System Robustness Optimization with SymTA/S

R. Racu[1], S. Schliecker[1], R. Jubeh[1], A. Hamann[1], R. Henia[1], M. Jersak[2], K. Richter[2], R. Ernst[1]

[1] Institute of Computer and Communication Network Engineering
Technical University of Braunschweig
Hans-Sommer-Str. 66, D-38016 Braunschweig, Germany
Tel: +49 (0)531 391-3734 Fax: +49 (0)531 391-4587
{racu, schliecker, jubeh, hamann, henia, ernst}@ida.ing.tu-bs.de

[2] Symtavision GmbH
Hans-Sommer-Str. 66, D-38016
Braunschweig, Germany
Tel: +49 (0)531 391-3724
{jersak, richter}@symtavision.com

Overview

SymTA/S is a software tool for formal performance and timing analysis of heterogeneous multiprocessor systems with several RTOSes, buses, and networks. The focus is on component interaction and communication, since these are usually a major source of complexity, opening the door to design errors.

The underlying technology uses event streams and event interfaces to combine several local scheduling analysis techniques into a global system performance model. Based on symbolic simulation and efficient formal techniques, SymTA/S quickly calculates corner-case timing data. An extendible interface allows detailed analysis of specialized components. On top of the SymTA/S analysis engine have been implemented a framework for flexible design space exploration and system optimization, and a framework for the sensitivity analysis of different system parameters.

Robustness Optimization using Sensitivity Analysis

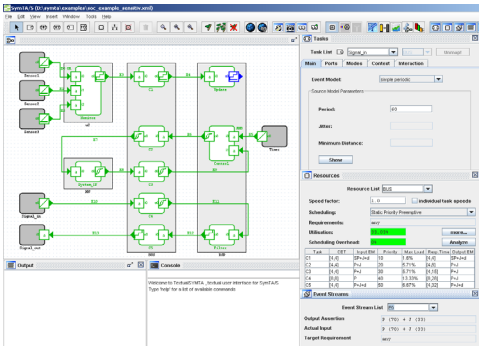
In systems with complex dependencies, small variations of local system parameters may have unpredictable effects on the timing constraints, leading to difficult-to-handle performance bottlenecks. Therefore, system robustness represents a major concern during the design of real-time systems. However, the design space exploration aiming classical design goals does not necessarily guarantee robust systems.

Recently, we coupled the results of the sensitivity analysis engine with the objectives of the design space exploration framework, in order to determine conforming system configurations that have, at the same time, optimal timing properties and large flexibility of certain parameters.

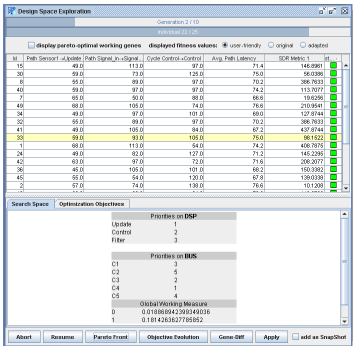
A second technique uses the sensitivity analysis of resource speeds and task execution time scaling factors to optimize the system power dissipation using DVS (dynamic voltage scaling).

SymTA/S Framework and Plug-ins

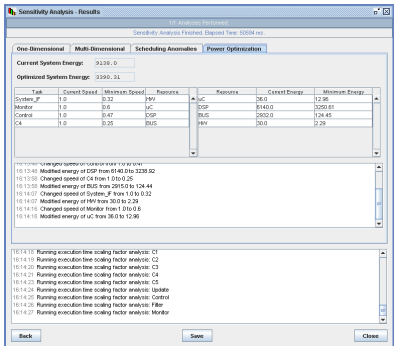
The main element of the SymTA/S GUI is the application area where complex tasks graphs are drawn and the architecture is designed incl. environmental sources and sinks. Several other windows allow configuration of individual elements or control the analysis. The design space exploration and sensitivity frameworks are built-on the SymTA/S analysis engine using a client-server interface to allow a high parallelization of the performed algorithms.



SymTA/S Framework



Robustness Optimization Results



Power Optimization Results

The design space exploration is based on evolutionary search techniques and allows the search space to be dynamically reconfigured without discarding already obtained solutions. A variety of optimization objectives can be formulated and combined into a pareto-optimization with multiple dimensions. The sensitivity analysis framework uses a binary search technique and a set of formal equations to quickly determine the flexibility of different system parameters. Recently, the sensitivity analysis was extended to consider simultaneous variation of multiple parameters.

Additionally, there exists plug-ins for the analysis of memory-accesses or for the integration of 3rd party analysis algorithms.