iHawk Systems Running RedHawk Linux

RT-LAB RLX takes full advantage of Concurrent iHawk symmetric multi-processors running the RedHawk Linux real-time operating system. The iHawk is a high-performance PCI-based computer platform especially designed for real-time data acquisition, simulation, and industrial systems applications. The iHawk features from one to eight Intel® Pentium® Xeon™ processors and up to 4 GB of memory in a single rackmount or tower enclosure.

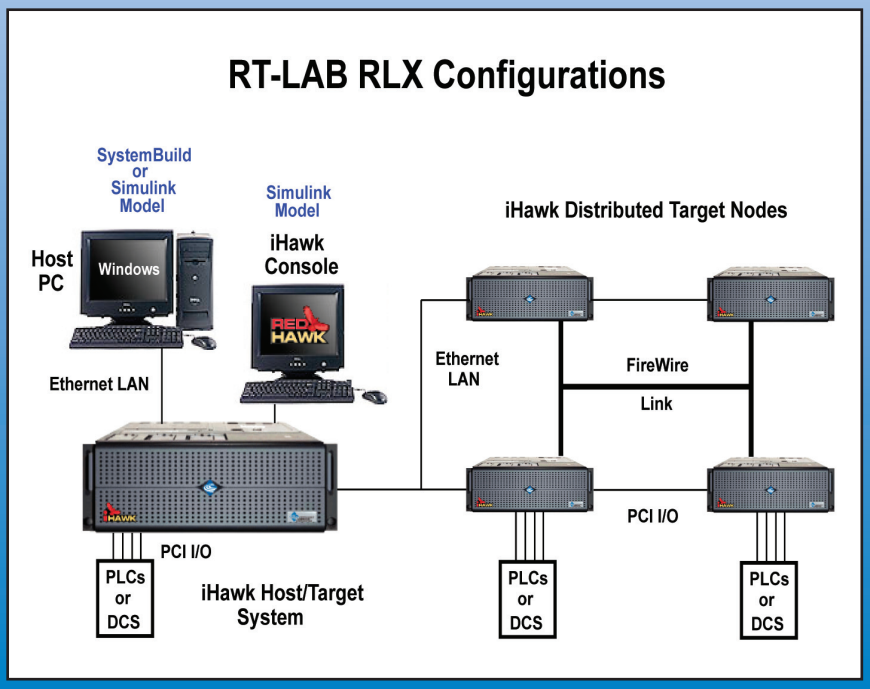
At the heart of each iHawk system is Concurrent's RedHawk real-time Linux. Compatible with the popular Red Hat® Linux distribution, RedHawk features high I/O throughput, fast response to external events, and optimized interprocess communication. RedHawk's multithreaded, fully preemptible Linux kernel with low-latency enhancements make it the ideal Linux environment for complex modeling applications. RedHawk's true symmetric multiprocessing support includes load-balancing and CPU shielding to maximize determinism and real-time performance in RT-LAB RLX target execution.

GUI Control Panel

RT-LAB RLX includes RT-Scope, a powerful GUI that allows the user to select and view signals as plots or gauges while the simulation is running. Users can interact with the simulation by changing parameters and I/O signals through sliders and buttons. Once running, a user views signals by selecting the signal name from drop-down menus in any of the displays on the panel. RT-Scope extracts the signal names directly from the model so it is easy to identify which signals to view. RT-Scope also provides many options found on an actual oscilloscope, such as time-base adjustment and synchronization with a base signal.

Execute Models Via Simple Six-Click GUI

- **OPEN** the model to be executed
- **EDIT** the model into desired components
- **COMPILE** the model on the target platform
- **ASSIGN** model components to selected target nodes and processors
- **LOAD** the executables into the target nodes
- **EXECUTE** the simulation



RT-LAB RLX supports self-hosted target systems or distributed networks of target nodes

For users who wish to create a customized operator GUI, RT-LAB RLX offers programming interfaces for C, Visual Basic, Python, MATLAB M script and the popular LabVIEW interface.

Input/Output And Data Logging

RT-LAB RLX provides unique data visualization and logging tools that make it the industry's most complete and convenient real-time system design environment. Emphasis is placed on providing full, on-line access to a model's signals in real-time. RT-LAB RLX provides a wide range of high-performance RedHawk Linux I/O driver support for the most demanding applications. Supported PCI hardware includes analog and digital data acquisition, CANbus, MIL-STD-1553, ARINC 429, high-speed OHCI and FireWire.

Dynamic Signal Tracing

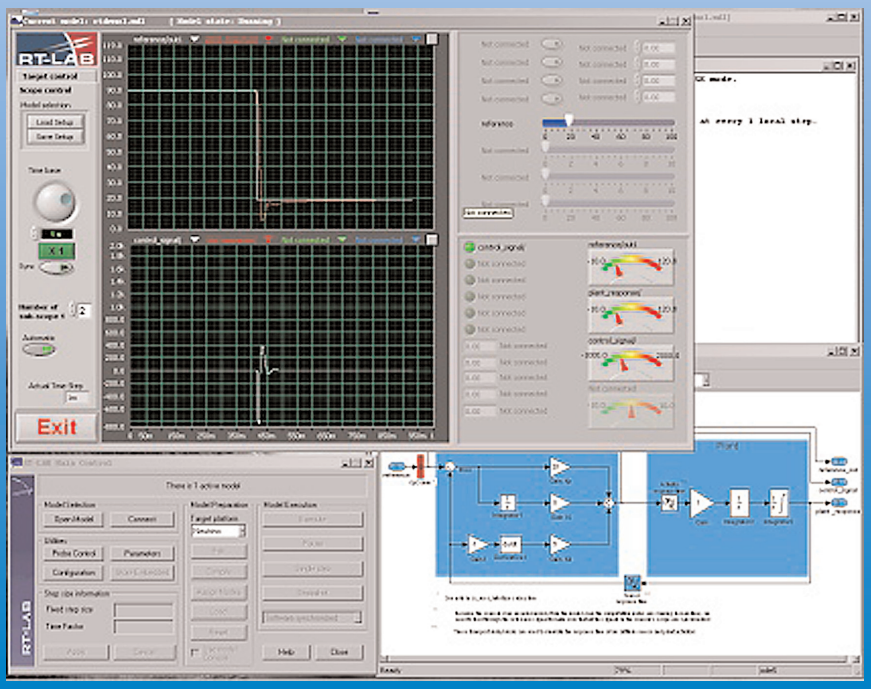
RT-LAB RLX's on-the-fly Dynamic Signal Tracing feature significantly optimizes the building and testing of simulations. Instead of having to define which signals need to be displayed or logged from the simulation before creating and compiling the model, Dynamic Signal Tracing allows you to access the name and value of any signal in the model at run-time. This feature can save a significant amount of time and effort, particularly when developing and debugging a model.

Multiple-Rate Support

RT-LAB RLX supports true multi-threaded, multi-rate execution of subsystems. This feature allows selected subsystems to be updated at faster rates than others rather than executing the whole model at the fastest time step. Removing redundant time steps frees up computation cycles for the more demanding subsystems which in turn allows larger models to consume less processing power.

Distributed Target Execution

RT-LAB RLX provides tools for easily separating a model into subsystem components that can be executed in parallel on multiple target systems. The target environment can be a single multiprocessor iHawk system or multiple iHawk systems connected by a high-speed network. At execution time, RT-LAB RLX offers seamless support for interprocessor communication using any combination of



Select and view signals and interact with the simulation using RT-Scope

TCP/IP, IEEE 1394 FireWire and shared memory, all providing low-latency communication of data between target systems. Users can interact with the simulation in real-time from the host station using TCP/IP or FireWire depending upon the update rate required.

Distributed User Stations

RT-LAB RLX's unique ability to allow subsystem simulation on parallel targets makes it an ideal platform for group collaboration on large simulation projects. Each group can focus on developing the simulation of their own subsystem, testing it in real-time on their own simulator. Individual models can then be readily incorporated into a simulation of the complete system. RT-LAB RLX allows groups to analyze data from the entire simulation to study how their subsystem interacts with other subsystems, and to change parameters to optimize the subsystem design.

RT-LAB RLX Industry Applications

Automotive

RT-LAB RLX's distributed target environment provides the compute power needed for parametric study, early control system verification and virtual integration. Automotive engineers can utilize RT-LAB RLX simulation and analysis before actual road or bench tests. As a result, engineers can identify and resolve critical technical obstacles and integration errors early, shortening the development cycle. In addition, up-front system engineering can help accurately plan the need for physical prototypes, reducing overall program cost. Many automotive industry leaders have selected RT-LAB RLX for advanced development projects. RT-LAB RLX allows reuse of models from early analysis and prototyping work in order to bring a hardware-in-the-loop system online faster than ever.

Aerospace

RT-LAB RLX simulations can be employed to validate and debug aircraft subsystems early in the design process, thus minimizing the need for costly redesigns. Areas of applicability include real-time simulation, dynamic systems analysis, model creation and flight sciences engineering. RT-LAB RLX can also be used for producing aerodynamic, flight control and engine models for training simulators that are certifiable under FAA and JAA regulations. RT-LAB RLX's DINAMO flight dynamics package option is available to support aerospace applications.

Electromechanical

RT-LAB RLX is very useful in applications such as electric circuit, electric drive and power system modeling, simulation and control. RT-LAB RLX can create real-time simulations of electrical systems found in energy distribution networks, power generation plants, aircraft, trains and electric vehicles.

Simulink's SimPowerSystems blockset and RT-LAB RLX's ARTEMIS application package are available to support electro-mechanical simulation. SimPowerSystems allows users to create models of electrical power circuits using familiar component blocks inside a Simulink schematic diagram. Although SimPowerSystems is designed for off-line, non-real-time analysis, RT-LAB RLX users can readily convert SimPowerSystems models into real-time simulations.

Industrial Control

Startup is a critical phase in most industrial plant operations. Design errors often lead to costly delays and damage to expensive equipment. Experience has shown that the best way to achieve a trouble-free startup is to test the control system on a simulated plant prior to going online in the real plant. RT-LAB RLX can be used to simulate the most complex plant dynamics. RT-LAB RLX can generate analog and digital I/O for wire-to-wire simulation or can communicate directly to distributed control systems (DCS) or PLCs via industry-standard protocols. When the plant is operational, operators can reuse the simulator to practice their responses to abnormal conditions.

RT-LAB RLX Application-Specific Packages

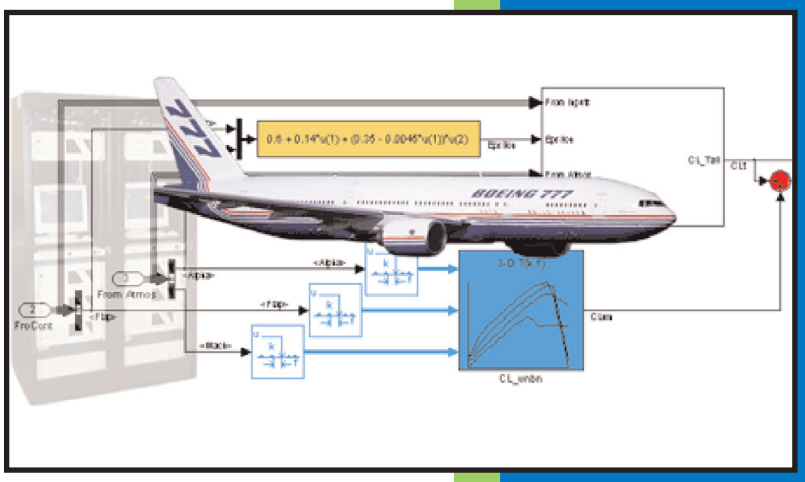
ARTEMIS™ High Precision Real-Time Simulation of Electromechanical Systems

ARTEMIS is designed for users of MathWorks' SimPowerSystems toolbox who need to accelerate power system models or

simulate them in real-time. ARTEMIS provides enhanced algorithms that ensure the reliable, accurate and fast fixed step-length computations essential for high-fidelity, high-performance simulation. Unlike SimPowerSystems on its own, ARTEMIS was designed from the ground up to provide real-time power system simulation with dramatically improved computational speed and accuracy.

ARTEMIS is targeted specifically to real-time, hardware-in-the-loop and other fixed-time-step applications such as electric drives, hybrid vehicle energy conversion systems, power and control system design and electricity generation, transmission and distribution. ARTEMIS is essential for obtaining high-precision, hard-real-time performance from SimPowerSystems models.

A fundamental constraint of real-time simulation is that a model must use fixed-step integration solvers. In stiff systems like electrical power circuits, the traditional approach is to use a variable step solver for resolving high-frequency components in the behavior of the system. Because the time to solve at each timestep is non-deterministic, variable solvers must be replaced with fixed-step solvers which introduce errors into the solution. ARTEMIS introduces innovative fixed-step solvers and efficient computational techniques that dramatically improve the computational performance of SimPowerSystems. ARTEMIS allows users to create robust, accurate real-time simulations of power systems up to 15 times faster and without the inherent errors associated with standard fixed timestep methods.



RT-LAB RLX simulations can be created to validate and debug aircraft subsystems early in the design process

DINAMO Flight Dynamics Simulation and Analysis

Contemporary aircraft manufacturers and flight mechanics engineers face the complexity of producing trimable, flexible and fast executables of their flight models. Intended specifically for aerospace industry specialists, DINAMO simplifies this task through a series of custom library blocks and model format conventions. Without the need for handwritten code, DINAMO can produce executables from Simulink models that can be trimmed and run in real-time. DINAMO is ideal for aerospace applications such as flight mechanics analysis, test rig excitation and hardware-in-the-loop simulation.

DINAMO processes flight mechanics models defined as block diagrams in Simulink. DINAMO's simple GUI eases the task of creating trim, input, parameter-estimation and batch files. Defaults such as longitudinal and lateral trims are provided and reference speeds such as Vmu are automatically computed. DINAMO is also designed to run parameter-estimation batch files tailored to standard flight mechanics analysis. RT-LAB RLX uses Real-Time Workshop to automatically generate and run the model's C-code.

RT-EVENTS Time Compensation for Mixed-Mode Simulation

The RT-Events blockset is used with Simulink to improve the efficiency and accuracy of continuous-time and discrete-time system simulations whose dynamics change due to discrete events. RT-Events relies on a compensated discrete-time simulation method that features both improved accuracy for mixed-mode systems and fast simulation of cyclic event-driven systems. RT-Events compensates for errors introduced when events occur between samples. Accuracy is dependent upon the time step selected with respect to the frequency content of continuous signals. RT-Event uses a non-iterative fixed time-step algorithm that results in faster simulation than obtainable with variable-step algorithms.

RT-Events supports distributed real-time simulation suitable for hard real-time applications such as hardware-in-the-loop or embedded systems.

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