Hypersim

Power System Real-Time Simulator

The Most Powerful and Intuitive Power System Simulator for Utilities, R&D Centers and Manufacturers

OPAL-RT
TECHNOLOGIES

overview

The Most Powerful and Intuitive Power System Simulator for Utilities, R&D Centers and Manufacturers

Hypersim is the only real-time digital simulator with the power to simulate and analyze very large-scale power systems with more than 2000 three-phase buses. It is used for factory acceptance and system integration testing, as well as for R&D works and commissioning tests.

This solution relies on open architecture, high-speed parallel processing and modular scalability to deliver standard real-time simulators designed to meet the evolving needs of the most demanding utilities and manufacturers.

Its intuitive and convenient interface allows engineers – within a single day – to create complex power system topologies and tackle operational and reliability issues.

Backed by 30 years of expertise. Looking forward more than ever.

Based on decades of research by Hydro-Quebec on one of the world's most complex transmission power systems, Hypersim is an ever-improving solution with a proven track record. Dozens of engineers from

OPAL-RT and their partners, supported by millions of dollars in investments every year, have helped to further develop the solution.

Hypersim is used every day in extremely demanding situations and is constantly updated to increase performance, reliability and ease of use. As a result, it is rapidly becoming the new standard for very large power systems.

Real-time digital simulator using SGI super computer

Hypersim user interface
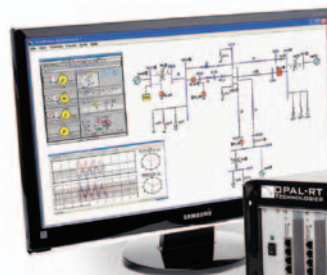
I/O modules on OP7000 chassis

User Benefits

The Most Powerful Solutions on the Market

Hypersim is faster than any other system, thanks to an SGI super computer equipped with the latest Intel processors. This high performance and scalability also makes for easy upgrades and expansions of up to 2560 processors. With the integration of the OP7000 chassis and I/O system it also gains the capacity to use a multi-FPGA board (2012-Q4).

Expertise From Real Users

Users will benefit from the experience of Hydro-Quebec and other utilities and research centers requiring an optimized solution for productive utility works.

## Speed up Testing with Flexible and Intuitive Features

- Increases productivity for factory acceptance and integration.
- Speeds up model development and test preparation with a rapid compilation process, an offline simulation mode, an easy-to-use load flow analyzer and an I/O management server.
- Incredible ease of use with a top one-line diagram editor, convenient data forms, and results database.
- Improves system understanding and fine tuning with quick online parameter modification while simulation is running in real time.
- Produces professional reports and conducts more refined studies with leading-edge, real-time signal analysis, data processing and visualization software.

A Constantly-Evolving Solution

- Selected by utility and R&D centers as the simulation system of choice for major restructuration work taking place over the next decade. All innovations will be passed on to the user community in the form of product upgrades and new functionalities. Large utilities in Europe and China have also selected Hypersim as their main real-time simulation tool for integration testing involving large HVDC systems.
- Reuses the platform from project to project by using a solution based on standard PC processors, the Linux operating system and COTS hardware.

Reliability You Can Depend On

- Developed and validated by an internationally-renowned power system simulation laboratory at Hydro-Quebec's research institute.
- Provides the highest accuracy with a wide selection of easily-configured electrical models tailored to the needs of the power industry, including power systems, power electronics and control blocks.
- Increases power grid performance and security by performing system integration testing with several FACTS and HVDC systems connected to a very large power grid.
- Analyzes all controller conditions and prevents potential dangerous interactions between controllers.
- Possesses a highly-stable simulation environment that can run thousands of manoeuvres to increase the test coverage.
- Improves power system reliability with an intuitive automatic testing tool that executes tests overnight.
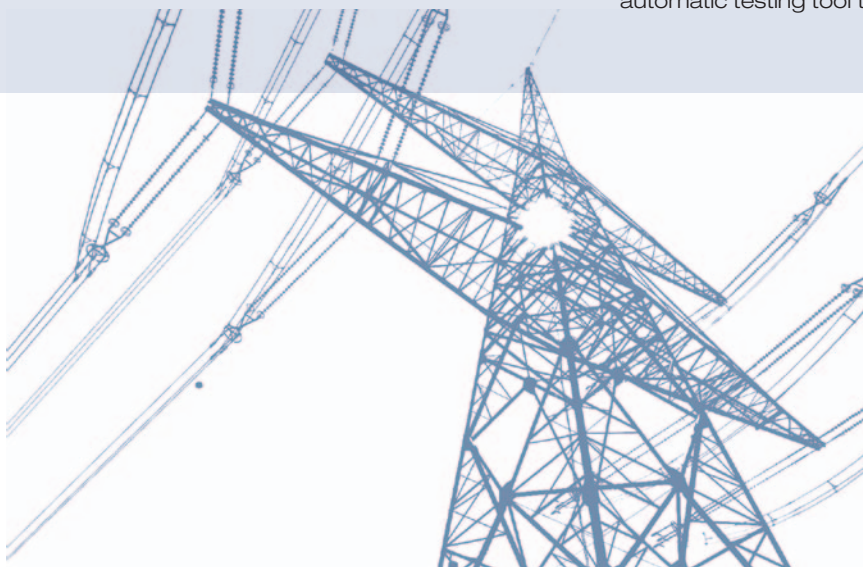
features

Take Power System Simulation to the Next Level

Hypersim is a world-class, fully-digital and real-time simulator for simulating three-phase electro-magnetic and electro-mechanical transients, and for studying complex phenomenon involving interaction between several controls, protection, and HVDC and FACTS systems. It delivers unique features that set it apart from other simulators.
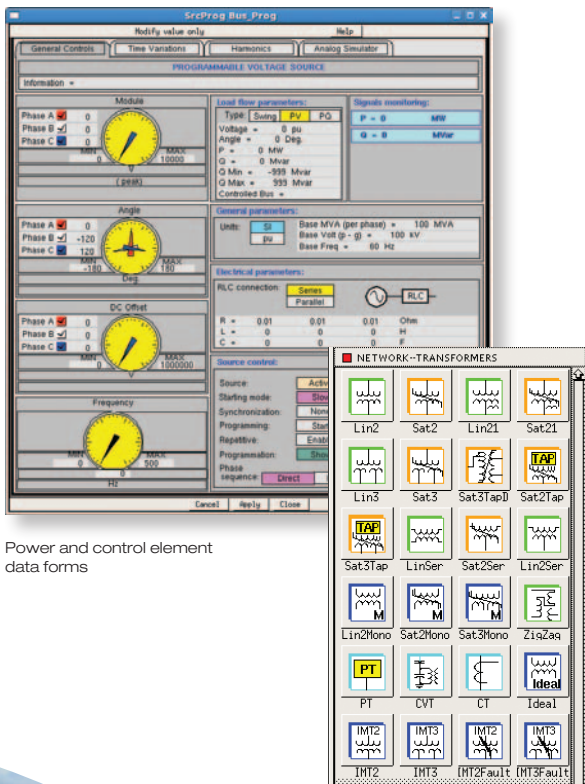
Power and control element data forms

Rich library of power and control elements

Blockset and Solvers

Rich Library of Power System Elements

Validated elements of all power systems are supplied with the capability to manually modify the parameters while the simulation is running or from the test management software.

Precise Load-Flow Analyzer for Automatic System Initialization

Hypersim provides a precise load-flow module for establishing the steady condition of a power system based on the power and voltage references.

High-Precision Valve Firing

The advanced interpolation techniques allow users to accurately simulate the valve firing operations occurring between two time-steps and to avoid non-characteristic oscillations.
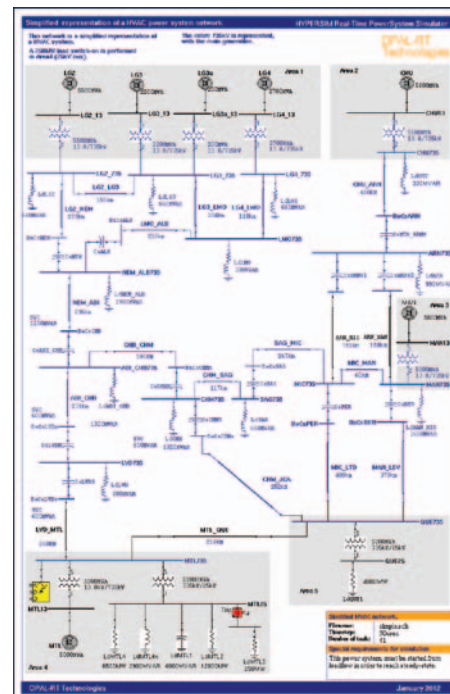

Large transmission system simulated with Hypersim

Software Environment

TestView

This tool helps program automatic test sequences and thus perform thousands of statistical, random and Monte Carlo tests with no user intervention and for overnight execution. Waveforms corresponding to worst cases can be stored, based on specified criteria for offline analysis.

ScopeView - Offline and Real-Time Waveform Display and Analysis

ScopeView is used to display signals and waveforms acquired from the simulator and field equipment during or after tests. It helps to perform mathematical calculations, conduct signal processing and produce reports. Its ease of use lets the user focus on the results, rather than working on complex scripts for viewing data.
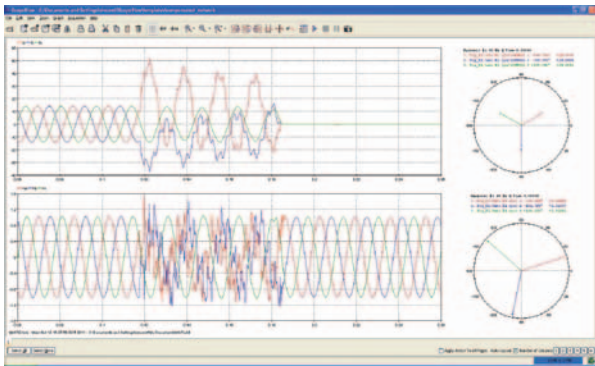
Waveform display and analysis with ScopeView

Automatic Task Distribution From One-Line Diagram Analysis

Hypersim automatically analyzes the power system topology and determines sharing of processing power to ensure the best simulation speed over multiple processors. This is a key feature facilitating and reducing the time to prepare large integration tests.

Hardware Platform

Extreme Scalability Using Off-the-Shelf Computers

Using the latest SGI and Intel technologies, Hypersim is the most powerful simulator for testing large-scale power systems with thousands of three-phase buses. Such capability available with off-the-shelf technologies is beyond the reach of competing solutions that use custom-made computer and communication boards. The standard hardware platform for the Hypersim simulator is the SGI UV super computer equipped with 10 to 2560 cores.

FPGA-based I/O modules on the OP7000 chassis

FPGA-Based I/O and Simulation System

Hypersim will be integrated (2012-Q3) with the OP7000 chassis and I/O system, enabling the use of multi-FPGA boards to implement electric circuits with fast voltage source converters with sub-microsecond time steps to reach maximum accuracy.

applications

Hypersim helps you design and test your conceptual, protection and controller systems for a wide variety of applications including:
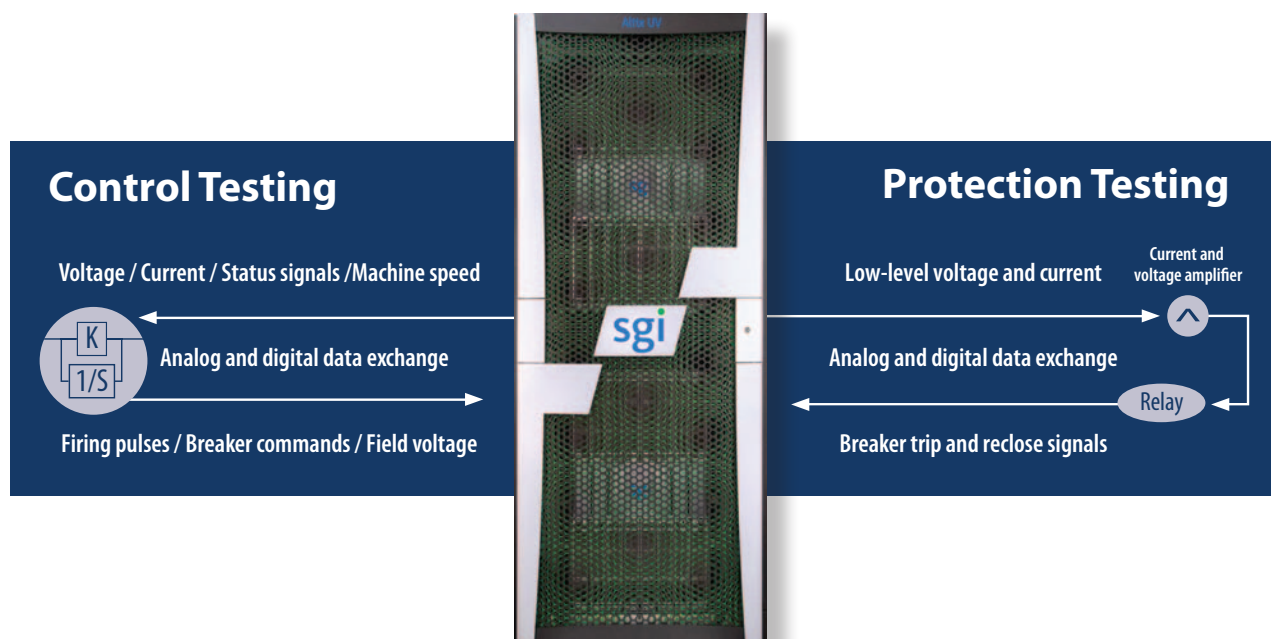
Power System Studies

- Analysis of voltage, dynamic and system stability of AC and DC power systems
- AC and DC power systems interactions
- Evaluation of electro-magnetic transients caused by faults, line switching and ferro-resonance phenomenon
- Analysis of custom power devices and FACTS
- Contingency studies of various conditions

Advanced Education and Training

- Training of utility resources specialized in power system protection and control
- Training of operators and technicians for emergency situations
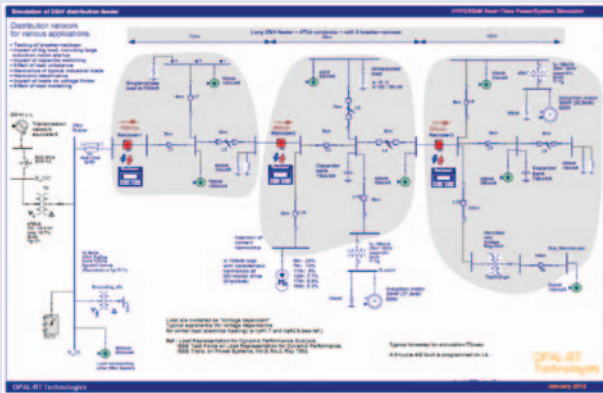- Applied courses in universities

Hardware-in-the-loop Control and Protection System Testing

- Performance and functional testing (Factory Acceptance Tests) of control and protection systems, such as automatic switching of shunt compensation devices and stabilizers, and validation of their settings
- Testing of complex SCADA systems
- FACTS dynamic performance tests
- Statistical evaluation of synchronous switching devices
- Closed-loop testing of relays and auto-reclosure devices
- Integration of several HVDC converters and FACTS systems on a large AC transmission system
- Analysis of new technologies such as MMC HVDC converters and their integration with actual power grids
- Reduced controller commissioning time
- Design of more efficient and robust controls
- Power HIL testing of high voltage equipment using amplifier

Control Testing

Voltage / Current / Status signals / Machine speed

K 1/S

Analog and digital data exchange

Firing pulses / Breaker commands / Field voltage

Protection Testing

Low-level voltage and current

Current and voltage amplifier

Analog and digital data exchange
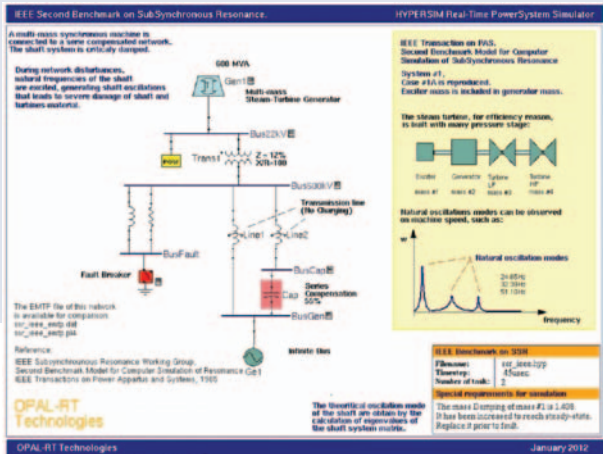
Relay

Breaker trip and reclose signals
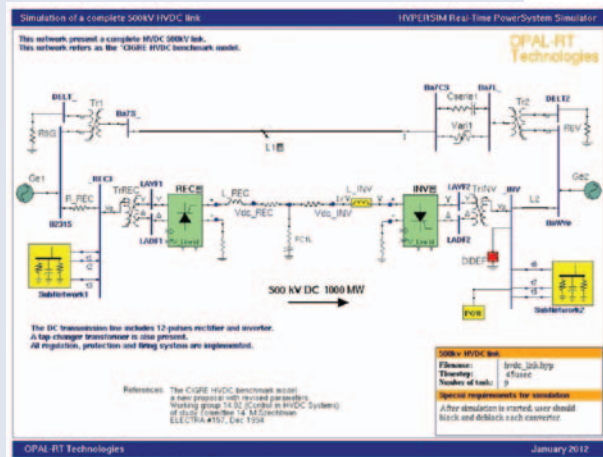
sgi

Application domains

- Generation, transmission and distribution systems
- Multi modular converter (MMC)
- HVDC systems
- Smart grid
- Microgrid with distributed energy resources (DER) such as photovoltaic arrays, wind turbines, synchronous machines and fuel cells
- Wind farm and wind turbines
- FACTS systems such as STATCOM, SVC and TCR
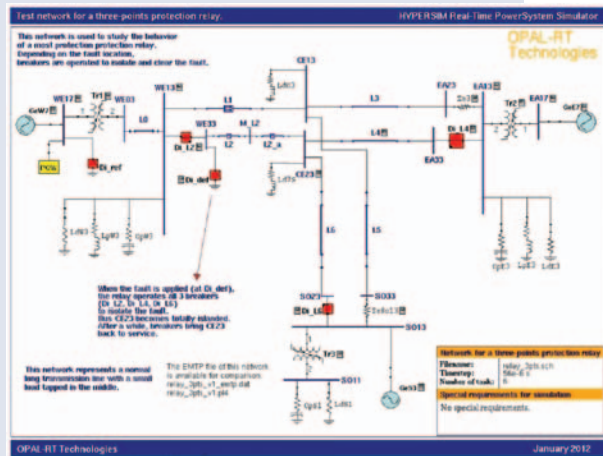- Relay and protection systems

HVDC 500kV link controller testing

Study of breaker and recloser operation on a 25kV distribution feeder network

Protection of a three-point transmission line

Study of the resonance of a multi-mass synchronous machine

from imagination to real-time

About OPAL-RT

Founded in 1997, OPAL-RT Technologies is a world-leading developer of open real-time digital simulators and hardware-in-the-loop testing equipment for electrical, electromechanical and power electronics systems.

OPAL-RT's unique technological approach integrates parallel, distributed computing with commercial-off-the-shelf technologies.

OPAL-RT's simulators are used by engineers and researchers at leading manufacturers, utilities, universities and research centers around the world.

Our customers perform rapid control prototyping, system integration, and hardware-in-the-loop testing of electric drives, electronic controllers and power distribution networks in a variety of industries including automotive, aerospace, electric ships, power generation, rail, and industrial manufacturing.

OPAL-RT helps projects to move from imagination to real-time.

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