

# Semi-automatic Model Integration using Matching Transformations and Weaving Models

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## ABSTRACT

Model transformations are at the heart of model driven engineering (MDE) and can be used in many different application scenarios. For instance, model transformations are used to integrate very large models. As a consequence, they are becoming more and more complex. However, these transformations are still developed manually. Several code patterns are implemented repetitively, increasing the probability of programming errors and reducing code reusability. There is not yet a complete solution that automates the development of model transformations. In this paper we propose a novel approach that uses matching transformations and weaving models to semi-automate the development of transformations. Matching transformations are a special kind of transformations that implement heuristics and algorithms to create weaving models. Weaving models are models that capture different kinds of relationships between models. Our solution enables to rapidly implement and to customize these heuristics. We combine different heuristics, and we propose a new metamodel-based heuristic that exploits metamodel data to automatically produce weaving models. The weaving models are derived into model integration transformations.

## Categories and Subject Descriptors

D.2.11 [Software architectures]: Domain-specific architectures.  
D.2.12 [Interoperability]: Data mapping.

## General Terms

Algorithms, Standardization, Languages

## Keywords

Model engineering, matching transformations, model weaving.

## 1. INTRODUCTION

Model transformations are a central component in model driven engineering practices. There are many model transformation languages emerging from industrial and academic efforts [3][12][14][15]. As a consequence, there are an increasing number of model transformations that are being developed for

different applications scenarios. For instance, there are transformations to provide tool interoperability, to translate from textual to graphical representations, or to merge models.

However, the development of transformations involves many repetitive tasks. Consider for example a generic model integration scenario that transforms one source model into one target model. The transformation development consists of creating rules that transform a set of elements of the source model into a set of elements of the target model. The properties of these elements are transformed using a set of transformation expressions. Most part of these expressions consists of 1-to-1 relationships or other common patterns, such as nesting or concatenation of elements.

These transformations are often created manually. To the best of our knowledge, there is not a MDE approach that provides enough generic mechanisms to semi-automate the development of transformations. A semi-automatic process based on well-defined patterns brings many advantages: it accelerates the development time of transformations; it diminishes the errors that may occur in manual coding; it increases the quality of transformational code.

The discovery of transformation patterns to integrate models is closely related to schema and to ontology matching approaches (see the survey at [22]). These approaches aim at discovering semantic relationships between elements of different schemas or ontologies. These relationships are used for different purposes, such as ontology alignment [9][19] or data translation [6]. However, these approaches have some drawbacks. Most part of solutions cannot be applied to models conforming to different metamodels. Metamodels are models that describe the structure of models. The distance between the conceptual basis (models) and the implementation (heuristics) is too important. This makes difficult to decompose and to customize different heuristics. There is no support for different kinds of relationships between models. Hence, native constructs of transformation languages are not supported, such as rule inheritance or nested relationships.

In this paper, we present a novel solution to semi-automate the development of model transformations. We propose the execution of matching transformations. Matching transformations are transformations that select a set of elements from a set of input models and that produce links between these elements. These links are captured by a weaving model, as we proposed in [7]. The weaving model conforms to extensions of a weaving metamodel. We define links that act as specifications for model integration transformations. Model integration transformations are used in standard model integration applications.

Matching transformations enable to rapidly implement new or to adapt heuristics to create weaving models. In addition, we propose a new metamodel-based heuristic that exploits the

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