Merging Alignments for Decomposed Replay

Eric Verbeek
Wil van der Aalst
• Preliminaries
  – Monolithical replay
  – Decomposed replay
• Merging alignments
  – Pseudo alignment
  – Alignment of alignments
  – Stitching rules
• Wrapping up
  – Conclusions
  – Future work
• Preliminaries
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Initial marking

Activity-labeled transitions

Silent transitions

Final marking(s)

Accepting Petri net
\[ \langle a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8 \rangle \]
Synchronous move on $a_1$ and $t_1$
\[ \langle a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8 \rangle \]
Synchronous move on a2 and t3

\[ \langle a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8 \rangle \]
\[ \langle a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8 \rangle \]
\[ \langle a_1, a_2, a_3, a_4, a_5, a_6, a_7, a_8 \rangle \]
Computation times for replay

Not decomposed

DMKD 2006
12-42 act.

IS 2014
32-59 act.

BPM 2013
275-429 act.

Takes too long
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Decomposition of net into subnets

- Places join arcs
- Silent transitions join arcs
- Transitions with same label join arcs
\[ \langle a_1, a_2, a_3, a_4, a_6 \rangle \]

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Adapted costs
Visible model move
• Non-decomposed costs 0 if and only if decomposed costs 0
• Decomposed costs less or equal to non-decomposed costs
Computation times for replay

- Computation time (in seconds)
- Not decomposed
- Decomposed

All in 12 seconds
• Preliminaries
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• Merging alignments
  – Pseudo-alignment
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  – Future work
Motivation for pseudo-alignments
Transitions with same label join arcs
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Alignment of $a_1$

Synchronous moves: Match

Alignment
### Invisible model move: Match

**Alignment of t2**

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**Alignment**

- **Move:** Match
- **Alignment:**
Synchronous move vs log move: No match

Pseudo-alignment
Synchronous move vs log move: No match

Pseudo-alignment
Alignment of subalignments

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Pseudo-alignment
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1. All done

2. Activity without conflict
   – All agree on next synchronous or log move

3. Transition without conflict
   – All agree on next visible model move or invisible model move

4. Activity with conflict
   – Guided by trace, so no confusion what the next activity is
   – Take a most expensive move

5. Transition with conflict
   – No guidance possible, multiple transitions are possible
   – Take a most expensive move
• Alignment if costs 0
  – That is, if perfect match

• Costs 0: No conflicts
  – Synchronous moves
    • ‘Interface’ activity
      – Unique transition
    • ‘Shared’ activity
      – Unique subnet
  – Invisible model moves
    • Unique subnet
Implemented in ProM 6, integrated into decomposed replayer
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• Alignment
  – If costs 0
  – If possible

• Pseudo-alignment
  – Otherwise

• Decomposed replay
  – Includes alignment merge
  – Faster than non-decomposed replay
"Replay using Decomposition" Plug-in in ProM 6.6
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• Reduction of pseudo-alignments
  – Replayer
    • Now returns a best alignment
    • Might return the set of best alignments
    • Reconsider alignment merge
      – Which best alignments to use?
    – No guarantee
      • See example shown earlier
  • Optimization
    – Choice if visible transition moves conflict
    – Now we take one with maximal support:
      • We prefer 2 out of 3 over 1 out of 2
Questions?