PHD FELLOWSHIP PROGRAM

ÉCOLE DOCTORALE SCIENCES EXACTES ET LEURS APPLICATIONS - ED 211

Avenue de l'université BP 1155 64 013 PAU Cedex – France

PHD THESIS TOPIC

TITLE: Validation & Monitoring Methods for Model Execution

ABSTRACT: The PhD thesis will take place in the context of the European project MegaM@RT of the cluster ECSEL-JU. This project aims to develop model-based methods and tools for continuous software development between the design stage and the execution stage, including verification, testing, monitoring or system tracing at run-time. These methods and tools seek the improvement of the quality and productivity level for the development of complex industrial systems.

In the spirit of Model Driven Engineering (MDE), models will be involved throughout the system development cycle. Traditionally, this occurs in the design stage of course, but the system also aims at being embedded in the system during its execution. The concept of models@runtime consists in having models that causally reflect the current state of the system over time. From these models, one can obtain an analyzable execution trace, detect a problem during the execution of the system or even decide to alter the execution.

Another way to use a model@runtime is to own executable models: such a model defines the behavior of the system and is executed by a dedicated engine. The advantage of model execution is that it straightforwardly allows us to use at runtime a behavioral model defined at the design time (e.g., state machines, Petri nets, workflows...), thereby avoiding a significant part of the error-prone implementation phase. Moreover, an executable model can be simulated at design time, which makes it possible to detect problems at a very early stage of the development cycle and thus to save time and money.

The research subject of the PhD thesis lies in the field of model execution and targets the development of methods and tools for verification, validation or monitoring for model execution. The goals of these methods and tools is to ensure that the execution of the system proceeds correctly, to analyze the execution and derive valuable data in order to improve models back in the design stage. These methods and tools should also be used in the design stage, in a simulation mode, for early problem detection.

One of the main advantages of MDE is that it allows us to develop modeling languages (DS(M)L: Domain Specific (Modeling) Languages). The developed approach should be applicable on any kind of executable DSL, but with a special focus on the PauWare engine. This tool was developed by the LIUPPA MOVIES team and allows us to run UML state machines. It will be important to extend the tool with verification, tracing and monitoring features. Meanwhile, the project will provide an excellent opportunity to validate the usability of PauWare within industrial projects and to tailor it to the needs of companies for their embedded systems. The case studies of the industrial partners of the MegaM@RT project are in the areas of railway or air transportation management, energy or telecoms networks.

Keywords : software engineering, model-driven engineering, model execution, models@runtime, verification, validation, monitoring, industrial systems, embedded systems

THESIS CONDITIONS

Laboratory: LIUPPA

Website: http://liuppa.univ-pau.fr/live/

Supervisor: Franck Barbier
Advisors: Eric Cariou & Olivier Le Goaer

Location : Pau	
Anticipated starting date: 01/09/2017	**Duration:** 3 years
Employer : Université de Pau et des Pays de l'Adour (UPPA)	
Gross monthly salary: 1685 €	

RESEARCH LABORATORY EXPERTISE

The thesis subject, the MegaM@RT project as well, take place in research fields of the LIUPPA MOVIES activities. Indeed, LIUPPA MOVIES team has a great expertise in MDE in general and model execution in particular. The research topics covered by the PhD thesis and the European project perfectly match the skills of the 3 advisors since they have worked primarily on that topic for many years, i.e., MDE and model execution. Moreover, the 3 advisors of this thesis already have supervised a thesis that has been successfully defended (Samson Pierre, November 2015). The subject was about adaptation of model execution. Works on verification in the context of MDE have also been conducted in recent years.

DUTIES - MAIN ACTIVITIES

Scientific context

The thesis will be carried out within the framework provided by the MegaM@RT European project, whose purpose is to improve the quality and productivity of the development of complex industrial systems by means of model-based methods and tools. The full title of the project is « *MegaModelling at Runtime – scalable model-based framework for continuous development and runtime validation of complex systems* ». The project was funded by the ECSEL-JU (*Electronic Components and Systems for European Leadership – Joint Undertaking*) cluster.

28 partners from France, Spain, Italy, Finland, Sweden and the Czech Republic are participating in the project for a total budget of € 10 millions. The ECSEL-JU cluster is oriented towards applied research and industrial research. Thus, among the 28 partners, there are 11 academics, 9 small and medium-sized enterprises and 8 major groups (Nokia, Thales, Volvo, Bombardier, Schneider Electric, Softeam, ATOS, INTECS).

The thesis is co-funded by the European Union and the "Communauté d'Agglomération Pau Pyrénées".

Objectives

The objective of the thesis is to develop methods and tools for verification, validation or monitoring of model execution. The purpose of these methods and tools is to ensure that the execution of the system is carried out correctly. This also covers the ability to analyze its execution in order to obtain valuable information which will, in turn, improve the models created in the design stage. These methods and tools can also be used at design time, as a simulation support, to detect problems as early as possible.

Expected results

In addition to scientific publications in well-ranked conferences and journals, the expected results are the following:

- Development of methods for verification, validation or monitoring of models under execution. These methods have to be applicable on any executable DSL.
- Extension of the PauWare engine, which allows us to run UML state machines, to integrate these newly developed methods.
- Use of the extended version of PauWare engine on industrial cases provided by the project. This project will be a unique opportunity to validate the relevance of this academic prototype with the needs and requirements of industrial groups that are developing complex systems.

Research collaborations

The research collaborations will be large since the MegaM@RT project has 28 partners across 6 European countries.

REQUIRED COMPUTER SKILLS

The applicant must have followed a Computer Science academic program, preferentially with a specialization in software engineering, and strong development skills (mainly in Java). Competencies in MDE and/or verification techniques would be greatly appreciated.

APPLICATION EVALUATION

Recruitment process: Selection board

Candidates will be selected first on the quality of their application. An interview will be scheduled after that. The successful candidate will have:

- Adequacy of the Master Certificate with the Thesis
- Great grades of the Master's diploma, and regular attendance
- English language skills
- Communication/presentation skills
- Work experience in a laboratory (internship or others); eventually past research achievements (reports, publications).

HOW TO APPLY

Send by email your complete application including:

- Curriculum Vitae
- Cover letter
- Master diploma's grades and ranking
- Recommendation letters
- Names of (at least) two references with their full contact information

FIRM DEADLINE:	**30th of June**

CONTACT

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