UDE Code Coverage

Proving the Quality of Tests Through Non-Intrusive Code Coverage

Assuring high software quality in electronic control units is a challenging task. Extensive and, above all, suitable tests are essential to achieve this.

Code coverage is generally considered a very meaningful metric for assessing test quality. Relevant standards for functional safety of electronic systems, e.g. ISO 26262, therefore require evidence and documentation of the code coverage achieved by the software test.

In particular, for real-time critical multicore systems, typical control-flow oriented methods that use compiler-assisted code instrumentation for coverage measurement reach their limits very quickly.

UDE Code Coverage support is a trace-based, non-intrusive method for determining statement coverage (C0 coverage) and branch coverage (C1 coverage) even with optimized code. The measurement is based on instruction traces provided by hardware trace channels.

Highlights

- Non-intrusive, no change of run-time behavior
- No code-instrumentation required
- Compact presentation of coverage results
- Meaningful code coverage reports
- Export of reports into different formats
- Scripting and automation support by UDE Object Model

Code Coverage Analysis

Different views are provided by UDE to enable interpretation of code coverage results.

The **Code Coverage Window** provides details of the coverage on 4 levels:

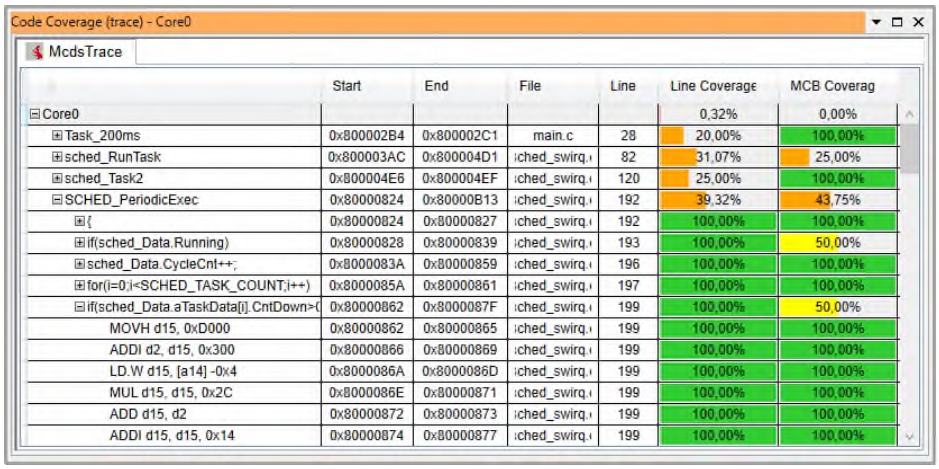
- Core minimum-coverage
- Function coverage
- Source line coverage
- Machine instruction coverage

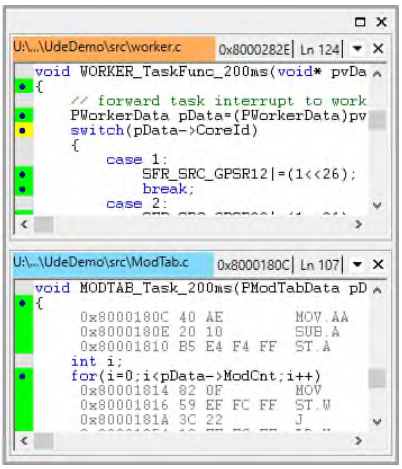
For C0 and C1 coverage the results are displayed as a percentage bar chart.

Additional functions include

- Sorting functions by name, start address, coverage value
- Pre-filtering the trace for analysis of specific functions
- Accumulation of coverage data over multiple trace recordings and sessions

The **Program Window** displays per-core statement coverage information as line markers for completely covered, partially covered, and uncovered source lines and machine instructions.





Trace Data Collection for Code Coverage

The code coverage measurement is based on instruction trace data. The trace data are generated by commonly used hardware trace systems: Infineon **MCDS**, **NEXUS 5001™** class 3, and Arm® **CoreSight™ ETM**, **PTM**. Trace systems with on-chip trace buffers are supported as well as high bandwidth trace interfaces (e.g. HSSTP, AURORA, NEXUS 5001™ and Arm® parallel trace).

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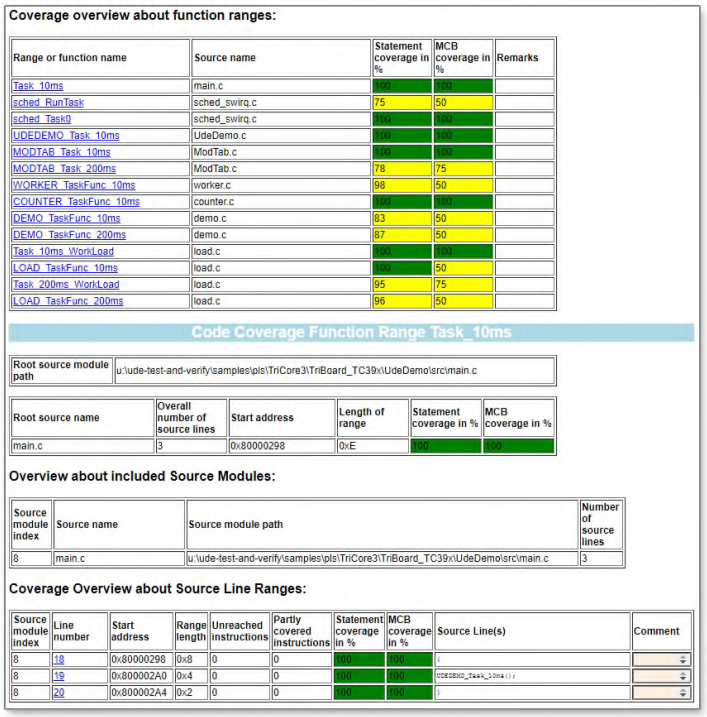
Code Coverage Reports and Documentation

To meet the requirements for evidence of the performed code coverage measurements within the overall software quality assurance process, complete reports with all details must be generated. These reports are essential for the subsequent traceability of the performed measurements and their interpretation. The reports include:

- Used target application
- Date of measurement
- Overview about function coverage results
- Line based coverage of source files
- Address based coverage of machine instructions
- List of uncovered instructions and branches.



Coverage overview about function ranges:

Range or function name	Source name	Statement coverage in %	MCB coverage in %	Remarks
Task_10ms	main.c	100	100	
sched_RunTask	sched_swirq.c	75	50	
sched_Task0	sched_swirq.c	100	100	
UDEDEMO_Task_10ms	UdeDemo.c	100	100	
MODTAB_Task_10ms	ModTab.c	100	100	
MODTAB_Task_200ms	ModTab.c	78	75	
WORKER_TaskFunc_10ms	worker.c	98	50	
COUNTER_TaskFunc_10ms	counter.c	100	100	
DEMO_TaskFunc_10ms	demo.c	83	50	
DEMO_TaskFunc_200ms	demo.c	87	50	
Task_10ms_WorkLoad	load.c	100	100	
LOAD_TaskFunc_10ms	load.c	100	50	
Task_200ms_WorkLoad	load.c	95	75	
LOAD_TaskFunc_200ms	load.c	96	50	

Code Coverage Function Range Task_10ms

Root source module path	u:\ude-test-and-verify\samples\pls\TriCore3\TriBoard_TC39x\UdeDemo\src\main.c

Root source name	Overall number of source lines	Start address	Length of range	Statement coverage in %	MCB coverage in %
main.c	3	0x80000298	0xE	100	100

Overview about included Source Modules:

Source module index	Source name	Source module path	Number of source lines
8	main.c	u:\ude-test-and-verify\samples\pls\TriCore3\TriBoard_TC39x\UdeDemo\src\main.c	3

Coverage Overview about Source Line Ranges:

Source module index	Line number	Start address	Range length	Unreached instructions	Partly covered instructions	Statement coverage in %	MCB coverage in %	Source Line(s)	Comment
8	18	0x80000298	0x8	0	0	100	100	{	
8	19	0x800002A0	0x4	0	0	100	100	UDEDEMO_Task_10ms();	
8	20	0x800002A4	0x2	0	0	100	100	}	

Report Export

- Formats: HTML, XML, CSV and plain text files
- XML and text reports contain the same information as the HTML report
- CSV reports are user configurable in terms of different levels of details, ranging from function level only to detailed machine instruction level

Automation Support

The code coverage analysis is available via the UDE Object Model, as trace stream-based service. The interfaces provide fine grained control over each aspect of the coverage analysis, including configuration, control, access to results and creating of reports. User-controlled or automatic start of analysis or creating of reports and storage exports are provided.

If you have any questions about our products, please feel free to contact us:

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