Stefan Baerisch

Domain-Specific Model-Driven Testing

VIEWEG+TEUBNER RESEARCH

Software Engineering Research

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Prof. Dr. Wilhelm Hasselbring

Im Software Engineering wird traditionell ein Fokus auf den Prozess der Konstruktion von Softwaresystemen gelegt. Der Betrieb von Systemen, die kontinuierlich Dienste mit einer geforderten Qualität bieten müssen, stellt eine ebenso große Herausforderung dar. Ziel der Reihe Software Engineering Research ist es, innovative Techniken und Methoden für die Entwicklung und den Betrieb von nachhaltigen Softwaresystemen vorzustellen.

Traditionally, software engineering focuses on the process of constructing and evolving software systems. The operation of systems that are expected to continuously provide services with required quality properties is another great challenge. It is the goal of the Series Software Engineering Research to present innovative techniques and methods for engineering and operating sustainable software systems.

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Foreword

Meeting the requirements on software systems is a great challenge in software engineering. To meet the *real* user requirements, domain experts need to participate in the software engineering process. The research work presented here addresses the integration of domain experts into the testing activities, particularly with respect to acceptance tests.

Stefan Baerisch presents with MTCC (Model-Driven Test Case Construction) an innovative approach to formally specifying automated acceptance tests in the application domain of digital libraries. Digital libraries may be grouped into a system family of software systems sharing some commonalities as well as some variability. With MTCC, test cases are generated with model-driven techniques within the context of the digital-libraries system family. With MTCC, domain experts are involved into the testing process without requiring programming capabilities from these domain experts.

In software engineering, it is not sufficient to propose new engineering techniques. It is required to empirically evaluate the new techniques. The work presented in this book does not only present the new MTCC approach, it also reports on a significant empirical evaluation of MTCC by domain experts at the GESIS institute. Particularly, the detailed documentation of the validation goals and the according experiment design with a candid discussion of the threads to validity may serve as an example for other software engineering research projects—which is why this book is a valuable addition to a researcher's library.

Wilhelm Hasselbring

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Many people deserve my gratitude for the support and encouragement they gave me during my work on this work.

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I thank all my colleagues at the GESIS, both past and present. Max Stempfhuber gave me the freedom to combine this dissertation with my other responsibilities and pointed out areas of improvement. Patrick Lay and Holger Heusser gave me important feedback on my thoughts.

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Rielies Neitzke proved that a librarian can be found at the heart of all research. Harald Deuer and Maria Zens always had time for some words. My deepest thanks to Vivien Petras for our discussions as well as for her support and encouragement.

It is always worthwhile to present ones ideas to a fresh audience. My thanks to the ESEC/FSE 2007 Doctoral Symposium for their time and insights, in particular for emphasizing the importance of a sound evaluation.

The Software Engineering Group at the Carl von Ossietzky University of Oldenburg gave me the opportunity to present and discuss many of the ideas that are presented in this work. I thank you both for this and for the friendly atmosphere I could always count on.

My parents made this dissertation possible in more than one way. Elke and Wolfgang, you have my sincerest thanks and gratitude for all you have done in the past 31 years.

Stefan Baerisch

Abstract

This work presents MTCC (Model-Driven Test Case Construction), an approach to the construction of acceptance tests by domain experts for testing system families based on feature models. MTCC is applied to the application domain of Digital Libraries.

The creation and maintenance of high quality systems that fulfill both formal requirements and meet the needs of users is one of the primary goals of software engineering. A prerequisite for the quality is the absence of faults. Software engineering has defined a number of techniques for avoiding faults, identifying them or fixing them. Testing identifies faults by exercising an implementation artifact and comparing its actual and expected behavior. MTCC is an approach to automate acceptance tests for the members of system families.

The basic hypothesis of this work is that the involvement of domain experts in the testing process for members of system families is possible on the basis of feature models and that such a testing approach has a positive influence on the efficiency and effectiveness of testing. Application quality benefits from the involvement of domain experts because tests specified by domain experts reflect their needs and requirements and, therefore, can serve as an executable specification.

One prerequisite for the inclusion of domain experts is tooling that supports the specification of automated tests without formal modeling or programming skills. In MTCC, models of automated acceptance tests are constructed with a graphical editor based on models that represent the test-relevant functionality of a system under test as feature models and finite state machines. Feature models for individual testable systems are derived from domain-level systems for the system family. The use of feature models by the test reuse system of MTCC facilitates the systematic reuse of test models for the members of system families. MTCC is a model-driven test automation approach that aims at increasing the efficiency of test execution by automation while keeping independence from the implementation of the testee or the test harness in use. Since tests in MTCC are abstract models that represent the intent of the test independently from implementation specifics, MTCC employs a template-based code generation approach to generate executable test cases.

In order to validate the approach, MTCC is applied to the Digital Library application domain. Digital Libraries are Information Retrieval systems that aim at providing the scientific community with relevant information. A MTCC prototype

is designed and realized for a system family of three Digital Libraries and an Information Retrieval system. The capability of representing tests relevant for the application domain, for reusing these tests for multiple systems and for generating executable tests from the abstract test models are validated. An assessment of the understandability by domain experts and of the usability of the editor is conducted. The feasibility and practicality are shown by a validation involving domain experts for a system family of Digital Libraries.

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