michel Bruel, University of Toulouse, France
- Jeff Gray, University of Alabama, USA
- Robert B. France, Colorado State University, USA

Participants: env. 40 personnes.

Workshop GEMOC 2015 (http://gemoc.org/gemoc2015) :

3rd International Workshop on The Globalization of Modeling Languages, September 28, 2015, Otawa, Canada. Co-localisé avec la conférence MODELS 2015.

Organisateurs:
- Benoit Combemale, University of Rennes 1, France
- Julien De Antoni, University of Nice Sophia Antipolis, France
- Jeff Gray, University of Alabama, USA

Participants: env. 40 personnes.

B.1 - Etat d'avancement du projet scientifique du projet
(this part is in English because the text was written in collaboration with the partner from USA)

Software intensive applications for the Future Internet assemble software services distributed over multiple devices. These software applications are deployed in dynamic and open environments. The environments are dynamic because the availability of services and support resources varies in time, and open because new clients and providers can move in and out of the environments over time. These applications are also used in sectors that provide critical services to society, for example, assisted living and energy management. Furthermore, these applications often manipulate data and resources that must be protected from unauthorized access. Model-Driven Software Development provides effective concepts and techniques for modeling and analyzing security and other system integrity concerns at design time. However, in a dynamic and open environment, software systems have to adapt to dynamic environments after deployment. This makes it necessary to analyze the system at runtime to ensure that the system still fulfills security and other integrity requirements.

System monitoring and reflection mechanisms can be used to extract and maintain abstract views (models) of a system at runtime. These models at runtime can serve to reason about runtime adaptation of software systems, as well as to analyze the changes required by an adaptation. MBSAR focuses on extending the applicability of Model-Driven Software Development to adaptive systems. In particular, we investigate the use of models at runtime to support the evolution and analysis of security concerns at runtime.

The core principle of models at runtime is to include, in the running system, a set of models. Each model presents a perspective that serves specific reasoning and analysis purposes, with respect to software adaptation at runtime. For example, it is possible to embed (1) an architecture model in a running system that captures the deployed structure of the system, (2) a variability model that captures the set of features that can be used to vary behavior at runtime, and (3) a security access control policy model that determines how users access the resources of the system.

Models at runtime raise a number of difficult challenges for the design and deployment of adaptive software. MBSAR focuses on the issues related to runtime analysis of access control policies. In particular we focus on three related topics: developing a model typing theory to support rigorous model composition; runtime analysis of security policies; runtime enforcement of context-based access control policies.

The third year of the project was dedicated to the application of the foundational basis in MDE developed during the two first years. We also established the scientific background for a broader initiative, namely the GEMOC initiative, resulting in a book published from the results of a Dagstuhl seminar.

Below is the summary of the major book, article and paper resulting from the collaboration in the PICS MBSAR, and published in 2015:

"Globalizing Domain-Specific Languages" (Betty H. C. Cheng, Benoît Combemale, Robert B. France, Jean-Marc Jézéquel, Bernhard Rumpe), In Lecture Notes in Computer Science 9400, Springer, 2015

The development of modern complex software-intensive systems often involves the use of multiple DSMLs that capture different system aspects. Supporting coordinated use of DSMLs leads to what we call the globalization of modeling languages, that is, the use of multiple modeling languages to support coordinated development of diverse aspects of a system.
In this book, a number of articles describe the vision and the way globalized DSMLs currently assist integrated DSML support teams working on systems that span many domains and concerns to determine how their work on a particular aspect influences work on other aspects.
Globalized DSMLs offer support for communicating relevant information, and for coordinating development activities and associated technologies within and across teams, in addition to providing support for imposing control over development artifacts produced by multiple teams. DSMLs can be used to support socio-technical coordination by providing the means for stakeholders to bridge the gap between how they perceive a problem and its solution, and the programming technologies used to implement a solution. They also support coordination of work across multiple teams. DSMLs developed in an independent manner to meet the specific needs of domain experts have an associated framework that regulates interactions needed to support collaboration and work coordination across different system domains.
The articles in the book describe how multiple heterogeneous modeling languages (or DSMLs) can be related to determine how different aspects of a system influence each other. The book includes a research roadmap that broadens the current DSML research focus beyond the development of independent DSMLs to one that provides support for globalized DSMLs.

"Using Slicing to Improve the Performance of Model Invariant Checking" (Wuliang Sun, Benoît Combemale, Robert B. France, Arnaud Blouin, Benoit Baudry, Indrakshi Ray), In **Journal of Object Technology**, vol.14, no. 4, 2015
and
"Towards the use of slicing techniques for an efficient invariant checking" (Wuliang Sun, Benoît Combemale, Robert B. France). In **MODULARITY 2015**, ACM, pp. 23-24, 2015

In Model Driven Development (MDD), it is important to ensure that a model conforms to the invariants defined in the metamodel. Such invariant checking can improve developers' understanding of modeled aspects of complex systems and uncover structural errors in design models. General-purpose rigorous analysis tools that check invariants are likely to perform the analysis over the entire metamodel and model. Since modern day software is exceedingly complex, the size of the model together with the metamodel can be very large. Consequently, invariant checking can take a very long time. For example, checking a model consisting of 5,000 elements can take up to several hours if the analysis completes. Moreover, sometimes the analysis process cannot be completed as the system resources get exhausted. To this end, we introduce model slicing within the invariant checking process, and use a slicing technique to reduce the size of the inputs in order to make invariant checking of large models feasible with existing tools. The evaluation we performed provides evidence that model slicing can significantly reduce the time to perform the invariant checking. In the experiments that we conducted, we achieved speedups ranging from 1.5 to 36.0 and we also demonstrate the correctness of the checking results.

B.2 - Co-encadrement de doctorants et/ou participation à des jurys

Benoit Combemale (IRISA) participe à l'encadrement des travaux de Peter Wuliang Sun, dont les travaux sont dirigés par Robert B. France à CSU.

B.3 - AUTRES ACTIVITES COMMUNES

Robert B. France (CSU, USA) et Benoit Combemale (IRISA, France) sont les fondateurs de l'initiative internationale GEMOC (cf. http://gemoc.org) et font tous les deux partie de son *Advisory Board*.

Robert B. France a obtenu une chaire internationale Inria dans l'équipe DiverSE sur la période 2013-2017 (12 mois dans l'équipe sur la période).

C. PRODUCTION SCIENTIFIQUE CO-SIGNEE AVEC LES PARTENAIRES ETRANGERS DU PROJET

Proceedings :
- Proceedings of the 3rd Workshop on the Globalization of modeling languages (GEMOC'15) : published on CEUR

Book :
- ***Globalizing Domain Specific Languages.*** *Combemale, B., Cheng, B.H.C., France, R.B., Jézéquel, J.-M., Rumpe, B. (Eds.), Springer, 2015. Cf. http://www.springer.com/gp/book/9783319261713*

Article :
- ***Using Slicing to Improve the Performance of Model Invariant Checking*** (Wuliang Sun, Benoît Combemale, Robert B. France, Arnaud Blouin, Benoit Baudry, Indrakshi Ray), In Journal of Object Technology, vol.14, no. 4, 2015

InProceeding :
- ***Towards the use of slicing techniques for an efficient invariant checking*** (Wuliang Sun, Benoît Combemale, Robert B. France). In MODULARITY 2015, ACM, pp. 23-24, 2015

Voir toutes les publications à l'adresse : http://gemoc.org/publications

Autres co-productions

- Site internet du projet : http://gemoc.org/mbsar
- Bases de modèles : http://www.cs.colostate.edu/remodd/v1/content/gemocmodels

D. OBSERVATIONS EVENTUELLES

RAS.