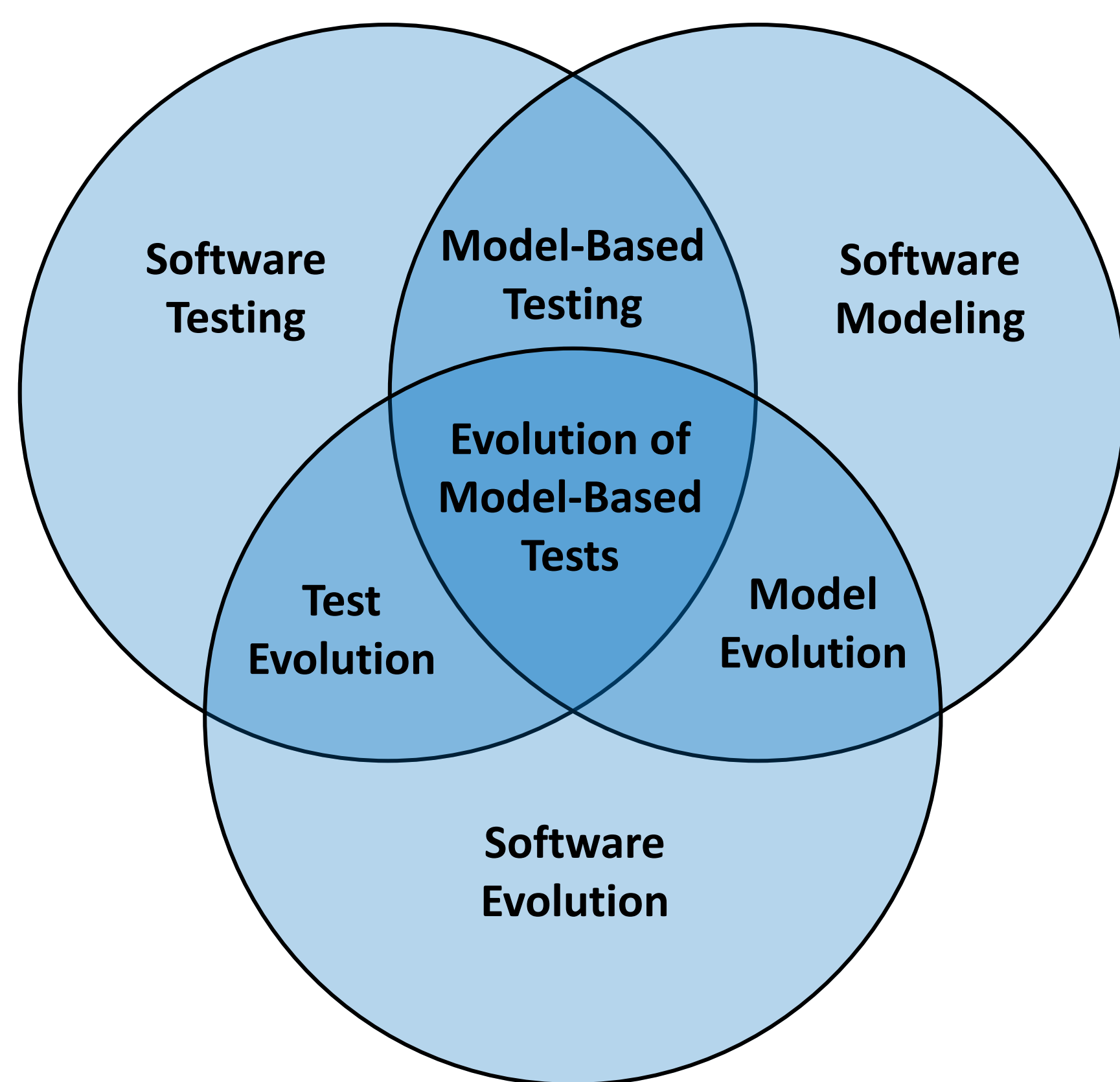


Co-Evolution of Model-Based Tests for Industrial Automotive Software

Fields of Study



Motivation

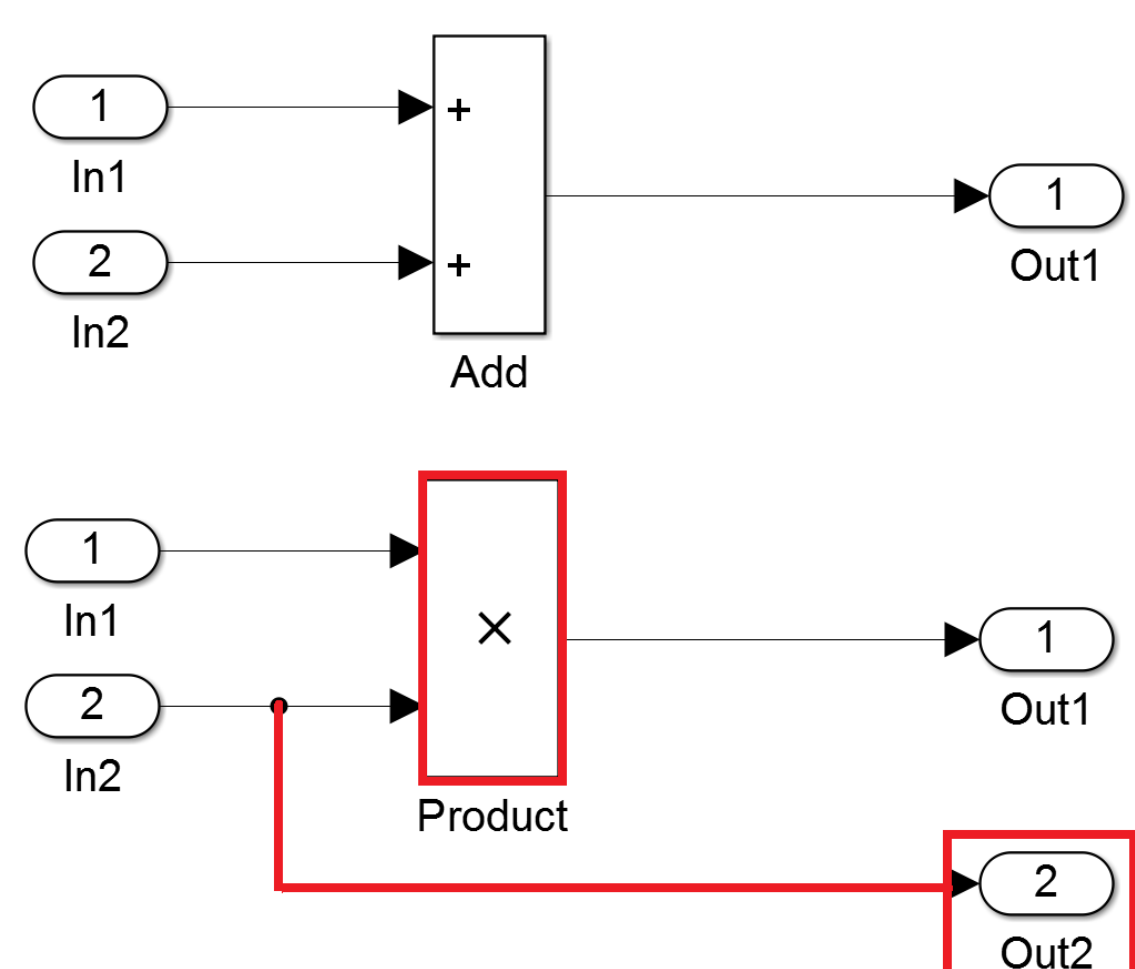
- The iterative nature of model-driven engineering leads to the redundant regeneration of model-based tests.
- Understanding how changes in models impact associated tests will lead to better understanding of model evolution.
- Improving the efficiency of automotive model-based testing through possible reductions is of interest to our industrial partners.

Model Selection



- Model Type: MATLAB Simulink
- Domain: Automotive Software
- Sources: MATLAB Central, General Motors

Proposed Methodology



Compare Versions

Using model differencing tools, we will determine exactly how two versions of a model differ.

| In1 | In2 | Out1 | In1 | In2 | Out1 | Out2 |
|-----|-----|------|-----|-----|-------|------|
| 1 | 1 | 2 | 1 | 1 | 1 | ? |
| 1 | 2 | 3 | 1 | 2 | 2 | ? |
| ... | ... | ... | ... | ... | ... | ... |
| 5 | 5 | 10 | 5 | 5 | 25 | ? |
| 5 | 6 | 11 | 5 | 6 | 30 | ? |
| ... | ... | ... | ... | ... | ... | ... |
| 100 | 100 | 200 | 100 | 100 | 10000 | ? |
| 100 | 101 | 201 | 100 | 101 | 10100 | ? |
| ... | ... | ... | ... | ... | ... | ... |

Apply Updates (when possible)

For possible changes in the test cases, updates are made directly to the source test files. Updates such as changing values will be simple, however added signals become more difficult and may require manual interaction.

| Model Evolution | Impact on Tests |
|-------------------------|---------------------|
| ... | ... |
| Add Output | Add output signal |
| Modify Output | ... |
| ... | ... |
| Modified Function Block | Alter Output Values |
| Delete Function Block | ... |
| ... | ... |

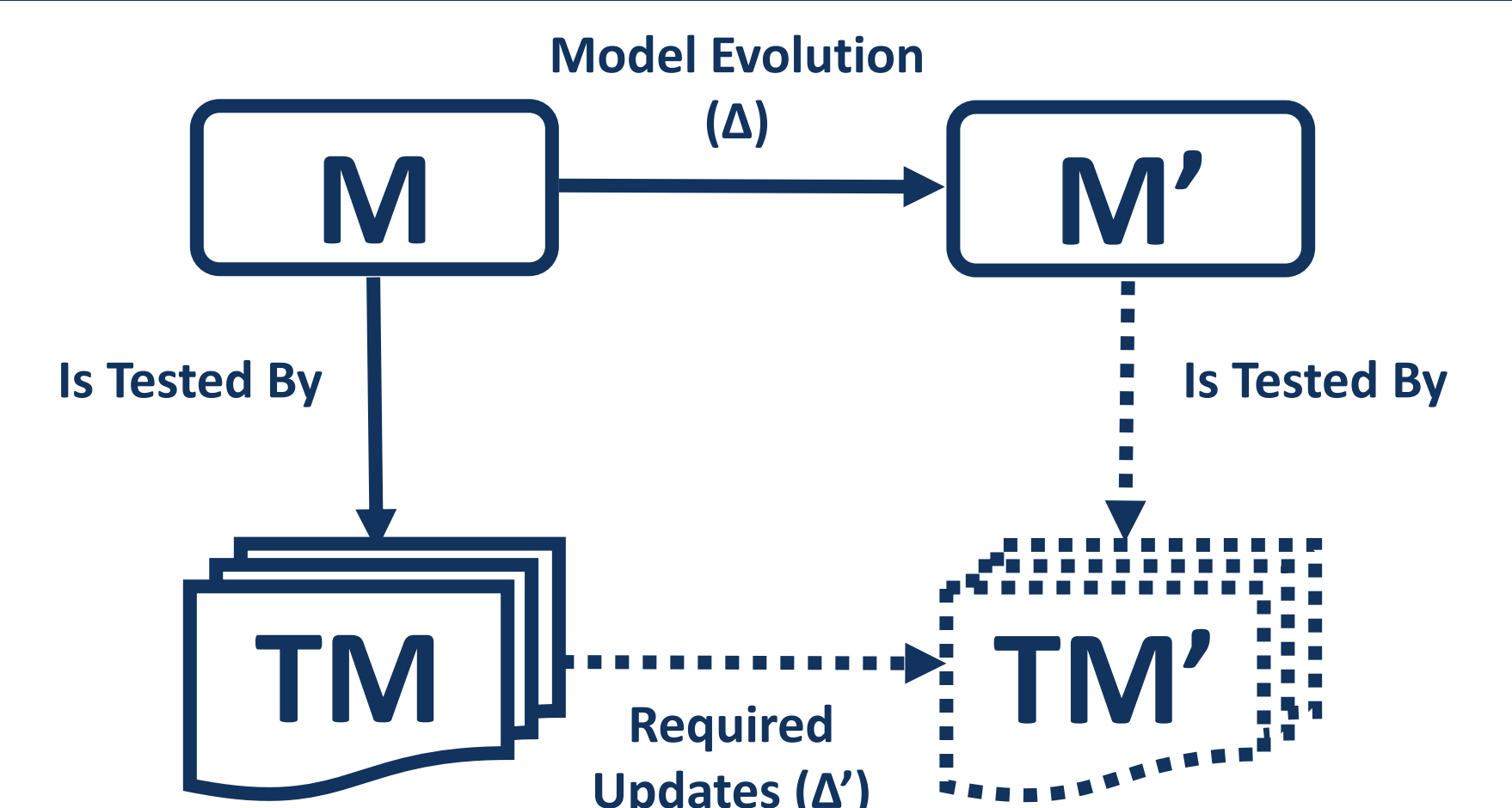
Determine Impact

Based on an initial **Evolution Study** we will search our catalog of evolution impacts to determine what, if any, impact the evolution has on tests.

| In1 | In2 | Out1 | Out2 |
|-----|-----|-------|------|
| 1 | 1 | 1 | 1 |
| 1 | 2 | 2 | 2 |
| ... | ... | ... | ... |
| 5 | 5 | 25 | 5 |
| 5 | 6 | 30 | 6 |
| ... | ... | ... | ... |
| 100 | 100 | 10000 | 100 |
| 100 | 101 | 10100 | 101 |
| ... | ... | ... | ... |

Manual Interaction (when required)

There may be differences in model versions that require manual interaction by the test engineer, such as the introduction of a new signal (input or output), which will require a set of values for the signal.



Identify Updates

Based on the determined impact, identify the tests that need to be updated and which signals, values and times need to be adjusted. Additionally, identify any additional tests required.

| In1 | In2 | Out1 | | Out2 | |
|-----|-----|------|-------|------|-----|
| | | Old | New | Old | New |
| 1 | 1 | 2 | 1 | - | 1 |
| 1 | 2 | 3 | 2 | - | 2 |
| ... | ... | ... | ... | ... | ... |
| 5 | 5 | 10 | 25 | - | 5 |
| 5 | 6 | 11 | 30 | - | 6 |
| ... | ... | ... | ... | ... | ... |
| 100 | 100 | 200 | 10000 | - | 100 |
| 100 | 101 | 201 | 10100 | - | 101 |
| ... | ... | ... | ... | ... | ... |

Present Updated Test Suite

Our prototype implementation will then display the results of the co-evolution to the test engineer, summarizing the changes, and presenting the option to run the new test suite, examine, or save and quit.

Validation

- Correctness
 - Benchmark Comparisons
- Performance
 - Timed Experiments
- Usability
 - User Surveys

Limitations & Risks

- Availability of industrial models
- Obtaining results for user surveys
- Constrained to one modeling technology

References

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