Bachelor Thesis: Active Object Languages for Railway Modeling

TECHNISCHE UNIVERSITÄT DARMSTADT

Software Engineering Group – Eduard Kamburjan

Contact: kamburjan@cs.tu-darmstadt.de

Context

With the rise of cloud architecture, concurrent systems became omnipresent and are an important part of critical infrastructure. Even so, the analysis and design of such systems remains a major challenge. The *actor* paradigm emphasizes the analyzability of concurrent systems by strictly encapsulating objects and restricting communication to message passing. Mainstream languages like Java offer libraries to use actors and several modeling languages based on actors have been proposed to analyze distributed systems. Two such languages are ABS and Rebeca:

The **A**bstract **B**ehavior **S**pecification Language (ABS)[1] was developed to model distributed software systems, with a focus on resources analysis, usability and verifiablity. A rich toolkit has been developed for ABS, including tools for test case generation, monitoring, deductive verification and deadlock analysis.

The **Re**active **Objec**ts **L**anguage (Rebeca)[2] also models such systems, but focuses on analysis of probabilistic behavior. Its toolkit includes schedulability analysis, deadlock analysis and model checking.

Both languages share the explicit modeling of time and deadlines and use of the actor paradigm, but differ in essential design choices how the paradigm is realized in the language.

One example of a critical distributed system are railways. The FormbaR project[3] aims to analyze railway operation by formalizing the rulebooks used by Deutsche Bahn AG in ABS. In FormbaR established tools and best practices from computer science are applied to railway engineering, especially the object-oriented model and the analysis realized in ABS.

Thesis

The aim of the thesis is to compare at least the active object languages ABS and Rebeca and their toolkits, by modeling a railway operation system in each of them. The student is expected to learn these languages, to acquire a basic understanding of communications in railway operations and to implement a model of it in both languages. The comparison is supposed to focus on comparing design aspects of the languages, as well as their toolkits.

As the documentation of railway operations is in German, the student **must** be able to read and understand technical documents in German.

Approximate Work Distribution

Analysis

Programming

Literature

References

[1] R. Hähnle, "The abstract behavioral specification language: A tutorial introduction," in *Proc. Formal Methods for Component-Based Systems (FMCO)*, 2012.

[2] M. Sirjani, A. Movaghar, A. Shali, and F. S. de Boer, "Modeling and verification of reactive systems using rebeca," *Fundam. Inform.*, vol. 63, no. 4, pp. 385–410, 2004.

[3] E. Kamburjan and R. Hähnle, "Uniform modeling of railway operations," in *Fifth Intl. Workshop on Formal Techniques for Safety-Critical Systems (FTSCS)*, 2016.