SIMULIA

Isight

Automate Design Exploration and Optimization

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See Your Way to a Better Design

Simulation process automation and design optimization solutions—reduce time and costs while significantly improving product performance, quality, and reliability

Industry Challenges

In today's computer-aided product development and manufacturing environment, designers and engineers are using a wide range of software tools to design and simulate their products. Often, the parameters and results from one software package are required as inputs to another package, and the manual process of entering the required data can reduce efficiency, slow product development, and introduce errors in modeling and simulation assumptions. SIMULIA provides market-leading solutions that improve the process of leveraging the power of various software packages. Isight is used to combine cross-disciplinary models and applications together in a simulation process flow, automate their execution, explore the resulting design space, and identify the optimal design parameters subject to required constraints. Isight's ability to manipulate and map parametric data between process steps and automate multiple simulations greatly improves efficiency, reduces manual errors, and accelerates the evaluation of product design alternatives.

Process Automation and Design Optimization

Isight is a desktop solution that provides a suite of visual and flexible tools for creating simulation process flows—consisting of a variety of applications, including commercial CAD/CAE software, internally developed programs, and Excel spreadsheets—in order to automate the exploration of design alternatives and identification of optimal performance parameters.

Isight enables users to leverage advanced techniques such as Design of Experiments, Optimization, Approximations, and Design for Six Sigma to thoroughly explore the design space. Advanced, interactive postprocessing tools allow engineers to explore the design space from multiple points of view.

Open Component Framework

Isight provides a standard library of components which form the building blocks of simulation process flows. A component is a container with its own interface for integrating and running a particular model or simulation application directly from within Isight.

The direct link between Isight and the components allows for easy modification of a reference input deck, execution of the component, and the extraction of the output information. Isight comes with a set of components for a wide variety of applications like Excel™, Word™, MATLAB®, COM, Text I/O applications, Java and Python Scripting Scripting, and Databases.

An open API and a Component Generator support the development of components. The Component Generator is a tool for wrapping components, creating custom GUIs for wrapped components, and extending your Isight capabilities.

This open architecture allows SIMULIA and its partners to offer application components that provide a tighter integration with models developed in popular engineering software applications, such as Abaqus™, CATIA V5™, Solidworks™, Pro/ENGINEER™, Unigraphics™, ENOVIA™, Teamcenter™, ANSYS™, LS-DYNA™, MADYMO™, STAR-CCM+™, AVL™, Adams™, and different versions of Nastran™. It also enables partners and customers to add custom design techniques including DOE, approximation, approximation error analysis, optimization, Monte Carlo sampling methods, and random variable distributions. This approach makes it easier to create process flows, reduces maintenance costs, and provides timely access to new components or updates through an independent release process.

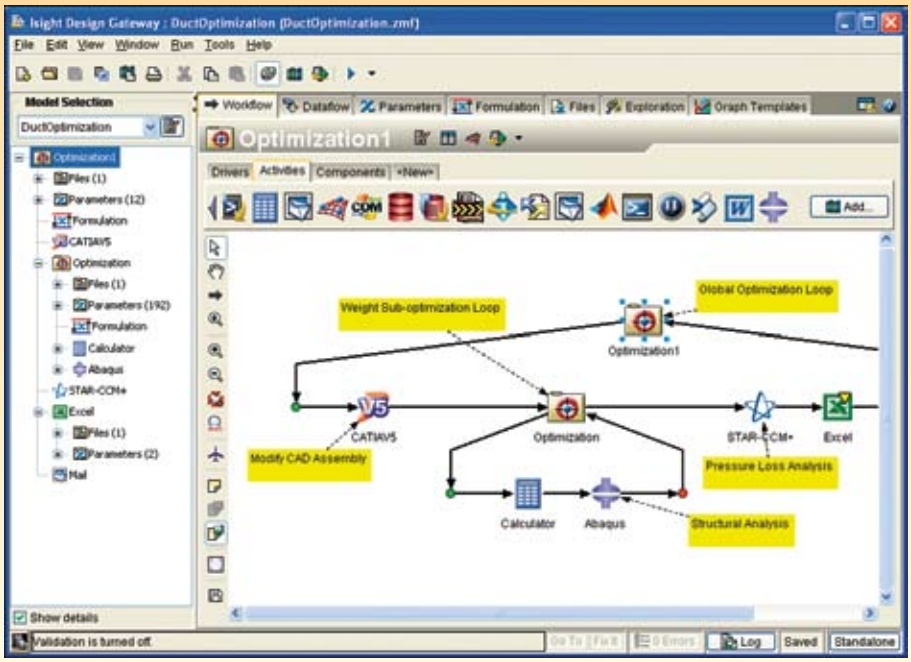
Creation of Simulation Process Flows

The intuitive Design Gateway graphical user interface enables users to quickly create integrated simulation process flows, which couple simulation programs regardless of discipline, programming language, or format. It provides drag-and-drop process flow creation, parameter mapping, and problem formulation. This feature-rich process editor supports powerful file parameters that can represent simulation models as variables, as well as dynamically sizable arrays for both inputs and outputs. The software also provides branching, looping, conditional, and other execution logic. This flexibility, combined with scripts to alter the runtime behavior of the model as a function of changing parameter values, allows the creation of highly reusable processes. Once the process flow is defined, the user interface enables easy import of externally defined parameter values and problem formulations. Utilities such as model search, model content viewer, parameter search, and parameter grouping are also available.

Execution, Results Visualization, and Postprocessing

The Runtime Gateway enables local execution of engineering process flows and creation of graphs and tables to visualize results. All job results are saved automatically to a locally-managed MySQL database. The user interface supports the creation of visual tools for real-time postprocessing of data such as tables, 2D and 3D plots, and statistical analysis. Run data can be filtered and graded with a flexible set of criteria before postprocessing. All scatter plots allow easy one-click visualization of the virtual prototype by dedicated simulation results viewers. It provides interactive tools for visualizing parameter relationships as well as performance attribute trade-offs with interactive approximations. Users can share these approximations with non-Isight users by exporting them to Excel.

Isight is offered as a standalone desktop product. However, any simulation process flow created with Isight can be seamlessly executed on the SIMULIA Execution Engine from the Runtime Gateway.



Isight provides an easy-to-use drag-and-drop interface to quickly create integrated simulation process flows.

Isight offers an extensive library of parallel process components, such as Design of Experiments & Optimization as well as Approximation methods that enable engineers to thoroughly and quickly explore the design space.

Design of Experiments

The Design of Experiments (DOE) component enables engineers to quickly assess the impact of the various design variables on the objectives and identify significant interactions among the design variables. The structured set of design data produced by DOE runs also can be used in conjunction with approximation models for use with optimization methods. Methods included are central composite, full factorial, Latin Hypercube, optimal Latin Hypercube, orthogonal arrays, and parameter study. In addition, an external data file can be used to define the matrix of experiments.

Optimization

Isight provides a comprehensive selection of parallelized optimization techniques that can be applied to a variety of problems. These include numerical optimizers such as NLPQL, LSGRG-2, Hooke-Jeeves, Adaptive simulated annealing, Downhill-simplex, MOST, Multi-Island Genetic algorithm as well as the Pointer-II automatic optimizer—an easy-to-use parallel hybrid technique that can tune itself. The software also includes several techniques that can handle multi-objective optimization problems like the archive based micro genetic algorithm AMGA, Particle Swarm, NSGA-II and NCGA.

Data Matching

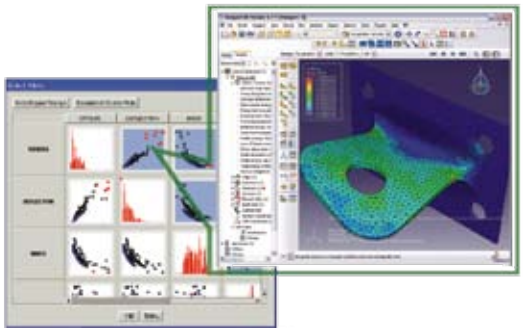
Data Matching is a process in which simulation models are calibrated by minimizing any of a variety of different error measures using optimization techniques. Target data can be either imported experimental results or simulation results generated by a higher-fidelity code.

Approximations and the Visual Design Driver

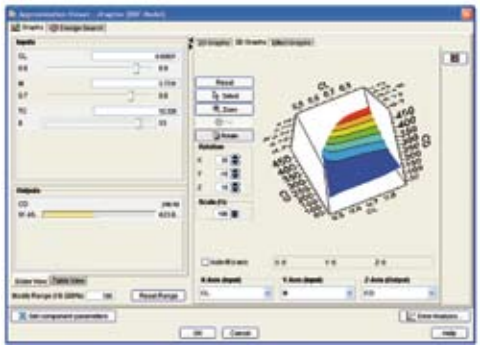
Approximations are powerful real-time tools to interpolate results of computationally intensive realistic simulations. They can be created using the response surface method (RSM), radial basis function (RBF) or Kriging. A setup wizard guides users in defining an approximation mode that can be used anywhere in the simulation process flow. Approximation models are automatically cross-validated to ensure accurate predictions. The Visual Design Driver allows users to see their approximation models from many different views and “surf” the design space graphically and interactively. The Visual Design Driver window provides a parameters panel that can display the parameters in either a slider or table interface. The sliders are directly coupled to all plots currently being viewed, and the plots change as the sliders are moved.

Quality Methods

Isight provides stochastic methods that account for variation in product designs and the environment in which they operate. The Monte Carlo Simulation (MCS) component offers an accurate method to address uncertainty and randomness in the design process. It allows users to sample the design space, assess the impact of known uncertainties in input variables on the system responses, and to characterize the statistical nature (mean, variance, range, distribution, etc.) of the responses of interest. The variations in input parameters can be specified as exponential, Gumbel, normal, skewed-normal, log normal, triangular, uniform, discrete-uniform, and Weibull distributions. Both random and descriptive sampling methods can be invoked. The MCS component can also be used in conjunction with the approximation methods.



Point cloud scatter plots of simulation results with run grading. Abstract data, like a stress field computed with Abaqus, can be visualized with one click in its native viewer.



The Visual Design Driver allows real-time interactive tradeoff of approximated design characteristics.

Using the Six Sigma reliability and robustness analysis component, a product or process is simulated repeatedly while varying the stochastic properties of one or more random variables to characterize the statistical nature of the responses of interest. The “sigma level,” or probability of satisfying design specifications, is reported along with performance variation statistics. The reliability analysis can be performed with a parallel 1st or 2nd order method, a Monte Carlo or a DOE.

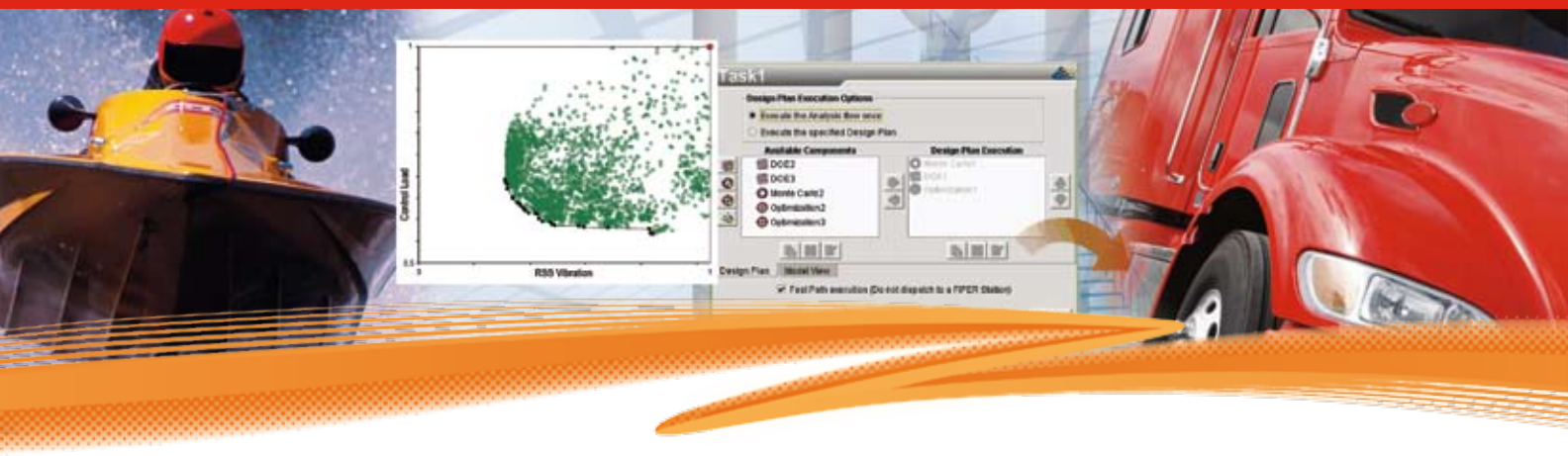
The Taguchi component can be used to improve the quality of a product or process by not only striving to achieve performance targets, but also minimizing performance variation.

Isight Used to Optimize Aircraft Engine Designs

Aircraft engines are complicated machines that involve many engineering disciplines, such as aerodynamics, heat transfer, structural analysis, combustion, rotor-dynamics, materials, vibration, and acoustics. They operate under conditions of extreme temperature, pressure, and stress, which put many of these disciplines in conflict. At the same time, customers demand highly efficient operation and long life with low maintenance costs.

Aircraft engine manufacturers use Isight extensively for integrating multi-disciplinary applications, such as CAD, FEA, CFD, and other programs, and automating the simulation process to perform trade-off studies.

By using Isight, engineers have achieved significant benefits such as increasing engine power while lowering turbine inlet temperature, reducing design cycles from two months to four days for airfoil shape optimization, and improving turbine efficiency while reducing weight and manufacturing costs.



Engineers Pinpoint Cause of Costly Refinery Shutdowns

An alliance of leading companies in the petroleum products industry needed to ascertain why certain operating conditions were triggering shutdowns in their lube/seal oil system auxiliary systems. During partial system shutdowns pressure valves were destroyed, leading to escalating costs in replacement parts and major losses in productivity.

Engineers knew they needed to meet minimum pressure requirements for both the lube header and governor trip. Time was of the essence. To arrive at an optimal pressure for both parts, engineers would need to quickly test hundreds of design alternatives.

The engineers adopted Isight to automate the design simulation process. They were able to use the application to simultaneously change the accumulator size and valve characteristics, allowing them to rapidly arrive at an ideal minimum pressure solution.

By using Isight, engineers were able to reduce design time from two weeks to two hours, while dropping governor trip pressure by 28.7%.

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About SIMULIA

SIMULIA is the Dassault Systèmes brand that delivers a scalable portfolio of Realistic Simulation solutions including the Abaqus product suite for Unified Finite Element Analysis, multiphysics solutions for insight into challenging engineering problems, and SIMULIA SLM for managing simulation data, processes, and intellectual property. By building on established technology, respected quality, and superior customer service, SIMULIA makes realistic simulation an integral business practice that improves product performance, reduces physical prototypes, and drives innovation. Headquartered in Providence, RI, USA, SIMULIA provides sales, services, and support through a global network of regional offices and distributors.

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