Formal verification of safety-critical systems using UML

Zamira Daw, Rance Cleaveland

Institute for Systems Research and Computer Science Department

THIRTY YEARS OF SYSTEMS RESEARCH EXCELLENCE

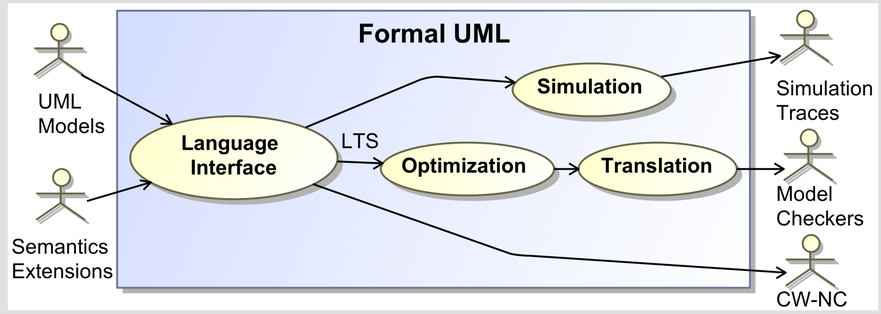
INSTITUTE FOR SYSTEMS RESEARCH
A. JAMES CLARK SCHOOL OF ENGINEERING

Research goals:

- Verification during model-driven development (MDD) of complex systems
- Integration of model cheking and UML modeling
- Extensible formal semantics for UML
- Facilitate the usage of formal methods (FM)

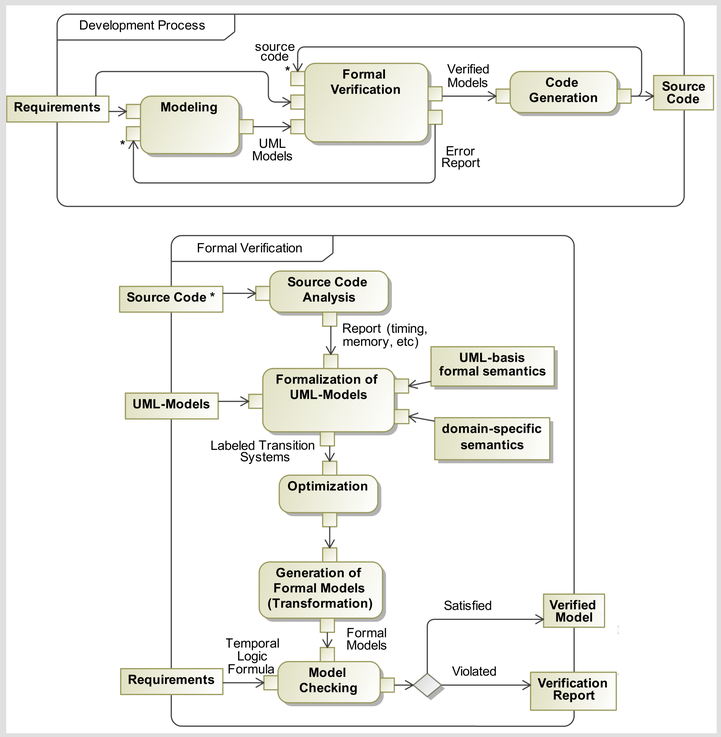
Future work:

- Simulation and verification of UML extensions
- Optimization of state spaces
- Verification of model transformations



Integration of FM into the development process

- Facilitate the verification of safety properties by introducing mathematical formality to MDD models
- Reduce state explosion by leveraging the abstraction of MDD models in the verification



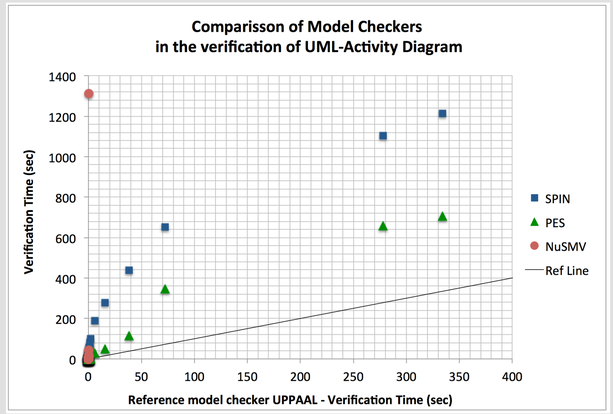
Comparison of model checkers

Goal:

Determine the influence of model checkers and of translation strategies for the generation of formal models on the verification performance (measured in time).

Testbench:

- Model checkers: NuSMV, SPIN, UPPAAL and PES (8 transformations)
- 67 UML activity diagrams



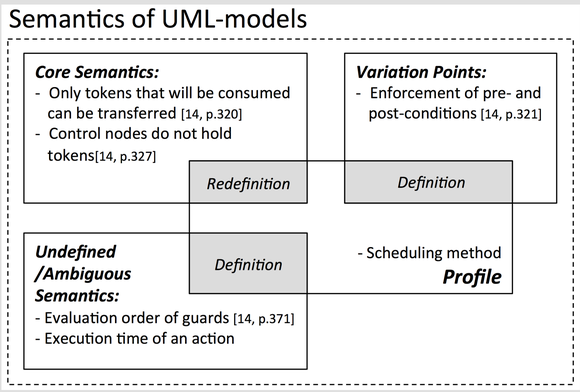
Results:

- Feasibility and advantages of the approach
- UPPAAL presents the best performance due to the variable management
- The big impact of model checkers and transformations drives the need of a model-checker independent formalization of UML-models

Extensible semantics

We are developing a reference semantics based on structural operational semantics, which can be:

- Extended according to domain-specific needs
- Used to verify the consistency of a UML extension/ interpretation using simulation
- Used to verify model-transformations using bisumulation



Relevant literature

Zamira Daw, and Rance Cleaveland, Comparing model checkers for timed UML-Activity diagrams, in Proceedings of Science of Computer Programming – *(in press).*

Zamira Daw, Rance Cleaveland and Marcus Vetter. Formal verification of software-based medical devices considering medical guidelines*, in International Journal of Computer Assisted Radiology and Surgery (IJCARS). 2014.*

Research supported by NSF Grant CCF-0926194.

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