Specifying Overlaps of Heterogeneous Models for Global Consistency Checking

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Motivation
Overlap? Consistency?
Homogenous Overlap and Consistency Checking by Merging

[Sabetzadeh, Easterbrook 2006]
Model D1

Model D2

Model D3

Merge model \( \Sigma \)
Model Correspondence via Span

Model A0 reifies all *same*-links

<table>
<thead>
<tr>
<th>Model A1</th>
<th>Model A0</th>
<th>Model A2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Order</td>
<td></td>
<td>OnlineOrder</td>
</tr>
<tr>
<td>price: int</td>
<td></td>
<td>price: int</td>
</tr>
<tr>
<td>date: Date</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

mapping (leg) f1

Triple (A0,f1,f2) is called a *span* from A1 to A2
Heterogeneous Overlap and Consistency Check
Can we do consistency check by merge?

What is the correspondence?
Heterogeneous Case

Class diagram
  cd

Sequence diagram
  sd

Statechart
  sc

?
Four problems
Problems 1: Type Safety

Incompatible types: Operation vs. MessageType!
Problem 2: Indirect correspondence

No explicit target in mmSD (and sd)!
Problem 3: Inter-Model Constraints

The inter-model constraint is neither in mmSD nor mmSC!
Problem 4: N-ary Metamodel Relations

Pairwise, ternary, ... overlaps!
Overlaps between overlaps!
Solutions
Problem 1: Type Correspondence

Operation ‘get’ models view execution mechanism
Problem 2: Indirect Overlap
Problem 3: Inter-Model Constraints

Inter-model constraint: Traces consistent with the flat Statemachine

A view to mmSD

Mapped to derived elements in mmSD

A view to mmSC
Problem 4: N-ary Metamodel Interrelations
Summary

• Heterogeneous consistency check is reduced to the homogeneous one but metamodel merging is minimal
  – only to manage inter-metamodel constraints, working as locally as possible
• Despite heterogeneity, matching is type safe
• Applicability to a wide class of metamodeling techniques (based on graph-like structures)
• Formal foundations based on the well-established institution theory
Local vs. total consistency checking: Discussion

Two approaches:

(a) Total direct merge: cd, sd, sc are considered instances of the same global metamodel M. M can be derived from the metamodel mappings.

(b) Local merge: we first specify an overlap metamodel CA = a common view to CD, SD, SC. Then project the three models to the overlap and apply Consistency Checking by Merge.
Future work

• Theoretical validation
  – complete the formal semantics outlined in the paper
  – prove that (a) local and (b) global (via total merging of all metamodels) CC are equivalent
  – develop a taxonomy of heterogeneous multimodels and verify its usability

• Experimental validation of the approach