

PhD Student Vacancy for RODIC Project

PhD Degree in Software Engineering

2022/2025

Nantes University is hiring a PhD Student for its RODIC Project in Nantes, France.

Research Subject

Performance Evaluation of Executable Domain-Specific Languages

Abstract

The RODIC project (4-year French national funding) has several open PhD positions. The research domain is Software Engineering, with the goal to help Industry 4.0 when reconfiguring production chains by the use of techniques and platforms based on Model-Driven Engineering, Domain-Specific Languages (DSL), Software Testing, Human-Machine Interfaces.

The current PhD position focuses on the performance evaluation of production systems designed with executable DSLs. It tackles the design of performance indicators and of test scenarios to be executed on production systems modelled when being reconfigured.

Supervisors

- Jean-Marie Mottu, Erwan Bousse, Massimo Tisi – LS2N lab – NaoMod Group
- Pascal Berruet - LAB-STICC lab

Key-words

- Domain: Model-Driven Engineering, Industry 4.0, Domain-Specific Languages, Software Testing
- Technologies: Java, Eclipse, EMF, DSL

Context

The evolution of industrial systems to so-called "Industry 4.0", "Factory of Future" or "Cyber-Physical Production Systems", is mainly based on the development of highly connected resources throughout the whole production process and beyond. The RODIC project focuses on the reconfiguration phase: when switching from one configuration to another, a Reconfigurable Manufacturing Systems [RMS] needs to reconfigure both hardware and software components. A model of the production chain can then be modelled (left of the Figure 1), the scenario can be verified (right of the Figure 1), and DSL can be used to simulate the execution (simplified example of such a DSL: https://github.com/szschaler/pls_language).

The approach of RODIC is to consider most of the reconfiguration using the same models for the definition, verification, evaluation, validation, and code generation. During the thesis, we focus on the *evaluation*: when a new configuration is being designed, the operator needs to evaluate its performance before the (costly, time consuming) reconfiguration of the production chain in the physical world. This evaluation must rely on the existing models used for designing the new configuration and verifying its correctness.

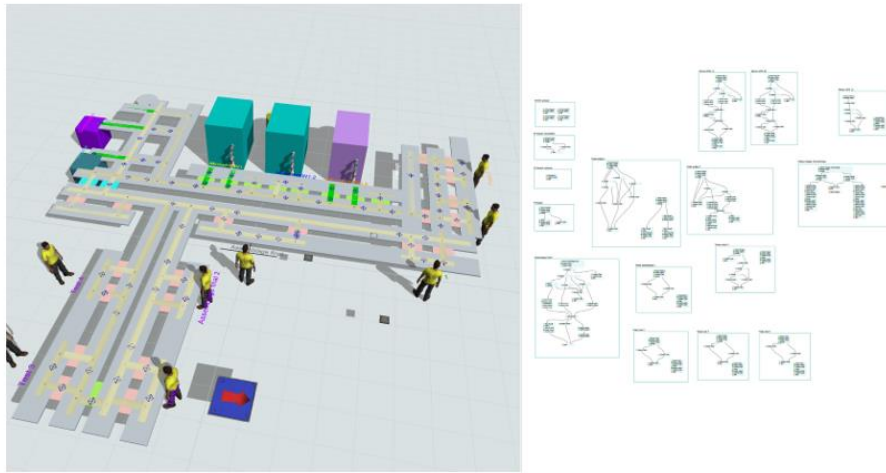


Figure 1- Simulation of chain configurations, graphical model and scenario [Capawa21].

Problematic and Objectives

RODIC aims to provide the operators of a factory with a Model-Based Software Engineering (MBSE) framework to reconfigure RMS. Such a framework is constructed around Domain-Specific Languages (DSLs) to design configuration models, and also provides methods and languages to manipulate the models and generate production code. In particular, for evaluating performance, the framework must provide a way to simulate the production system by *executing* the models (using a model interpreter) before the system can be deployed in real-world. For this task, executable DSLs (xDSLs) are a kind of modeling languages that allow the definition and the execution of the behavioural models of the system [Bousse20]. A preliminary work of the thesis has been initiated during an internship producing a state of the art about xDSL and their use for manufacturing systems and RMS. It will need to be updated.

Providing testing facilities for xDSLs—ie. to be able to define and execute test scenarios for executable models created with xDSLs—is a topic that was already studied for functional testing [Meyers16]. However, evaluating the performance of a simulated system requires modeling performance testing scenarios, which is a form of *non-functional* testing. **The first goal of the thesis is to consider how to add KPIs to the definition of an xDSL.**

In addition, we want to use a standard language for the evaluator to be able to design a performance evaluation in the same way while considering different systems and their xDSLs. The Test Definition Language (TDL) [TDL] is a standard language, and an interesting candidate for benchmarking [Gheorghe20]. In our previous work, we already considered how to use TDL to provide functional testing for xDSLs [Khorram20]. **The second goal of the thesis is to model test scenarios for non-functional testing.**

Thereafter, evaluating the performance requires to simulate the behaviour of test scenario. It requires to model discrete-event execution that can be run step by step, providing an execution trace. **The third goal is to define how to generically model and implement operational semantics to evaluate the performance of the system while running a test scenario.**

The proposals will be experimented on several case studies and will be integrated with the other contributions of the RODIC project.

Environment

The employer is Nantes University. The student will be a member of the [NaoMod research group](#) of the LS2N lab, and will be located at the IMT Atlantique, in Nantes. In addition, he/she will be supervised by the LAB-STICC, of University of Bretagne Sud, from Lorient city.

The 3-year PhD position is funded (~2000€ gross salary, including French social security)

The RODIC project supports three PhD students and a postdoc researcher that will collaborate together.

Requirements

The candidate must hold (or be about to obtain) a Master Degree in Computer Science with strong skills in Software Engineering.

The candidate can write and speak English fluently, the working language of the NaoMod group being mainly English, and the research results must be written in English.

Application

Applicants should provide a curriculum vitae with detailed information regarding their academic degree, research/development projects and a motivation letter.

To apply and for more information please contact jean-marie.mottu@univ-nantes.fr.

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