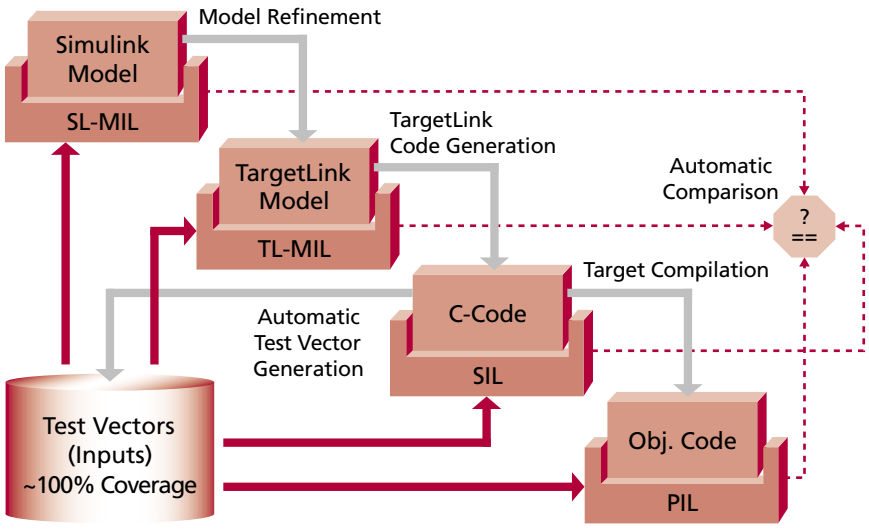
Generating Test Cases Automatically

- **Automated testing tool for software and function developers**
- **Generate test cases based on the TargetLink production code**
- **Especially high coverage and analysis rates**

Embedded in dSPACE's TargetLink tool environment for developing control functions, the new test tool EmbeddedTester™ from OSC - Embedded Systems AG sets another milestone for automated test case generation and code validation. With the TargetLink and EmbeddedTester duo, function and software developers can not only develop and implement functions quite easily and seamlessly from the Simulink® model up to target implementation, but can also perform structured tests and validate the functions at the same time.

Application Area

EmbeddedTester requires TargetLink and is seamlessly integrated in the Simulink/TargetLink development environment. EmbeddedTester supports the entire TargetLink blockset on the one hand, as well as external legacy code on the other. The current version 1.0 of EmbeddedTester can already generate an extremely high code coverage and test objective coverage for any hierarchically developed TargetLink fixed-point code. This has been proven for the past three years in production projects at major manufacturers and suppliers from Germany and Japan. A further development of EmbeddedTester for supporting floating-point applications is being worked on.



▲ *The automatically generated test vectors can be used in all simulation modes and their results can be compared.*

Automatic Test Case Generation and Code Validation

On the basis of the production code generated by TargetLink, EmbeddedTester can automatically find input sequences that can cover any kind of defined test objective. For test objectives, EmbeddedTester can also prove if the code is unreachable, up to any desired analysis depth. These two capabilities are guaranteed by special algorithms from the field of formal methods, a well-established application approach for the past 15 years. Thanks to the tight tool integration between EmbeddedTester and TargetLink, scalability is guaranteed even for rather large industrial applications, due to the automatic hierarchical approach. For code coverage criteria such as statement coverage, condition coverage, decision coverage and MCDC coverage, as well as for production code specific tests with division-by-zero, over- and underflow, type (down)-casting, saturation und relational operations (fixed-point vs. floating-point), automatic test objectives and coverage reports are managed and correspondingly high coverage and analysis rates of up to 100% are reached automatically.

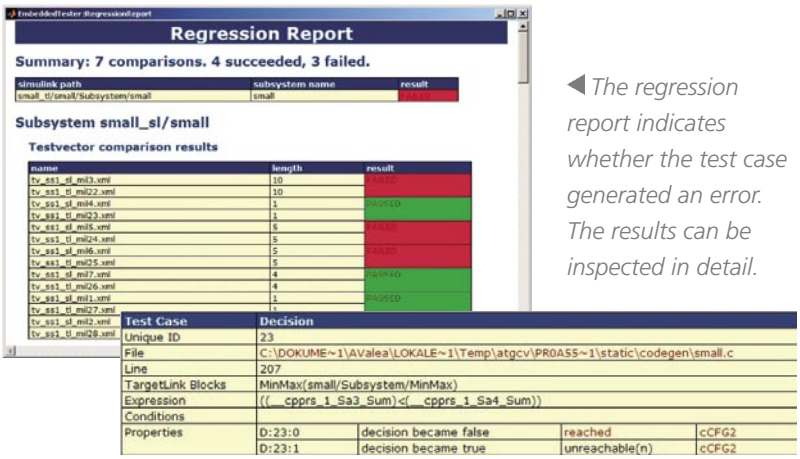
Automatic Test Execution

Due to EmbeddedTester's hierarchic, completely automated test execution method, the complete deterministic test cases, consisting of input signals and monitoring/expectation signals, are created from the automatically generated input sequences. This test execution/simulation can be performed automati-

cally by EmbeddedTester on any execution level such as Simulink model-in-the-loop (SL-MIL), TargetLink model-in-the-loop (TL-MIL), software-in-the-loop (SIL) and processor-in-the-loop (PIL).

Automatic Test Evaluation

In regression mode, EmbeddedTester automatically compares the next step of the test cases, including the expected values, with all of the levels (SL-MIL, TL-MIL, SIL und PIL) and shows the differences in an automatically generated report. Permitted comparison tolerances can also be defined in EmbeddedTester.



The regression report indicates whether the test case generated an error. The results can be inspected in detail.

Debugging Support

If differences between the execution levels are discovered, finding the error and correcting it becomes an issue. To do this, EmbeddedTester supports the user with linked coverage reports: with report entries, the points that cause the differences in the target code and in the TargetLink model can be called up with one mouse-click. When doing this, TargetLink and EmbeddedTester work together via a well-defined interface.

Import and Export Interfaces

EmbeddedTester offers the import and export of any number of test cases in and from numerous file formats such as XML, MAT, CSV, etc. This lets the user reuse already existing test sets from various sources and show them in coverage rates (code coverage) in EmbeddedTester. In the same manner, test cases can also be used which were generated with Embedded-Validator™ on the basis of requirements.
Test sequences and the expected values can be exported as a MAT file and reused in dSPACE tools such as AutomationDesk and MTest.

Interview with Hans J. Holberg, Senior Vice President Customer Relations, OSC - Embedded Systems AG:

Mr. Holberg, what problems should EmbeddedTester solve?
Holberg: EmbeddedTester quickly and automatically provides a sufficient number of test cases for a very high structured coverage of models as well as the corresponding code. This prevents untested model and code parts that could lead to problems later on.

What advantages can users expect?
Holberg: Initial experience in production development with EmbeddedTester indicates savings in time of up to 50% for test generation. The analysis and coverage rate can also be raised by 30-40% in most cases, which indicates a significant quality advantage. The debug support functions in EmbeddedTester are also rather important for the user.

What are EmbeddedTester's special strengths?
Holberg: No doubt about it ... automatic test generation with a coverage rate of up to 100%!

Are industrial customers already using this?
Holberg: Yes, MAN Nutzfahrzeuge, Nissan, Hitachi and Ford are already using EmbeddedTester successfully. Numerous evaluations are being made in the automotive and aerospace fields as well.

Why does OSC count on TargetLink?
Holberg: Based on feedback from our customers we have seen during the past 8 years that TargetLink has extremely widespread use. TargetLink is obviously the most often used production code generator in the automobile industry. The decision to match our product to this code generator was therefore quite obvious. Furthermore, TargetLink offers us powerful interfaces and it is excellent for external automation and process integration.


Hans J. Holberg