Brazil Test Center Research Group

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Abstract. *This paper overviews the Brazil Test Center Research Group, describing its structure, main research areas and achieved results. Aiming at testing process improvements, this group is part of a partnership involving UFPE, UFCG and Motorola Industrial Ltda.*

1 Introduction

The Brazil Test Center Research Group is a partnership between the Informatics Center (CIn) of UFPE, the Department of Systems and Computation (DSC) of UFCG, and the Brazil Test Center (BTC) of Motorola Industrial Ltda. The group's overall goal is to improve test development processes through generation, selection and evaluation of test cases for software applications. In addition to specific solutions for BTC, the group aims to yield valuable scientific contribution in the state of art in the area.

2 Overview

The BTC Research Group started in the beginning of 2005. Since then, its researches resulted in 9 MSc dissertations and 16 papers published in relevant conferences, including the best paper of the Brazilian Symposium on Formal Methods [Cabral 2006]. We also have submitted 12 patents proposals.

The current organization chart of the BTC Research Group includes a manager, a coordinator and 5 mentors (professors from UFPE and UFCG), 7 MSc and 6 PhD full-time students, 2 technical leaders, and 1 software developer that are mainly responsible for implementation activities. The Technical leaders steer the development, evaluation and delivery of proposed solutions.

As part of their research activities, the students work as trainees in BTC teams that are related to their research areas. This way, the students are able to better understand the BTC development process and to identify possible improvement. This interaction with real teams and real problems gives support to the development of tools, prototypes, artifacts that are valuable and applicable to the industry.

The prototypes developed by our the team are evaluated and compared to other tools using empirical software engineering methods (experiments, case studies, surveys, etc.) in the BTC industrial setting. Technical leaders and software developers are responsible for the upgrade and integration of the prototypes in order to provide solutions. Currently, we are evaluating and deploying TaRGeT (Test and Requirements Generation Tool), a tool that we have developed for generating test cases from use cases. TaRGeT is the integration of prototypes and techniques developed in different research works [Cabral 2006, Cartaxo 2006].

3 Research Areas

In general, automated approaches for test case generation and selection take as input representations in some formal notation. However, most testers and software developers are not used to formal notations. For this reason, the inputs of our tools are usually written in natural language (English). We are developing **natural language processing** tools for mapping natural language sentences to formal specifications [Leitão 2007]. This mapping allows an automatic translation of structured use cases written in natural language (NL) to a behavioral formal specification [Cabral 2006]. These use cases describe the software features and their interactions.

We adopt CSP (Communicating Sequential Processes) and Labeled Transition Systems (LTS) to formally specify input NL sentences and behavioral specifications. From these formal specifications, we apply **test case generation** algorithms from CSP specifications [Nogueira 2006] or LTS models [Cartaxo 2006, Andrade 2007] to generate the formal test case specifications (specification of setup steps, preconditions, test procedure, etc.) and test drivers for automatic execution. UML sequence diagrams can also be used as input for test case generation [Cartaxo, Neto and Machado 2007a]. The mapping from formal specifications to NL sentences [Torres 2006] allows the translation from formal test specifications (output of test generation) to natural language test procedures that are suitable for manual test execution.

Due to the costs of test execution and time-to-market, **test case selection** methods [Cartaxo 2007b] are applied to reduce the size of generated test suites and redundancies, while keeping acceptable coverage rates. In addition, researches on **software product lines** are identifying and isolating the variability between software artifacts, such as the use cases and the test specifications, improving the reuse and modularity of these artifacts, avoiding duplication and other common maintenance problems. To manage the test effort, we are developing **test effort and capacity estimation models** for better scheduling and allocation of test resources [Aranha and Borba 2007]. Several statistical techniques are used to create these models, such as regression analysis, analysis of variance and simulation.

Reverse model engineering tools can read a whole test suite written in NL and obtain the formal specification [Leitão 2007] for each contained test case. In sequel, such specifications are combined all together in order to build an up-to-date behavioral formal specification. Additionally, **model checking** techniques are used to perform static tests by comparing the model obtained from a reference implementation against the model obtained from an implementation under test, where both models are obtained through reverse engineering.

4 Conclusions

This paper briefly described the BTC Research Group and its research areas. It is a pioneer partnership between the academy and industry in Brazil. Researchers and developers are physically located in the same building, which facilitates the understanding of the problem under research. Models, techniques and tools are some of the results achieved by this research group.

Although the developed tools have been tested and customized for particular process and technology of BTC, they are not restricted to this context, i. e., they can be applied to other software development contexts.

One of our current research works focus on the investigation of a controlled natural language (CNL), which is a subset of English with restricted grammar and lexicon. The CNL will replace the free NL in order to allow a precise input sentence processing without complicating the use case authoring.

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