Internship: Model-Driven Engineering for Reconfigurable Manufacturing Systems (RMS)

Supervisors

- Erwan Bousse (erwan.bousse@univ-nantes.fr) - Naomod team

- Maroua Nouiri (maroua.nouiri@univ-nantes.fr) - CPS3 team

Context

The current industry is at a turning point, in particular because of the increase in the connectivity capacities of the production equipment. This revolution, often referred to as Industry 4.0, is changing the way production lines themselves are designed and operated. Thus, rather than talking about production lines, which are very rigid and symptomatic of the 1960s, and flexible systems, which can produce several products at once but are not very efficient, we now talk about Reconfigurable Manufacturing Systems (RMS). This concept is based on the idea of stopping production lines as soon as necessary, in order to reconfigure them physically and software-wise, before restarting them at full productivity. This type of system therefore requires a modular design, favoring reuse and reconfiguration. Nowadays, to overcome the difficulty of software maintenance, RMS rely on relatively simple controls, generally based on the product-driven paradigm, mimicking the modularity of hardware components.

Objectives of the internship

During this internship, the objective will be to use model-driven engineering tools to create a small domain-specific language (DSL) to define simple production systems. One task will be to define the scope of this language, i.e. what kind of systems we want to model. For example, one can imagine focusing on "producer", "assembler", "conveyor" type components, each with different configuration options (type of product, speed, etc.).

In addition, this language should allow the definition of *modules*, each module being a reusable "piece" of the production system. For each module, it will be necessary to be able to define how to connect it to the rest of the system by means of an interface. Thus, with this language, we will be able to design a production system by simply picking from a pre-existing set of modules. These modules are then instantiated, configured and connected together via their interfaces.

The language will be evaluated by demonstrating with examples (1) that it allows to define multiple different production systems from the same set of pre-designed modules, (2) that it allows to easily reconfigure a given system by re-arranging or replacing the modules it contains.

To achieve these objectives, the intern will have at the beginning of the internship to learn on both model-driven engineering, language engineering and production systems engineering. The trainee will also have to read about existing approaches in the scientific literature on the subject, in order to understand how his work can be compared to existing approaches.

Keywords

- Technologies: Java, Eclipse EMF (including Ecore), Flexsim,
- Concepts: DSLs, Automation, Manufacturing, Model Driven Engineering, Verification, Simulation.

Environment

The internship will last at least 5 months, with an internship bonus between 500 and 600€ per month, and will take place on two sites of Nantes University: the "Faculté des sciences et techniques" (Lombarderie campus in Nantes), and the IUT (Fleuriaye campus in Carquefou).

Desired profile

The candidates should:

- be currently in the last year of a master's degree in Computer Science,
- have knowledge of model-driven engineering,
- have good writing skills,
- know how to work in a team and how to communicate,
- are able to write and express themselves in English in a professional context.

A first experience of using model-driven engineering tools (Eclipse EMF technologies for example) will be appreciated.

Perspectives

A PhD funding (36 months, under a Nantes University PhD contract) is assured to continue the work with an effective start in September 2023.

Contact

To apply, please send by email to erwan.bousse@univ-nantes.fr and maroua.nouiri@univ-nantes.fr your CV and cover letter, as well as your academic results of M1 and M2.