

# Testing of Event-Triggered Real-time Systems - TETReS

First year report

Time period: 2000-01-01–2001-03-31

ARTES project 9905-11

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## 1 Introduction

This is the first year report for the project named Testing of Event-Triggered Real-time Systems (TETReS) at University of Skövde. Two problem areas are addressed in the part of the project funded by ARTES : *(i)* improving testability of event-triggered real-time systems by applying constraints on the application behavior, and *(ii)* automated test case generation and selection for such systems. Since this report considers the first year of the project, the results focus on an overview of the research area. One goal for the first year is to investigate and analyze current methods for improving testability. Another goal is to analyze current test case selection methods. The project has progressed according to the plan in the first year, and no changes have been made to the plan.

## 2 Project plan and achieved results

Section 2.1 gives a brief summary of the project plan and the expected results for the first year. Section 2.2 gives a description of the results that the project has produced during the first year.

### 2.1 Project plan summary

The project consists of two sub-projects with individual plans. Thus, there are two objectives in the plan for the first year of the project:

- Analysis of current methods for improving testability by using constraints on application behavior. The analysis to be available in December 2000.

- Analysis of current test case selection techniques. The analysis to be available in December 2000.

Future annual phases of the project include:

- Development or refinement of methods
  - Development of refined upper bound on test effort. Specification of enforcement mechanisms.
  - Development of test case generation and selection strategy.
- Implementation
  - Implementation of enforcement mechanism. Solutions to application specific problems.
  - Development of test case generation and selection tools.
- Evaluation
  - Enforcement mechanisms and solutions to application specific problems integrated into DeeDS.
  - Prototypes of automated tools for generating, selecting, and analyzing the quality of test cases.

## 2.2 Achieved results

We have achieved the two objectives listed in the plan above.

- A thorough literature survey has been conducted. Current methods for increasing testability has been analyzed and classified. This taxonomy has enabled an initial study of the impact on testability given by different constraints on the execution environment. The results were presented in a Masters Thesis (Lindström, 2000). We are also planning to submit a paper on this issue.
- An analysis, survey, and classification of current test-case generation and selection techniques with respect to event-triggered systems have been conducted. In this taxonomy we have also presented initial requirements on test cases and test-case generation to support deterministic timeliness testing of such systems. The results were presented in a Masters Dissertation (Nilsson, 2000). A paper with some of the results was also submitted for publication at the ICECCS conference in the summer of 2001.

## 3 Industrial cooperation and mobility

Our industrial partner in this project is Enea Test, with over 50 industrial testing consultants, a part of Enea Realtime AB (former Industrial Systems division of Enea Data AB). The customers of Enea Test cover a large proportion of the Swedish real-time industry.

### 3.1 Cooperation

Our reference person at Enea Test, Mats Grindal, is now employed 60% as an industrial PhD student in our research group. His experience (more than 10 years) and insight into current industry practice in testing of real-time systems gives an important contribution to our project. The research problem Mats Grindal addresses within TETReS is how to apply our results to unconstrained real-time systems. Enea's broad range of contacts with the industry provides an excellent opportunity to transfer the technology produced by our project into industry. Enea has provided material for a PhD-course in testing that was held at University of Skövde during Spring 2001. The same lectures that Enea gives to their own staff and to their industrial customers was included as a part of our PhD course. Our group has provided feedback and input to Enea on their test course in order to contribute to improvement of their course.

### 3.2 Mobility

Mats Grindal is currently present at our department 1-2 days a week. This means that we have a weekly contact with Enea. We have also had an off-site meeting with the rest of the staff from Enea Test during the last week in March 2001. One of the issues discussed was the opportunity for us to participate in one of their projects. This would give us practical experience and a better understanding of the testing process and the industrial needs. Participation in one of the projects that Enea is involved with is planned to take place during 2001.

## 4 Publications

Lindström B. (2000), "Methods for increasing software testability", Masters thesis, University of Skövde, HS-IDA-MD-00-017.

Nilsson R. (2000), "Automated selective test case generation methods for real-time systems", Masters thesis, University of Skövde, HS-IDA-MD-00-010.

#### **Selected previous publications**

Birgisson R., Mellin J., and Andler S. (1999), "Bounds on test effort for event-triggered systems", *The 6th International Conference on Real-Time Computing Systems and Applications (RTCSA'99)*

Mellin J. (1998), "Supporting system level testing of applications by active real-time database systems", *Proceedings of the Second International Workshop on Active, Real-Time, and Temporal Database Systems*. LNCS 1553, Springer-Verlag.