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Automated Analysis of Integrity Constraints in Multi-level Models

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Abstract

Multi-level modelling is a technology for model-based development that enables the incremental refinement of models in successive meta-levels, which results in simpler and more intentional system descriptions in some scenarios. In this approach, integrity constraints can be placed at any meta-level, and need to indicate the meta-level below at which they should hold. This requires a careful design, as constraints defined at different meta-levels may interact in unexpected ways. Unfortunately, current techniques for the analysis of the satisfiability of constraints are designed for two meta-levels only. Hence, nowadays, the analysis of multi-level solutions is performed by hand, which is tedious and error-prone.

In this paper, we define an automated procedure to check the satisfiability of integrity constraints in a multi-level setting, leveraging on “*off-the-shelf*” model finders. This procedure is supported by our multi-level modelling tool METADEPTH, which has been extended to reason on the satisfiability of constraints in multi-level models, and to perform automated model completion.

Keywords: Multi-level modelling, Deep meta-modelling, Conceptual modelling, Management of integrity constraints, Meta-level flattening, Model finders, Constraint solving, METADEPTH

1. Introduction

Modelling is at the core of every model-based development approach [11]. In this context, multi-level modelling [7] is a promising technology which promotes a flexible way of modelling by allowing the use of multiple meta-levels at a time, instead of just two, as it is customary in mainstream modelling architectures nowadays [44]. This extra flexibility results in simpler models [9, 20], typically

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