SYNOPSYS®

Sentaurus Workbench
Comprehensive Framework Environment

Overview

Sentaurus Workbench is a complete graphical environment for creating, managing, executing, and analyzing TCAD simulations. Its intuitive graphical user interface allows users to navigate and automate efficiently the typical tasks associated with running TCAD simulations such as managing the information flow, including preprocessing of user input files, parameterizing projects, setting up and executing tool instances, and visualizing results with appropriate viewers. The use of mathematical and logical expressions serves to preprocess the simulation input dynamically.

Sentaurus Workbench includes a command and mask layout interface to create, edit, and organize process flows. Higher levels of abstraction support user-defined libraries that can map wafer fabrication process modules or electrical test programs.

With Sentaurus Workbench, users can automatically generate design-of-experiments splits and can distribute simulation jobs across a computer network.

The *Advanced* option of Sentaurus Workbench allows users to build response surface models (RSMs) using the factors and responses of the simulated experimental design. With RSMs, users can interactively optimize experimental design factors to meet one or more target responses.

The *Visualization* option of Sentaurus Workbench provides users with a state-of-the-art interactive 1D, 2D, and 3D visualization and data exploration environment.

Benefits

- Efficient and streamlined organization of simulation projects
- Minimal user interaction to automate and simplify large-scale simulations
- Convenient hierarchical representation of process simulations with support for libraries and hierarchical repositories of process recipes
- Comprehensive parameterization of simulations
- Easy-to-implement optimization and sensitivity analysis
- Advanced 1D, 2D, and 3D visualization of TCAD structures and simulation results

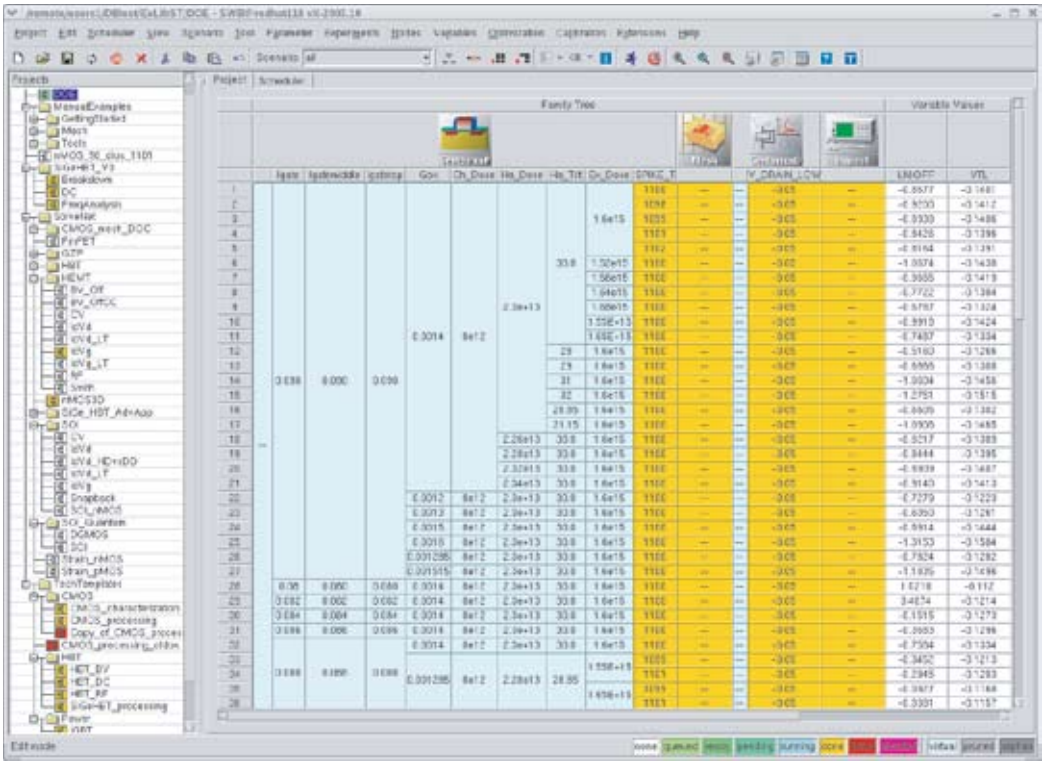

Figure 1. Typical layout of simulations in Sentaurus Workbench.

Simulation Flow Management, Control, and Parameterization

Sentaurus Workbench is an easy-to-use framework environment to help users create, manage, execute, and analyze TCAD simulations.

Process flows can be abstracted and organized at different levels of complexity in application-oriented ways. Users can add their own hierarchical libraries of process simulation modules (recipes) as required. Third-party simulators, editors, filters, and visualization tools are supported.

The abstraction achieved by encapsulating simulator syntax into modules is convenient when setting up manufacturing simulation environments for users with limited exposure to TCAD tools.

Input files for process simulation tool steps are automatically generated. The open architecture allows for customized modifications and additions of commands or simulator translation modules. Input files can be parameterized with user-defined parameters and variables extracted from simulation results.

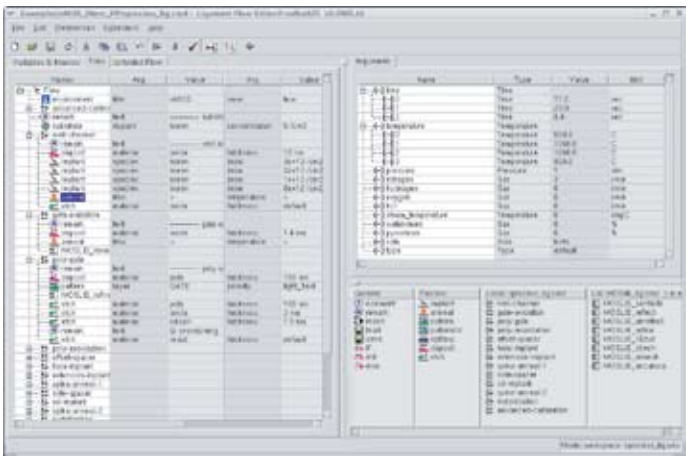

Figure 2. Ligament Flow Editor.

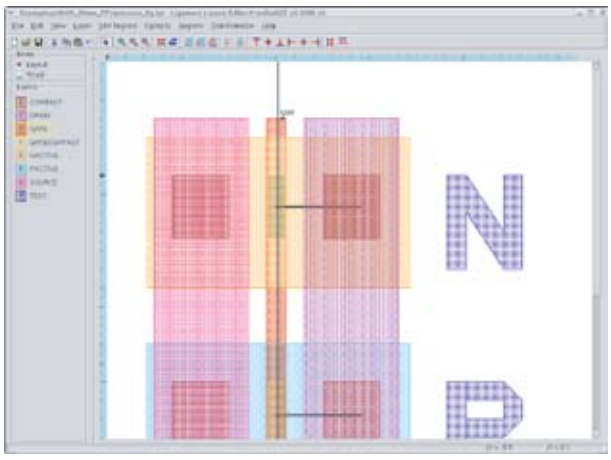

Figure 3. Ligament Layout Editor.

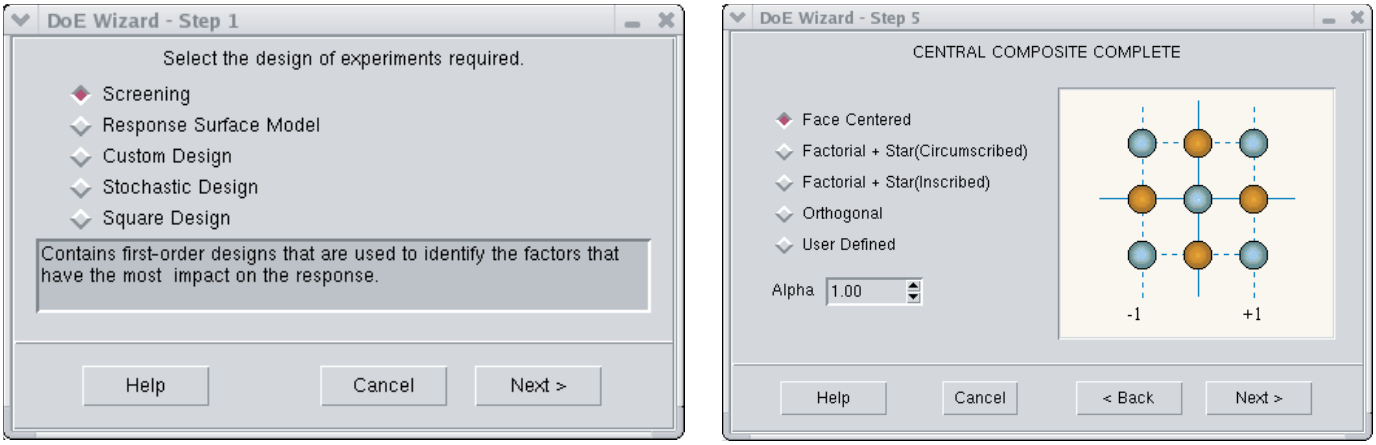

Figure 4. Design-of-experiments designer of Sentaurus Workbench.

Design-of-Experiments, Response Surface Modeling, and Optimization

The optimization capabilities embedded in Sentaurus Workbench are targeted at parametric studies in large-scale projects with hundreds of individual simulations, such as automatic iterative optimization, sensitivity analysis, and statistical analysis. Sentaurus Workbench is designed to perform these simulations with minimal user intervention.

A comprehensive set of built-in experimental designs is available. Design splits are generated automatically when the user has defined the design type, factors, ranges, and levels.

The large number of simulations characteristic of experimental designs can be executed in parallel across a computer network. Two job schedulers are supported: the built-in Synopsys scheduler and the Load Sharing Facility (LSF) from Platform Computing Inc.

Sentaurus Workbench supports iterative optimization of integrated (multi-tool) simulation flows. The iterative optimization is controlled by a heuristic search process that guides the choice of optimization parameters at each step until it converges to a local optimum. This approach is an alternative to RSM optimization when the response surface is not adequately fitted with the first-order or second-order polynomials used in the RSM. Iterative optimization is also useful in process fine-tuning or model calibration. For example, users can define process and model parameters as optimization variables and can extract electrical results as optimization targets.

With the *Advanced* option of Sentaurus Workbench, results from design-of-experiments simulations can be fitted to response surface models (RSMs) allowing for interactive evaluation and optimization of responses.

When used in conjunction with job scheduling, the design-of-experiments capabilities in Sentaurus Workbench make the application of TCAD to process optimization and sensitivity analysis a reality.

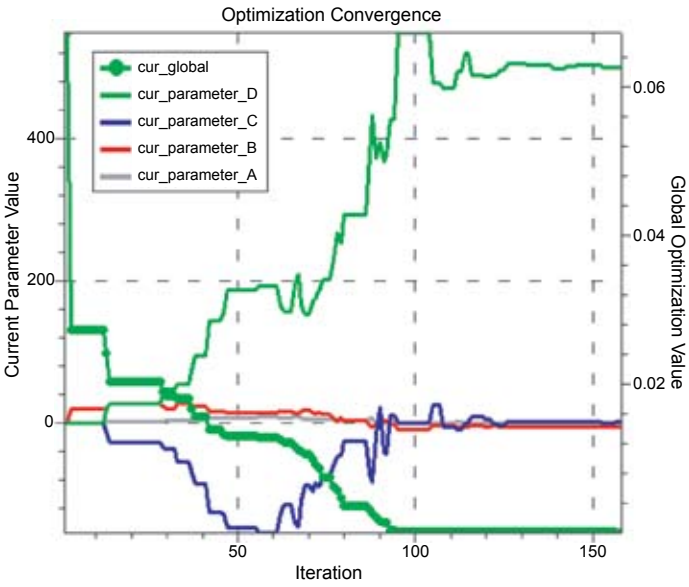

Figure 5. Convergence history of iterative optimization.

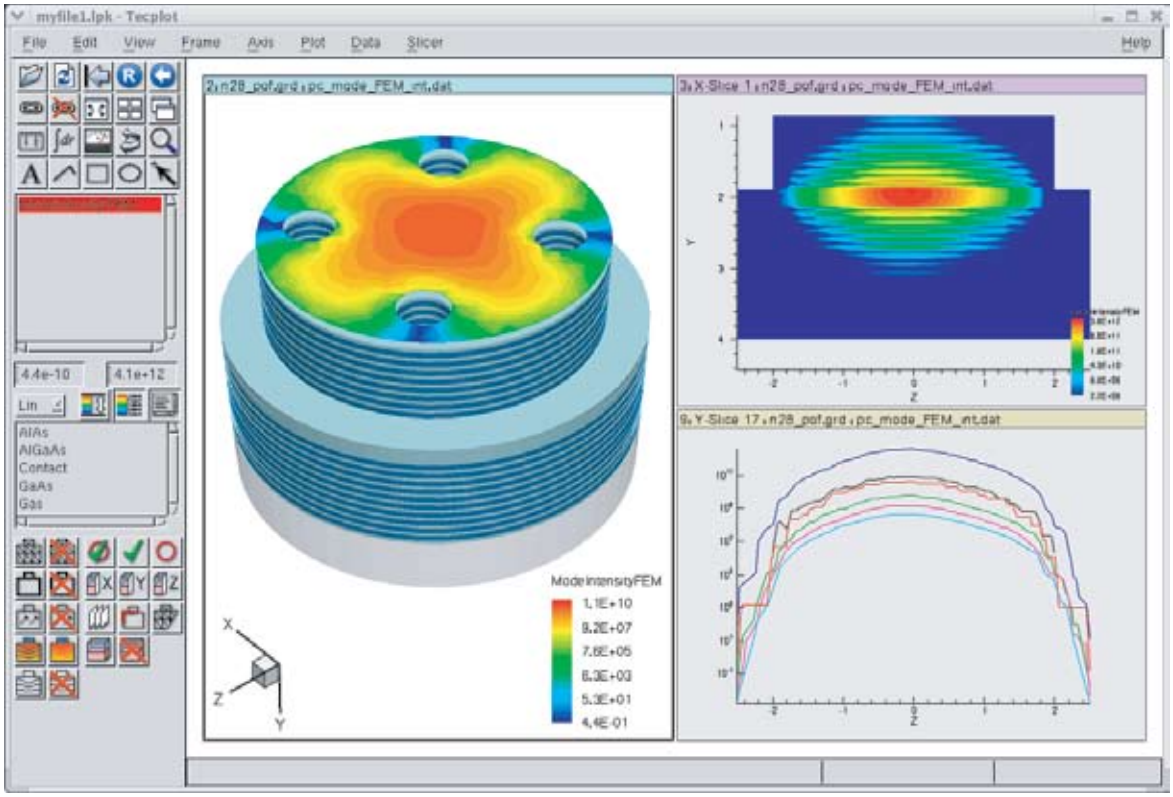

Figure 6. Visualization examples using Tecplot SV.

Visualization

Typically, TCAD simulators produce two types of data for visualization: X-Y data such as I–V curves and doping profiles, and 2D/3D scalar and vector data fields such as electrical potential, carrier concentration, and current flowlines. The *Visualization* option of Sentaurus Workbench supports both of these requirements.

For X-Y data, a scripting language and a comprehensive library of mathematical functions allow users to postprocess simulator output to generate new curves and extracted parameters. Values extracted in this fashion can be returned to the Sentaurus Workbench environment for further applications.

Visualization of scalar and vector data is accomplished through a fully integrated and customized interface to Tecplot®, which is dedicated software for scientific visualization by Tecplot, Inc. (www.tecplot.com). This state-of-the-art scientific visualization environment is the perfect tool for data exploration and analysis, giving TCAD users unsurpassed 2D and 3D views of internal device behavior. In addition, creation of presentation-quality plots and animations, and sharing of results on the Web are fully supported.

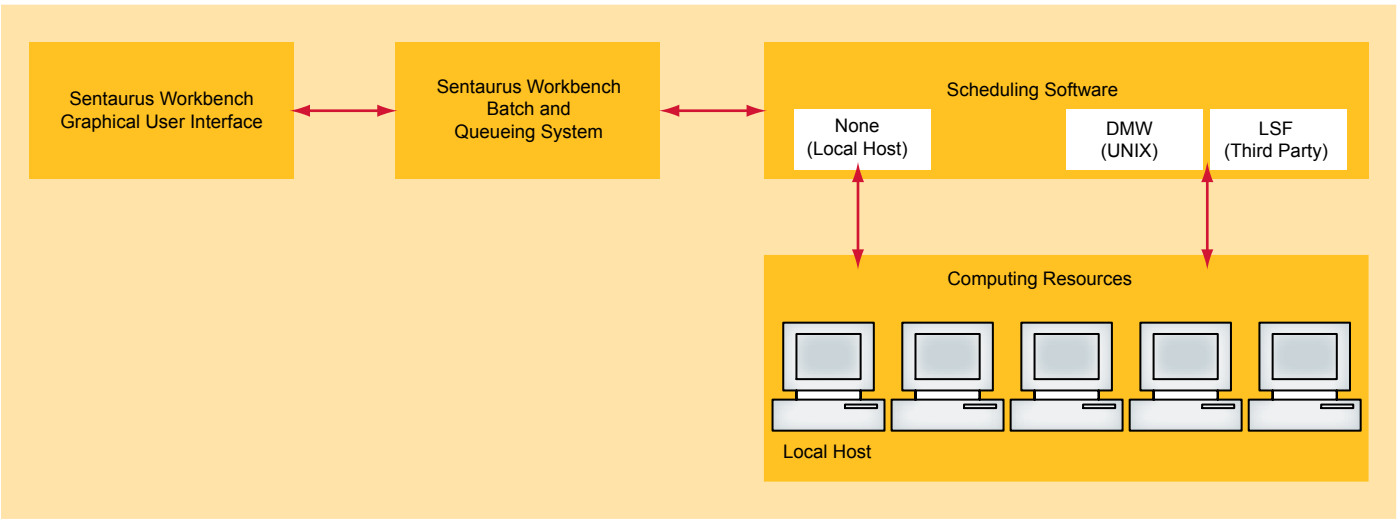

Figure 7. Scheduler of Sentaurus Workbench

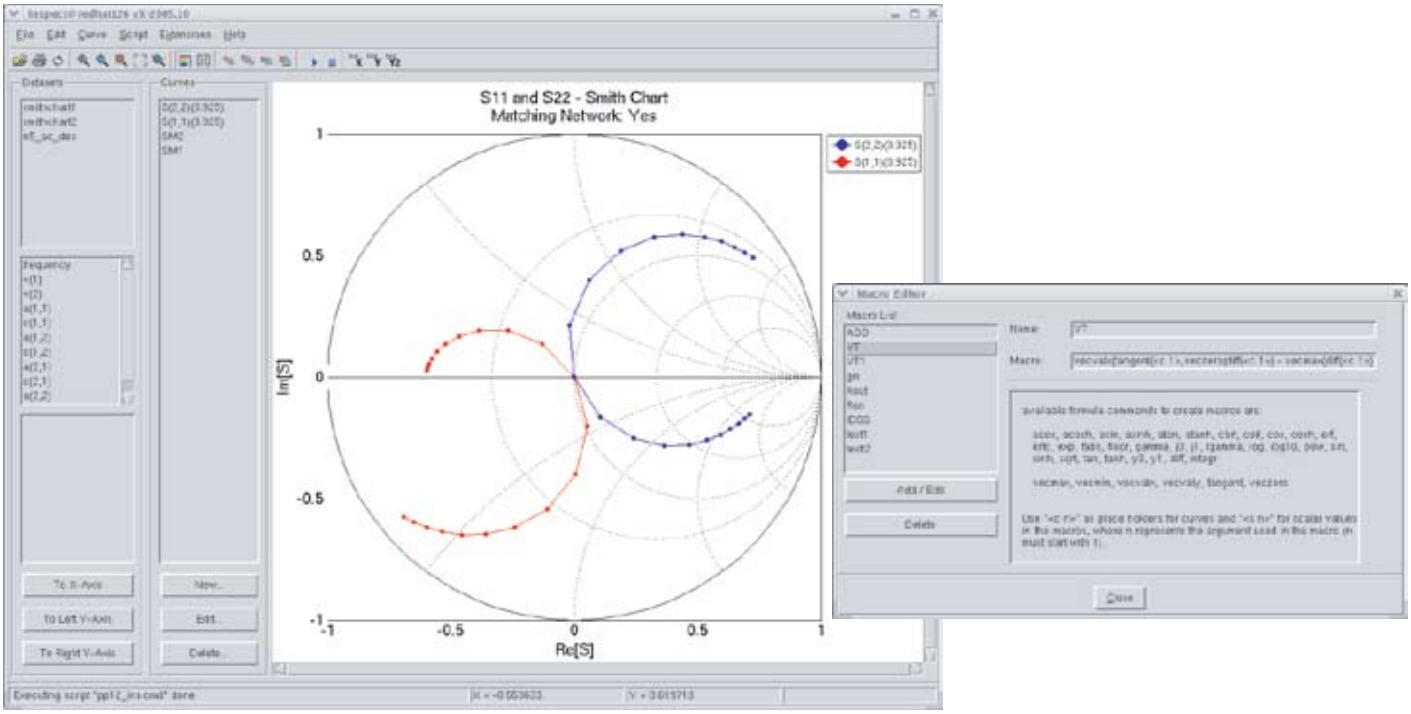

Figure 8. Plotting and analysis using Inspect.

Features

- Job scheduling
- Network computing
- Open architecture for integration of third-party tools
- Comprehensive support for design-of-experiments and response surface modeling
- Graphical user interfaces for editing process flows and layouts
- Taurus Workbench to Sentaurus Workbench converter
- Comprehensive visualization, extraction, and analysis of X-Y data
- Tool command language for postprocessing X-Y data
- Complete 1D, 2D, and 3D advanced visualization and plotting of internal device fields
- Powerful macro language for automating and customizing multidimensional plots
- High-quality print output

Supported Platforms

- AMD64 (Opteron) 64-bit
- HP (PA-RISC 2.0) HP-UX 64-bit
- Sun (SPARC) Solaris 64-bit
- x86 (IA-32) Linux 32-bit

SYNOPSYS®

700 East Middlefield Road, Mountain View, CA 94043 T 650 962 5000 www.synopsys.com