AN EFFICIENT APPROACH FOR MODEL-BASED TESTING: SIEMENS USE CASE IN THE MBAT EUROPEAN PROJECT

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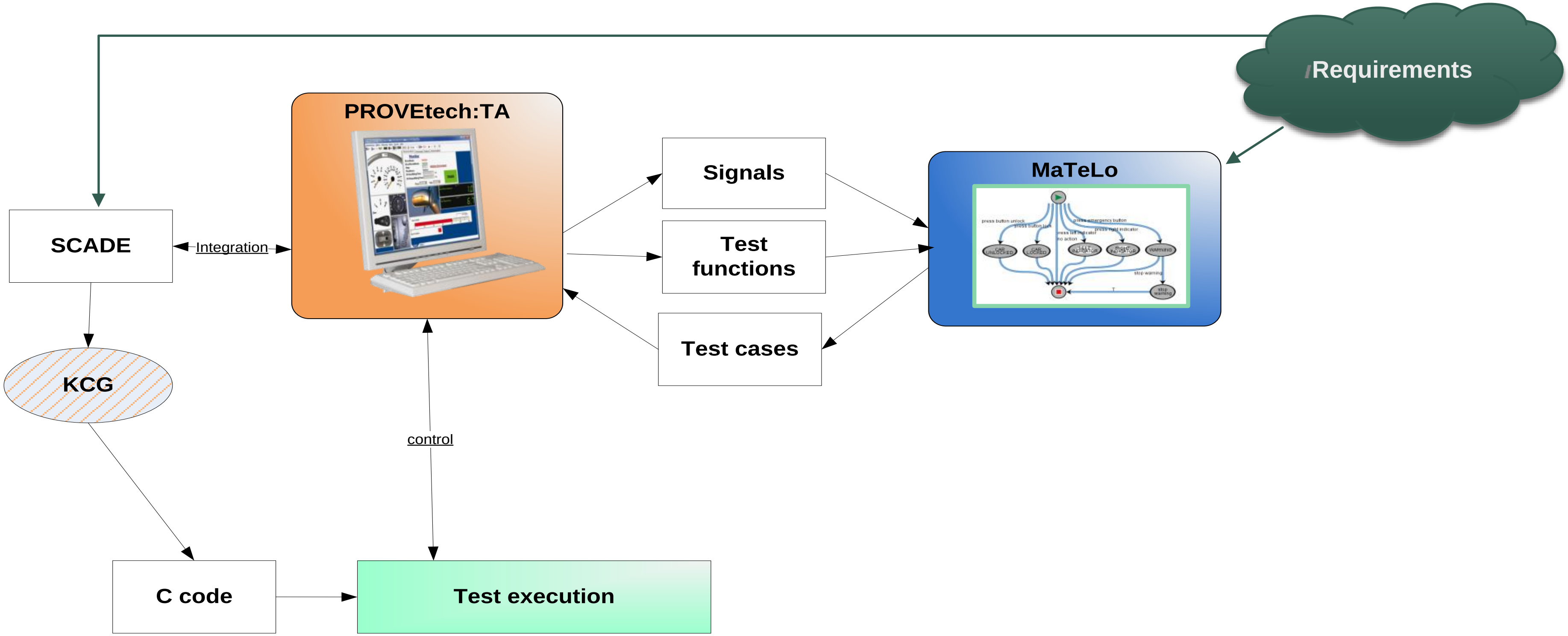
MOTIVATION OF THE APPROACH

- Test duration is still too important and testing can take 40% of the total project costs. For this reason, Siemens seeks new approaches to reduce these costs. The challenge is first to propose adequate methodologies and then to make them applicable in practice with powerful tool support.
- The methodology is under study in the ARTEMIS research project MBAT (Combined Model-based Analysis and Testing of Embedded Systems). MBAT aims at efficient validation and verification of embedded systems by using model-based technologies and effective combinations of analysis and testing activities. The improvements are evaluated in case studies provided by industrial partners.
- SCADE Suite doesn’t provide capabilities in terms of model based testing, test case generation, test execution, test management

INTEGRATED TOOLCHAIN



Requirements

PROVEtech:TA

Signals

Test functions

Test cases

MaTeLo

SCADE

Integration

KCG

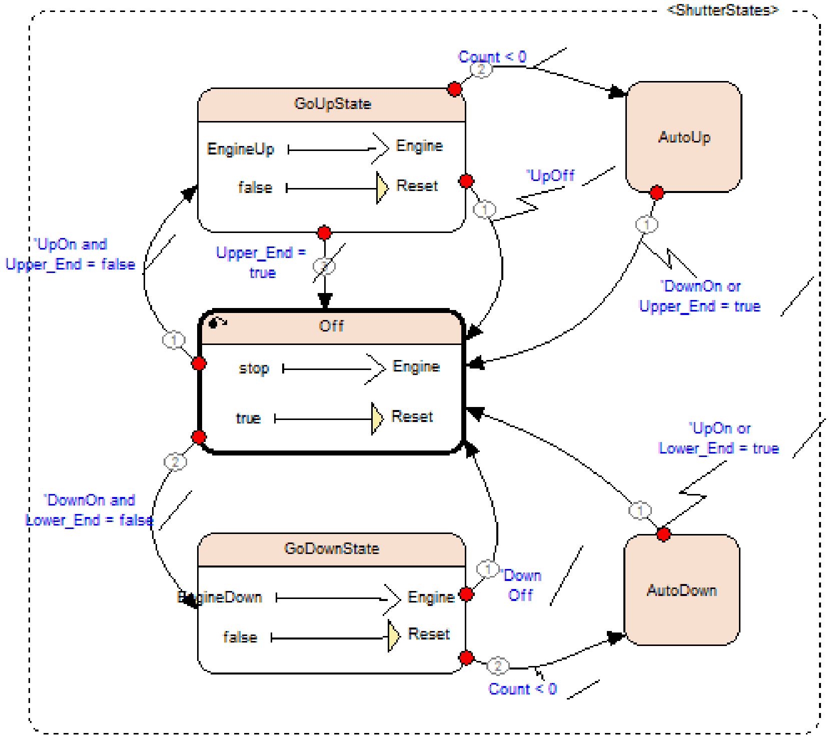
control

C code

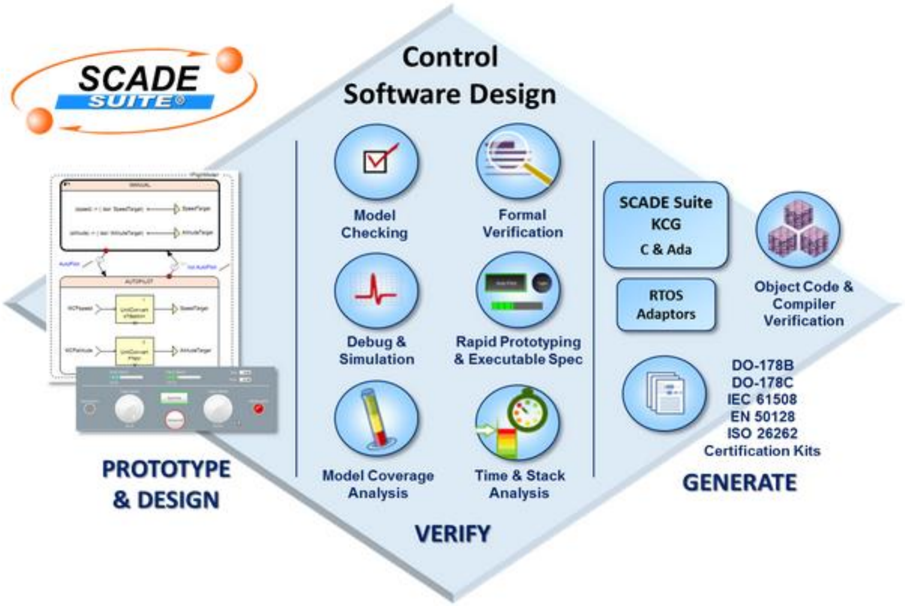
Test execution

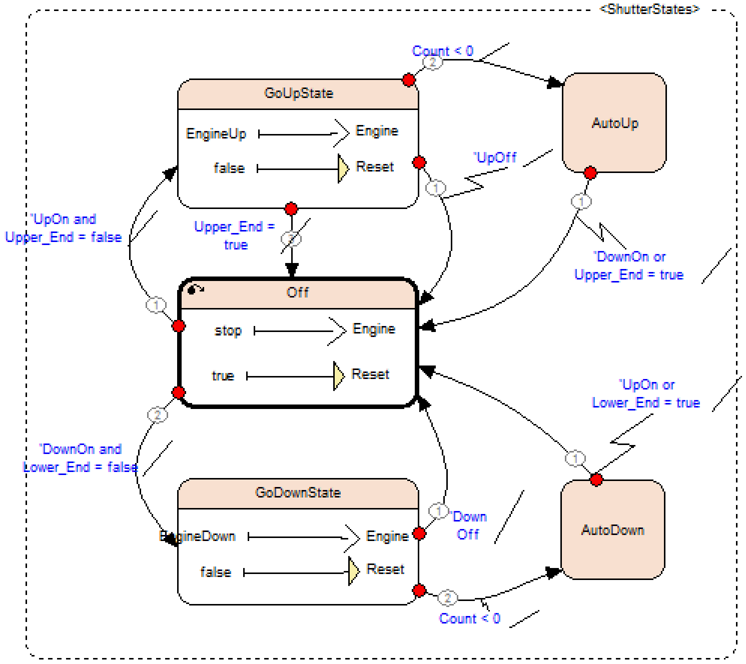
ILLUSTRATED BY AN EXAMPLE: A SHUTTER

- The shutter has an up and a low position.
- User can activate a movement up (or down) when the shutter in the lower (or upper) position or in a intermediate position.
- When the user presses a long time on the button, the shutter moves all the way up (or down)



TOOLS PRESENTATION: SCADE

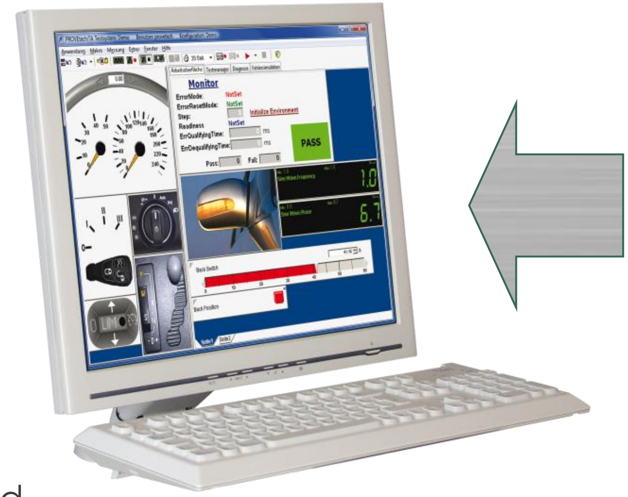




TOOLS PRESENTATION: PROVETECH:TA

PROVEtech:TA – Test Automation

- Visualization
- Test Management & Automation
- Integrated Diagnostics
- Fault Simulation
- Real-time Automation
- Integrated XCP & CCP
- Project & User management
- Statistics module
- Compatible with multiple standard HIL technologies



PROVEtech:RE

MATLAB SIMULINK

OPAL-RT

dSPACE

ETAS

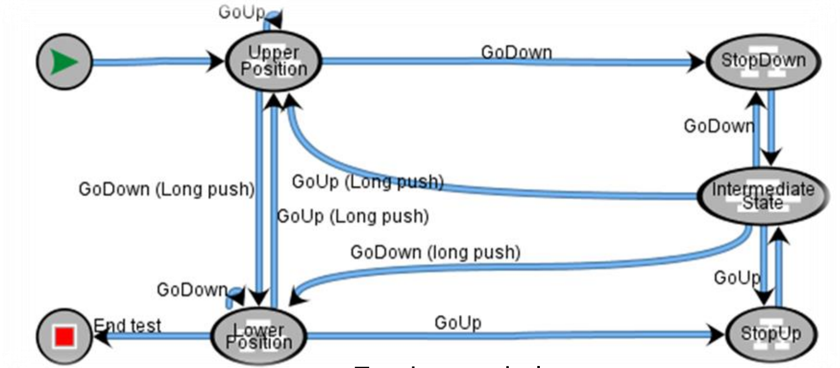
LabVIEW

NATIONAL INSTRUMENTS VeriStand

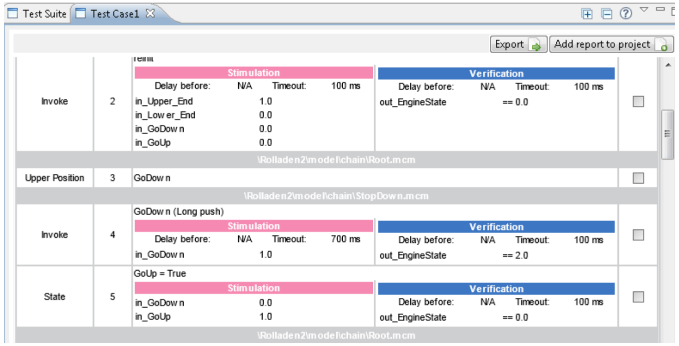
SCADE SYSTEM Demo status

TOOLS PRESENTATION: MATELO

- **MaTeLo** is a model-based testing tool which contains its own modeller. MaTeLo is used to generate test cases from the usage model
- With **MaTeLo**, Test engineers do not need to consider the implementation details (Black-box testing), but just focus on the way the system is used.
- **MaTeLo** model is based on Markov chains where stimulations and expected results are basically associated with transitions. Facilities are provided to define the expected results, to link the test model with system requirements and also to automate test execution.



Test model



Invoke	2	reinit Stimulation Delay before: N/A Timeout: 100 ms in_Upper_End 1.0 in_Lower_End 0.0 in_GoDown 0.0 in_GoUp 0.0	Verification Delay before: N/A Timeout: 100 ms out_EngineState == 0.0	☐
\Rolladen2\model\chain\Root.mcm				
Upper Position	3	GoDown		☐
\Rolladen2\model\chain\StopDown.mcm				
Invoke	4	GoDown (Long push) Stimulation Delay before: N/A Timeout: 700 ms in_GoDown 1.0	Verification Delay before: N/A Timeout: 100 ms out_EngineState == 2.0	☐
State	5	GoUp = True Stimulation in_GoDown 0.0 in_GoUp 1.0	Verification Delay before: N/A Timeout: 100 ms out_EngineState == 0.0	☐
\Rolladen2\model\chain\Root.mcm				

Test Case

WHAT IS NEW? WHAT IS DIFFERENT?

- A specific tool for each specific need: the language used in each tool is appropriate for each test level.
  - No need to know the script language when you design test cases (only basic test operations)
  - No need to know the specification when you are at the automation level
- Tools are interconnected: there is no need to enter the same information multiple timer in multiple tools
  - Scade -> PROVEtech:TA: signals list
  - PROVEtech:TA -> MaTeLo: inputs/outputs/test operations
  - MaTeLo -> PROVEtech:TA: test cases
  - PROVEtech:TA ->Scade: test cases execution

DEMONSTRATION

1. Connection between the System Under Test (SUT; here the **Scade** model) with a test execution tool (here **PROVEtech:TA**
2. At **PROVEtech** level, user can create some specific "Test operations" in order to stimulate input or make a check on output in a specific manner.
3. Test model creation using **MaTeLo**
4. Test cases generation with **MaTeLo**
5. Test cases execution with **PROVEtech:TA**
6. Coverage of **Scade** model (implementation level) and coverage of **MaTeLo** model (requirements level) are calculated

INTEREST OF USING MODEL BASED TESTING FOR SIEMENS

- Using MBT means build a test model to automatically generate test cases instead of manual test cases identification
- Design of test model is based on the system usage
- Automatic test generation of relevant test cases according to specific criteria -> quality improvement
  - Focused on the software parts where risk is higher
  - Coverage-based criteria or Reliability-based criteria
- Multiple generation options make it possible to generate many test cases from the same usage model i.e. for the same initial cost
- Models reuse is possible

BENEFITS FOR USING AN INTEGRATED TOOLCHAIN

- Only relevant information is entered in each tool, bridges are available to import/export information in the other tools
- Manual adaptations are no longer needed to translate test cases to test scripts

CONCLUSION

- Automatic test generation and automatic test execution interconnected in a toolchain
- Duration and effort saving
- Quality improvement