Delta-oriented Model-based SPL Regression Testing

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Outline

Motivation

Delta State Machines

Delta-oriented SPL Regression Testing
Motivation

- Model-based Testing
  - Test model describes system behavior
  - Test case generation
  - Conformance testing
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- Regression Testing
  - Testing of software versions
  - Reuse of test cases
  - Reuse of test results
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- **Model-based Testing**
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- **Regression Testing**
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  - Reuse of test cases
  - Reuse of test results

⇒ Combination for reasoning about reuse potentials
Variability in Test Models

How to encode **variability** in test models?

- Annotative/Selective [WSS08, LOGS11, COLS11]
- Compositional [UKB10, SV08]
- Transformational [LSKL12]
Delta State Machines

- Adaptation of Delta Modeling [Sch10] approach
Delta State Machines

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- Transformational
- Modeling and Generation of variable state machines
  - Model-based Testing
  - Model-driven Development
Delta State Machines

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- Modeling and Generation of variable state machines
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  - Model-driven Development
- Deltas define transformations
  - Add/Remove of basic state machines
  - Add/Remove of hierarchy
  - Add/Remove of states
  - Add/Remove of transitions
  - Modification of transition labels
Transformations (1/2)

Add a hierarchy and add a basic state machine
Transformations (1/2)

Add a hierarchy and add a basic state machine

Add a state and a transition
Transformations (2/2)

Modification of transition labels
Example BCS Delta

Name: DRemFPTransManPWAddTransAutoPW
Apply to: FP_BSM
After:
When: Automatic Power Window

fp_finger_detected/ fp_on = true;
finger_detected/ pw_auto_mv = 0; fp_on = true

FP_off

FP_on
Generation of State Machines

Feature Model

Feature Configuration

Application Condition

Core Product

Delta 1 Add

Delta 2 Rem

Delta 3 Mod

Core + Delta 1

Core + Delta 1 + Delta 2

Core + Delta 1 + Delta 2 + Delta 3

Product
Outline

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Product Test Artifacts

**Definition**

The collection of *test artifacts* for a product $p$ is a 4-tuple $ta_p = (tm_p, tg_p, ts_p, tp_p)$ consisting of a *test model* $tm_p$, a finite set $tg_p$ of *test goals* in $tm_p$ for a criterion $C$, a *test suite* $ts_p$, and a *test plan* $tp_p$. 
Product Test Model Generation

\[ \delta_{tm} = \{\text{add } t_2, \text{add } t_3\} \]

\[ \delta_{tm'} = \{\text{add } t_4\} \]

\[ \delta_{tm,tm'} = \{\text{rem } t_2, \text{rem } t_3, \text{add } t_4\} \]

\[ \delta_{tm} = \{\text{add } t_2, \text{add } t_3\} \]

\[ \delta_{tm}^{-1} = \{\text{rem } t_2, \text{rem } t_3\} \]
Product Test Model Generation

\[ \delta_{tm,tm'} = (\delta_{tm} \setminus \delta_{tm'})^{-1} \cup (\delta_{tm'} \setminus \delta_{tm}) \]
Delta-oriented SPL Regression Testing (1/2)
Motivation
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Delta-oriented SPL Regression Testing (2/2)

\[ \delta_{ta,ta'} = (\delta_{tm,tm'}, \delta_{tg,tg'}, \delta_{ts,ts'}, \delta_{tp,tp'}) \]
Body Comfort System Case Study
Case Study Statistics

- Previous results obtained in evaluation of MoSo-PoLiTe [OLZG11]
  - Representative subset of 17 product variants
  - 150% state machine test model
    - 105 states
    - 107 transitions
    - 26 input events
    - 33 output events
  - 64 test cases executed in average
Case Study Statistics

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- Remodelling of test model
  - 1 core
  - 40 deltas
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- Remodelling of test model
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- Testing of 18 variants
  - 10 test cases generated in average
  - 9 test cases executed in average
Case Study Results

![Graph showing case study results]

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- **Delta State Machines**
- **Delta-oriented SPL Regression Testing**

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Institut für Programmierung und Reaktive Systeme
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