SIMulation Workbench

Powering the world's most sophisticated simulators.

SIMulation Workbench (SimWB) provides a comprehensive framework for developing and executing real-time hardware-in-the-loop and man-in-the-loop simulations.

- Hard real-time performance
- Support for industry-standard modeling environments
- Multiple models executed concurrently
- Multi-rate, multi-core support
- Model-independent I/O mapping
- Client (GUI) / Server (real-time) architecture

SIMulation Workbench Architecture

The SimWB real-time core is organized around a very fast memory resident database (RTDB). Simulation models and I/O processes have direct access to the RTDB with very low latency. Models and I/O processes run sequentially during the real-time loop with their execution dispatched by the SimWB scheduler. This modular design allows for complete I/O independence from the various models with a point-and-click GUI (see Fig.1). It provides scalability across multiple cores as the number of simulation models and hardware I/O devices increase. SimWB leverages the powerful features of Concurrent's RedHawk™ Linux® real-time operating system and is fully optimized for multi-channel applications.
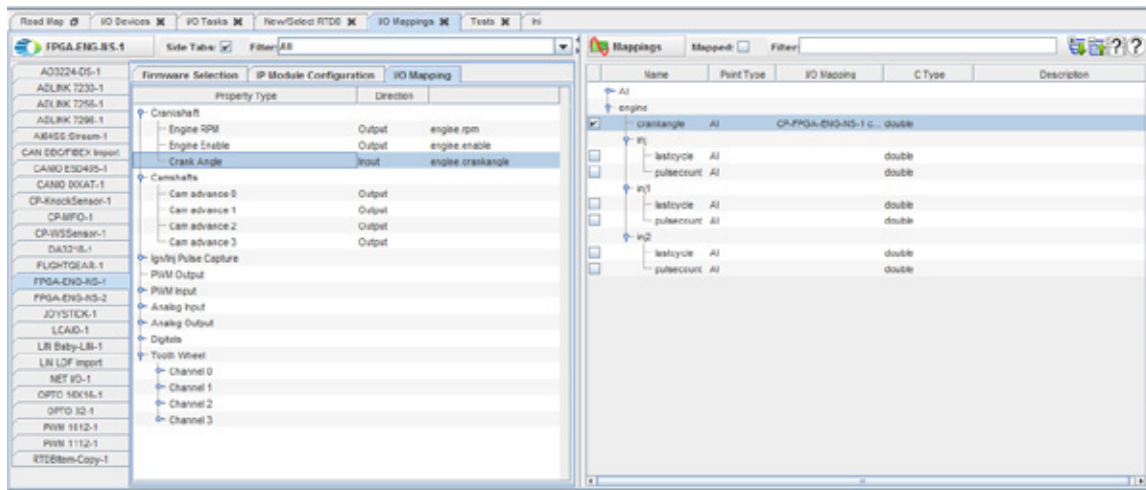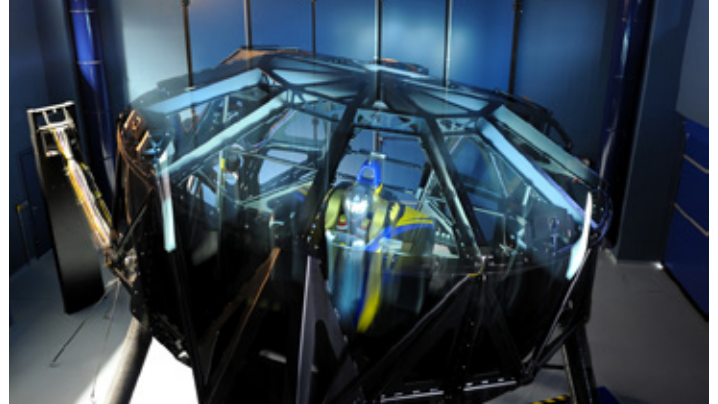

Figure 1 - Point and Click Mapping of RTDB variables to external hardware

Full Use of Multi-Core Processors

With SimWB, individual I/O processes can be targeted to different system cores (see Fig. 2) and I/O buses for parallel execution, thus allowing the simulation loop to run at faster frame rates. Without SimWB's ability to run I/O on different cores, I/O processing would be serialized thus extending the execution time of the real-time simulation loop. SimWB recognizes and utilizes multiple cores by default and there is no limit on the number of cores that can be used by SimWB.

Simulation models are scheduled (see Fig. 3) using the RedHawk Linux Frequency-based Scheduler under the control of the iHawk™ Real-Time Clock & Interrupt Module PCIe card.
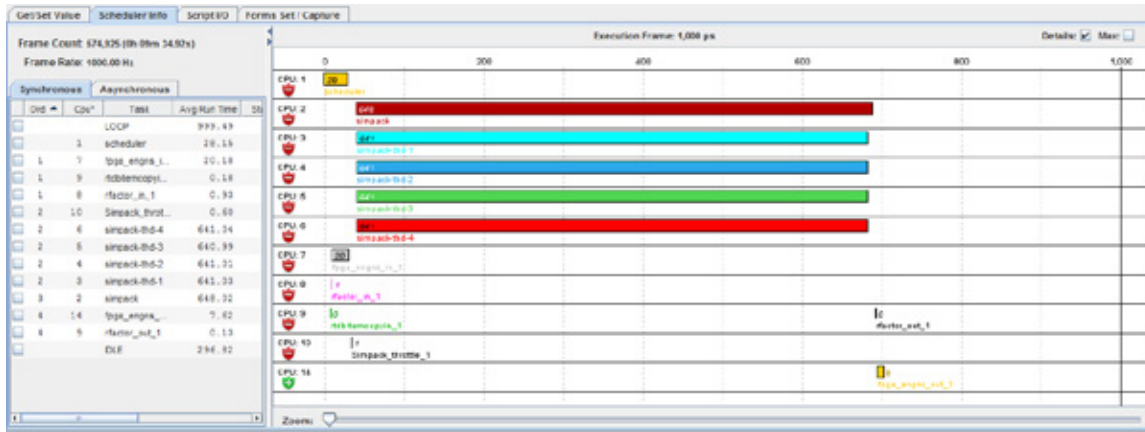

Figure 2 - Visualize and balance CPU load in real-time

Support for Industry Standard Modeling Tools

SimWB supports modeling environments such as Simulink®, VI-grade, SIMPACK, AMESim, Dymola, veDYNA, MapleSim®, GT-Suite and CarSim®. SimWB also supports the environment-independent FMI standard. An extensive API allows hand-written C, C++ and Fortran models to be integrated directly into SimWB and executed along with other models.

SimWB's MLToolkit component is fully integrated with MathWorks® Simulink. Models can be easily imported from Simulink using a SimWB tool without a need for inserting hardware specific S-function blocks. Model parameters are automatically extracted from Simulink models and mapped into the RTDB allowing them to be modified at run-time. SimWB natively supports multi-rate simulation models developed using Simulink by targeting different rates to different CPU cores.

Support for 3rd Party Visualization Tools

SimWB interfaces with products such as GenesisIG from Diamond Visionics™, rFpro, PreScan, FlightGear, X-Plane®, etc. SimWB provides a comprehensive API to allow customers to implement interfaces to other external environments.

Test Management via Real-Time Scripting

Swm, an easy-to-use scripting language, provides full control and visibility into SimWB test runs. Swm gives the user real-time access to simulation model data values as well as frame timing information and data recording functions. Users can directly read and modify data, test for logical conditions, trace their test execution and generate a complete HTML report of a test run. A Swm file is automatically compiled to a C executable and then run once per simulation cycle.

Complete GUI Control

SimWB's platform-independent Control Center (Windows® or Linux) provides the front end to configure and manage the real-time engine. The Control Center is a network client that can run on any system connected to the SimWB real-time machine.

Data Recorder

With the SimWB Data Recorder tool, any RTDB point can be logged in real-time. Hardware and engineering unit values as well as run-time flags and time stamps are recorded. Depending on the performance required, data recording can be run on the real-time host or on a separate networked server. Data recording can be turned on and off during simulation runs by GUI command, real-time script or user program.

Real-Time Database

The RTDB stores definitions of all data items used by the simulation such as model variables and their mapping to I/O boards and model parameters. RTDBs can be automatically created from Simulink and other modeling tools via a GUI. RTDBs provide for complete I/O independence from models. All the information necessary to configure I/O points and data bus protocols, and to read, convert, write and store simulation variables is maintained in the RTDB.
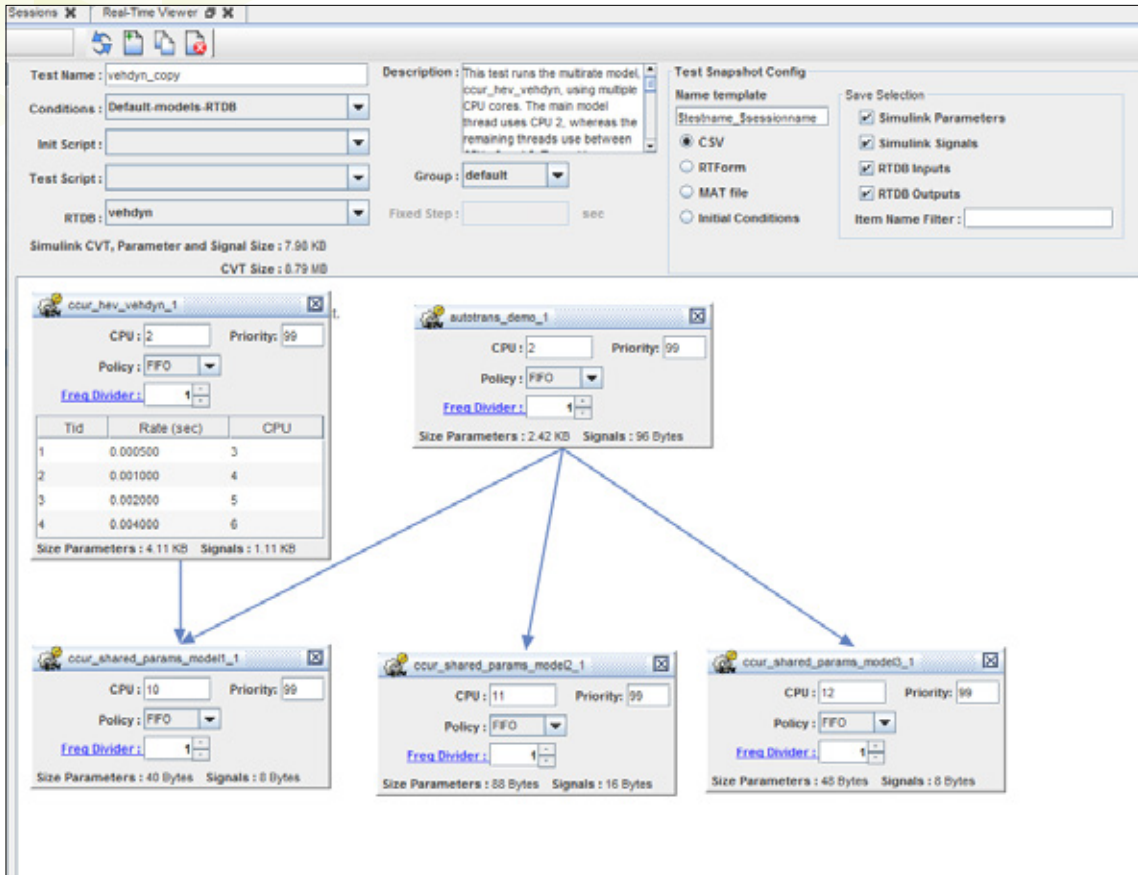
Figure 3 - Schedule multiple models to run on different CPU cores, integrate with Simulink and other modeling and visualization tools.

Simulation Playback

SimWB's Playback tool allows recorded test runs to be replayed into the system. The user selects the recorded session and simply starts a test run in playback mode. The playback interface allows a user to forward to a specified time within a recorded session as well as stepping through its execution frame-by-frame.

Data Visualization and Plotting

SimWB provides a GUI viewer tool to display and plot RTDB items in real-time. Values are refreshed in real-time and time plots can be zoomed in, paused and configured as needed. In addition, the viewer can be used to set RTDB item values. SimWB also provides a platform-independent HMI environment to build custom displays including charts, gauges, knobs and image animation. These widgets allow an operator to interact with a running test in real-time.

Real-Time Linux Simulation Platform

SimWB is delivered on fully-integrated Concurrent iHawk multiprocessor platforms running the RedHawk Linux real-time operating system. iHawk systems are based on COTS components offering the latest processor, chipset, memory and I/O bus technology. Concurrent's state-of-the-art COTS-based iHawk systems offer significantly greater performance than simulation solutions that use proprietary hardware. All I/O devices and Linux drivers required for a simulation are fully integrated and tested by Concurrent.

SimWB Multi-Vendor Integration

SIMulation Workbench Real-Time Engine Models

Features

- Support for a wide range of industry-standard modeling tools
  - 32-bit and 64-bit MATLAB/Simulink
  - SIMPACK real-time models
  - FMI standard support for leveraging FMU models from Dymola, MapleSim and other software
  - High-fidelity visualization software such as rFpro

- Environment simulation software such as PreScan
- Simultaneous execution of Simulink, SIMPACK, FMU and hand-coded models
- Multi-rate, multi-model, multi-core simulations
- Complete GUI control of all run-time activities
  - Data recording and playback
  - Flexible I/O mapping
  - Real-time data visualization and plotting
- iHawk COTS multiprocessing platforms
  - RedHawk Linux real-time operating system
  - Frequency-based scheduling
  - Real-time debugging with NightStar™ tools
  - Real-Time Clock & Interrupt Module PCIe card
- Asynchronous and synchronous data acquisition I/O tasks
- Real-time test scripting

SIMulation Workbench I/O Device Support

- Analog input and output
- Digital input and output
- AFDX / ARINC 664
- CANbus
- FlexRay
- EtherCAT
- MIL-STD-1553
- RVDT / LVDT
- Resolver
- Relay
- IRIG-B

- Counter/Timer
- Reflective memory
- Resistor simulator
- Serial
- Pulse generator
- Pulse width modulation
- Network I/O
- Wheel speed sensor
- Digital Input change-of-state
- Sent protocol
- Universal exhaust gas oxygen (UEGO)

About Concurrent Real-Time

Concurrent Real-Time is the industry's foremost provider of high-performance real-time computer systems, solutions and software for commercial and government markets. Its real-time Linux solutions deliver hard real-time performance in support of the world's most sophisticated hardware in-the-loop and man-in-the-loop simulation, high-speed data acquisition, process control and low-latency transaction processing applications. With over 50 years of experience in real-time solutions, Concurrent provides sales and support from offices throughout North America, Europe and Asia.

For more information, please visit Concurrent Real-Time at www.concurrent-rt.com

Visit our SIMulation Workbench Wiki at wiki.simwb.com