AT A GLANCE

COMPETENCES

- Search-based test case generation for safety-critical software
- Model-based testing for variant-rich systems
- Test automation: model-, software- and hardware-in-the-loop tests
- Metaheuristic search methods
- Domain-specific knowledge of norms and standards

SERVICES

- Evaluation of existing test procedures regarding potential for optimization
- Advice on the introduction and integration of new test methods into development processes
- Advice on the selection and customization of testing tools
- Testing and documentation of safety-critical systems as preparation for certification
- Industry-specific solutions

INDUSTRIES

Automotive, aerospace, railway and medical engineering

making cities smart

Fraunhofer FOKUS

FRAUNHOFER INSTITUTE FOR OPEN COMMUNICATION SYSTEMS FOKUS

CONTACT

Andreas Hoffmann
System Quality Center – SQC
Phone +49 (0)30 3463-7392
Fax +49 (0)30 3463-99 7392
andreas.hoffmann@fokus.fraunhofer.de

Fraunhofer FOKUS
Kaiserin-Augusta-Allee 31
10589 Berlin
Germany

www.fokus.fraunhofer.de/en/sqc

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SEARCH-BASED TESTING

CHALLENGE

Whether in aerospace, automotive or railway engineering – embedded systems are finding increasing use in safety-critical applications. There, they fulfil tasks such as controlling the airbag in a car or controlling the doors of a train. The increasing complexity of such applications leads to increasingly stringent requirements for their development and quality assurance, as evidenced by standards such as ISO 26262. This in turn raises the cost of assuring system quality. One way to improve quality assurance while simultaneously lowering the costs of software and system testing is test automation. Yet, a common problem for users is that they still have to design the test cases manually. While there are systematic approaches to manual test case design, such as equivalence partitioning, boundary value analysis or use of coverage criteria, it is often impossible to determine those test cases with high potential for error detection in complex heterogeneous systems. The reason for this is the near infinite number of input possibilities that have to be covered. The test cases required for this simply cannot be created on a limited budget and by manual methods. This is where search-based testing methods take over, fully automatically performing the task of the tester and generating near-optimal tests that reveal hidden and difficult-to-detect errors with regard to defined targets, such as violation of functional and non-functional requirements and structural coverage.

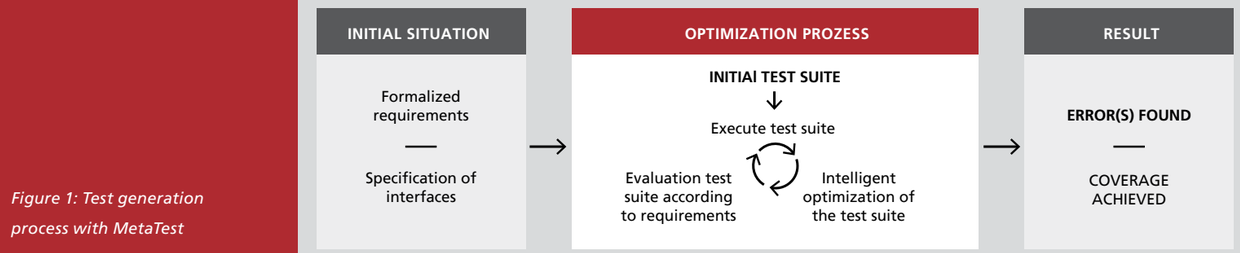

Figure 1: Test generation process with MetaTest

COMPETENCES

Search-based testing is one of the focuses of research at the SQC competence centre of Fraunhofer FOKUS. The Fraunhofer researchers offer custom and problem-specific adaptation of search-based testing methods. For this purpose, alongside a general platform, SQC has developed the tool MetaTest, which is tailored for use in the early validation phase in the context of a model/software-in-the-loop simulation (see Figure 1). The only preparation required for using this tool is to define the interfaces for stimulating and observing the simulation, as well as the desired test targets and quality criteria. Test targets can be specified, for example, according to system invariants that must never be violated. Specially developed algorithms then fully automatically analyze the behaviour of the system and, working from the test targets, attempt to find tests that would, for example, violate a specified invariant. Various simulation environments (e.g. MATLAB / Simulink) can be easily connected over the FMI (functional mock-up interface) or specialized adapters. The approach developed by SQC allows early detection of hidden and/or safety-critical errors in the system that, given their characteristics, might otherwise only be detected much later “by chance” during the development process or the service life of the product, and which could be very expensive to eliminate.

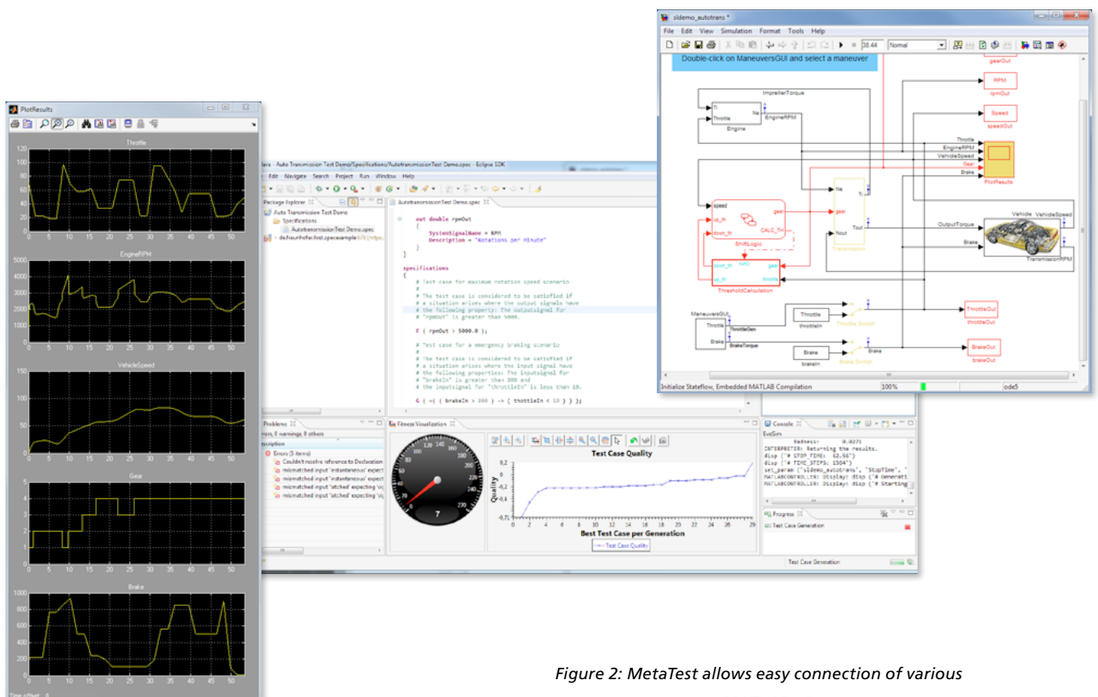

Figure 2: MetaTest allows easy connection of various simulation tools, e.g. MATLAB / Simulink

YOUR BENEFITS

Fraunhofer FOKUS advises and supports its customers and research partners on all areas of system development and system quality. We have many years of experience in quality assurance of safety-critical embedded systems. In providing our comprehensive advice on methods and processes, we also take economic and certification-related matters into consideration.To obtain the best possible results when employing search-based test methods, the customer’s area of application, testing procedures and test targets must be precisely known. Based on the analysis of these criteria, suitable tools are accordingly configured and specifically customized. This produces a tailored solution for embedding seamlessly into the development and testing process. Search-based testing allows early detection of critical and hidden errors, and errors that are difficult to detect using conventional methods, thereby sparing the customer the costs of later elimination. The fully automatic approach allows testing tasks to be performed without the expense of additional resources.