

# TSIM

## LEON/ERC32 System Simulator



### Introduction

TSIM is a high-performance SPARC architecture simulator capable of emulating LEON and ERC32-based computer systems.

### Features

- Accurate and cycle-true emulation of LEON and ERC32 processors
- Superior performance: up to +30 MIPS on high-end PC (P4@3.6 GHz)
- Accelerated processor standby mode, allowing faster-than-realtime simulation speeds
- Standalone operation and remote connection to GNU debugger (GDB)
- 64-bit time for unlimited simulation periods
- Loadable modules to include user-defined I/O devices
- Instruction trace buffer
- Stack backtrace with symbolic information
- Non-intrusive execution time profiling
- Unlimited number of breakpoints and watchpoints
- Check-pointing capability to save and restore complete simulator state
- Also provided as a library to be included in larger simulator frameworks

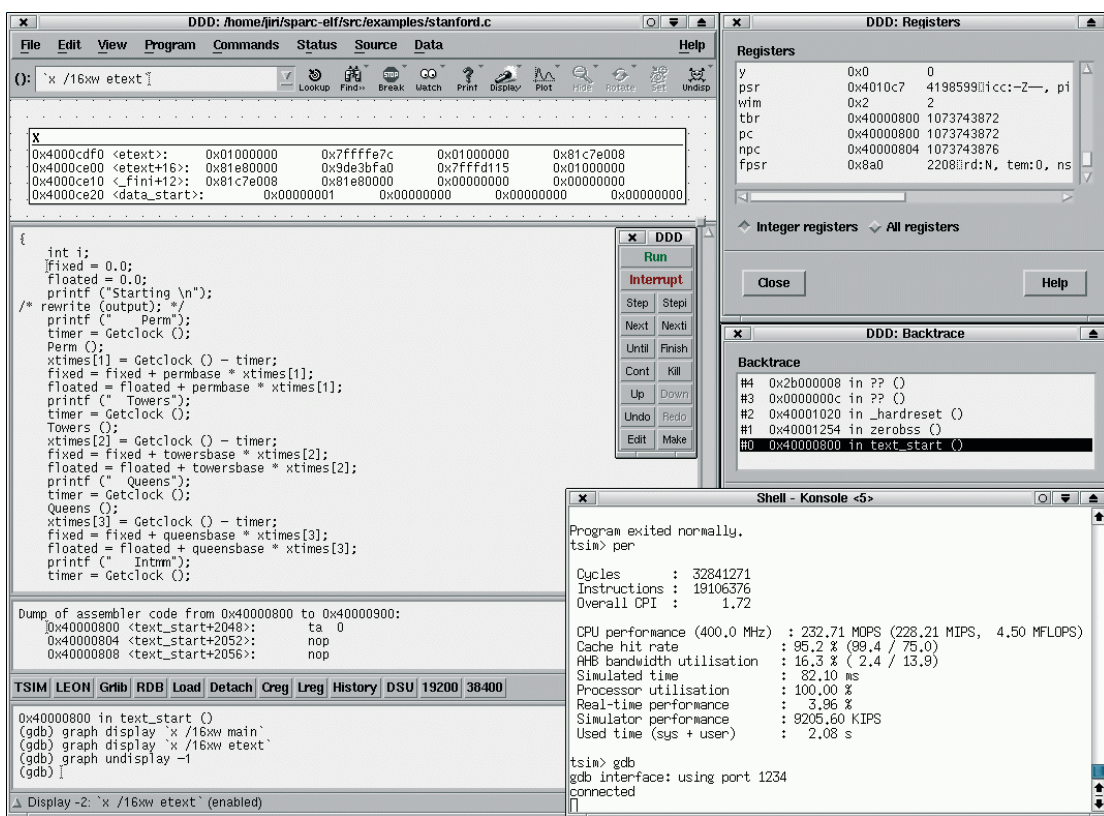


Figure: The screenshot shows TSIM connected to DDD/GDB

### CONTACT INFORMATION

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## Functional Description

TSIM can be run in stand-alone mode or connected through a network socket to the GNU debugger (GDB). In stand-alone mode, a variety of debugging commands are available to allow manipulation of memory contents and registers, breakpoint/watchpoint insertion and performance measurement. Connected to GDB, TSIM acts as a remote target and supports all GDB debug requests. The communication between GDB and TSIM is performed using the GDB extended-remote protocol. Any third-party debugger supporting this protocol can be used.

## Timing

The simulator is cycle-true, i.e. simulator time is maintained and incremented according to the IU and FPU instruction timing. The parallel execution between the IU and FPU is modelled, as well as stalls due to operand dependencies. Instruction timing has been carefully modelled and average timing accuracy of integer instructions is better than 0.5%. Floating-point instructions have a typical accuracy of 2% due to the somewhat unpredictable operand-dependent timing of the ERC32 and LEON2 FPU.

## ERC32 emulation

The ERC32 version of TSIM emulates the TSC691/2/3 chip-set and the TSC695 from Atmel. The amount of simulated memory can be configured at run-time. The memory size is limited by the ERC32 architecture: 256k - 32Mbyte ram, 128k - 4Mbyte rom.

## LEON emulation

The LEON version of TSIM emulates the full functionality of the LEON2 and LEON3 VHDL models and the AT697 chip from Atmel. The full behaviour is emulated, including cache memories, on-chip peripherals and memory controller. The amount of simulated main memory can be configured at run-time and is only limited by the resources of the host computer. The cache size and organisation can be configured between 1 - 64 kbyte/set, 1 - 4 sets, random/LRR/LRU replacement and 8 - 32 bytes/line. The multiplier latency can be programmed for 1 - 35 cycles.

## I/O emulation

TSIM has a unique capability to simulate user-defined I/O devices. The user can provide a module emulating an I/O device, which is loaded by TSIM at run-time. The I/O module has access to the simulator event queue, interrupts and other internal data structures, allowing for accurate and timing true emulation. The I/O module is typically written in C, and can use any feature of the host operating system. This provides high simulation performance and capability to communicate with external simulator frameworks.

## Profiling

The TSIM profiling function calculates the amount of (target processor) execution time spent in each function of the emulated application. This is done in a non-intrusive manner and without instrumenting the code. The profiling data is printed as a sorted list of execution time per sub-program.

## Performance

TSIM is highly optimised for speed and provides simulation performance of more than 1 MIPS / 100 MHz (host CPU frequency). TSIM can also accelerate simulation time when the emulated application is in idle mode. A typical real-time application rarely loads the processor with more than 35%, allowing simulation speeds exceeding real time. A collection of performance measurements are automatically calculated and can be displayed.

## Availability

TSIM is available for Sun Solaris-8, Linux-x86 and Windows-x86 platforms (native or with cygwin-1.1.x). Other (unix) platforms can be supported on request. The library version is also available as a native Windows (98/NT/2K/XP) DLL, which can be linked into a larger user application. The library provides access to all simulator internals and supports all TSIM commands and operations. An I/O interface is provided with the same structure as for the loadable modules.

