

Simulation Concepts to Model Real-Time Properties of Symmetric Multiprocessor Systems First Year Report

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Introduction

Within the research project "Simulation Concepts to Model Real-Time Properties of Symmetric Multiprocessor Systems" we explore the use of complete system simulation for analysing high performance systems with quality of service requirements. By using Simics, a system-level instruction set simulator, operating systems and time sensitive applications may be analysed without intrusion. Our goal is to develop tools and methods for performance analysis and debugging of complex, multiprocessor based real-time systems, using simulation as a building block.

The project plan mentions three main objectives:

- Development of tools for analysing quality of service sensitive applications within simulation models of multiprocessor systems.
- Development of environments for feeding modelled user input to simulation of interactive applications.
- Evaluation of proposed modifications to make conventional SMP capable operating systems support QoS guarantees.

Results

The activity during the first year has focused on the first objective, building tools. This is logical, as the second objective is supposed to complement the tools constructed, and the third objective is meant to demonstrate their usefulness.

During the first year, these specific accomplishments have been made:

- Design and prototype of a simulation based "temporal debugger", capable of analysis of operating system execution time flow. As a case study, we have used the temporal debugger to analyse short time critical sequences in Linux. These results are presented in [Alb00].

- Detailed design of a temporal debugger for analysis of user applications. Implementation of this tool is in progress.
- A support tool for probing of a simulated system. (A tool to build tools).
- Investigations of previous research in three fields related to the project: real-time system analysis, simulation of computer systems and real-time support in general purpose operating systems. There is a draft for a survey of related research. This survey will be updated continuously and later published as a technical report.

These accomplishments match the expected results presented in the project plan, with some exceptions. In particular, we have focused on analysis of operating systems, instead of user applications. This is due to the fact that building tools for user applications is much more difficult. However, we are currently addressing this problem.

The expected accomplishments of the second year are:

- Extending the temporal debugger to support analysis of user space applications.
- Building a tool attributing variations in execution time to source code. This tool will help a real-time system programmer to find frequent causes of missed deadlines.
- Solving a research problem involving time-sensitive sequences in operating systems. This will be performed in collaboration with another graduate student focusing on research in operating systems.

Industrial participation

The project is based on the use of Simics, developed by Virtutech, which is a spin-off company from SICS. As the project represents a novel use of Simics, it exposes services the simulator may need to support. It is therefore a source of input to discussions on future directions of Simics. Peter Magnusson, assistant supervisor, is the creator of Simics as well as the manager of Virtutech. He is familiar with the issues involved in complete system simulation, and plays a key role in the education.

Papers accepted for publication

[Alb00] Lars Albertsson. Using complete system simulation for temporal debugging of general purpose operating systems and workloads. In *Proceedings of MASCOTS 2000*. IEEE Computer Society, August 2000.