RWTH AACHEN
RHEINISCH-
WESTFÄLISCHE
TECHNISCHE
HOCHSCHULE
AACHEN

CHAIR OF
COMPUTER SCIENCE 2
SOFTWARE MODELING
AND VERIFICATION
(MOVES)

- Bachelor Thesis -

Dependency Analyses for Reconfigurable Component-Based Systems

What is it all about?

Reconfigurable systems have pervaded many fields of computing and are becoming more and more important. To make them amenable to systematic design and analysis methods, formal modeling languages are required. One such language is AADL (Architecture Analysis and Design Language), which is gaining widespread acceptance in automobile, avionics and aerospace industries for comprehensively modeling component-based, safety-critical distributed systems by capturing functional, probabilistic and hybrid aspects. In particular, AADL supports the specification of dynamic reconfiguration of systems in the form of mode transitions which (de-) activate components and their communication connections. However it turns out that one has to use this mechanism carefully as it can give rise to cyclic dependencies between communication ports, which are forbidden. It is well known [2] that this problem is closely related to the circularity problem in attribute grammars (AGs), a well-known formalism for describing syntax-directed translations such as the semantic analysis or code generation in compilers for programming languages.

What has to be done?

The goal is to exploit the close relation between data dependencies in AADL specifications and AGs by re-using existing circularity tests that have been developed for the latter for analyzing AADL specifications. More concretely, this will involve the followjng steps:

1. Adaptation and implementation of one of the existing circularity tests (such as [3]) in the COMPASS Toolset (`http://compass.informatik.rwth-aachen.de/`) that provides automatic analysis methods for AADL models (and that currently only uses the strong non-circularity check).
2. Performing case studies to assess the usability and scalability of the approach.
3. If possible, a re-investigation of the proof given in [1] to verify that the exponential complexity of the circularity problem also applies in the setting of AADL specifications.

Requirements

- Basic knowledge algorithms and data structures
- Basic knowledge in semantic analysis methods for compilers (in particular, attribute grammars)

Contact

Thomas Noll, `noll@cs.rwth-aachen.de`, Tel. +49-241-80-21213.

References

[1] Jazayeri, M., Ogden, W.F., Rounds, W.C.: The Intrinsically Exponential Complexity of the Circularity Problem for Attribute Grammars. Communications of the ACM 18(12), 679–706 (Dec 1975)

[2] Noll, T.: Analyzing Reconfigurable Component-Based Systems Using Attribute Grammars. In Proc. 8th Int. Symp. on Formal Aspects of Component Software (FACS 2011), 2011.

[3] Räihä, K.J., Saarinen, M.: Testing attribute grammars for circularity. Acta Informatica 17(2), 185–192 (1982)