HABILITATION (Abstract)

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MODEL CONSTRUCTION IN ANALYSIS AND SYNTHESIS TASKS

This thesis is on the automation of knowledge-intensive tasks.

The term "task" can be further narrowed with respect to analysis tasks and synthesis tasks in engineering domains. To the former we count classification problems, simulation problems, or diagnosis problems; to the latter we count configuration problems, design problems, or planning problems. We call such tasks knowledge-intensive because either a problem solving method is not at hand, or, it is unknown which of the available methods should be applied.

The term "automation" comprises a wide spectrum of interpretations. Ideally, task automation means to us that we can abandon the human engineering factor in the course of problem solving. However, in practice, a computer-based automation is restricted to selected aspects:
simulation, decision support, expert critiquing, model construction, search, visualization, etc. Our focus is on model construction.

Model construction is an artistic discipline, which highly depends on the reasoning job to be done. Model construction can be supported by means of a computer, and we investigate selected aspects from this field; the theoretical and conceptual contributions of this thesis can be grouped as follows:

  - Classification of existing work to automated modeling.
  - Automated model construction from a metamodel perspective.
  - Modeling knowledge on structure with design graph grammars.

Aside from conceptual considerations we present 9 case studies each of which establishing a contribution on its own in the field of knowledge-based problem solving. The case studies illustrate the application of model construction techniques in advanced technical scenarios such as design, diagnosis, or envisioning.