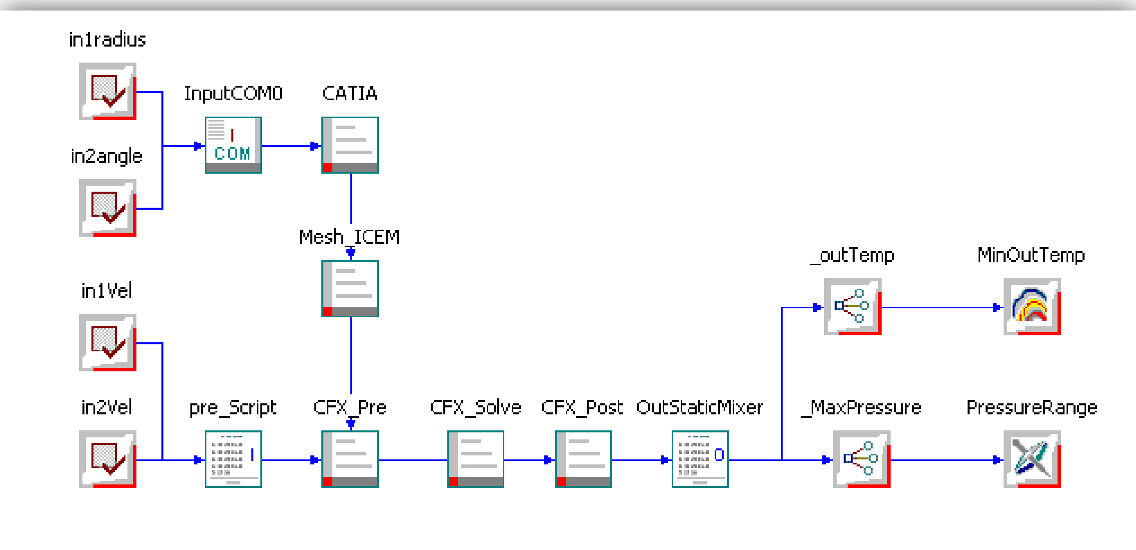
OptiY®

Multidisciplinary Analysis and Optimization

Process Integration

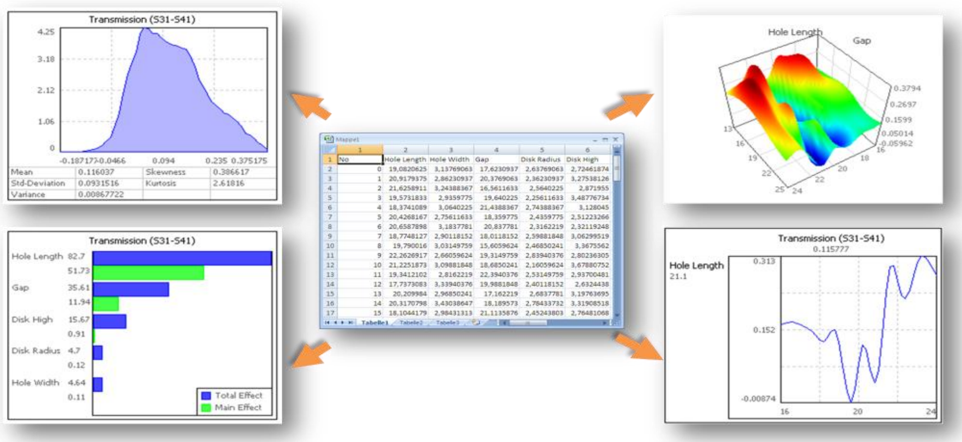
OptiY® is an open and multidisciplinary design environment, which provides direct and generic interfaces to many CAD/CAE-systems and house-intern codes. Furthermore, a complex COM-interface and a user-node with predefined template are available so that user can self-integrate extern programs for ease of use. The insertion of any system to an arbitrary process chain is very easy using the graphical workflow editor. Collaborating different simulation model classes is possible as networks, finite-element-method, multi-body-system, material test bench etc.



CAD Creo Catia SolidWorks etc.	**FEM** Ansys Abaqus Nastran etc.	**CFD** CFX Fluent Star-CD etc.	**MBS** MSC Adams Simpack RecurDyn etc.
Mechatronics SimulationX AMESim Dymola etc.	**Electronics** NI AWR Design LTSpice PSpice etc.	**Multi-Physics** Matlab/Simulink Comsol MapleSim etc.	**Electromagnetics** CST Studio Suite Infolytica MagNet JMAG Express etc.

Data-Mining

Data-Mining is the process of extracting hidden patterns from data. Data mining identifies trends within data that go beyond simple data analysis. Through the use of sophisticated algorithms, non-statistician users have the opportunity to identify key attributes of processes and target opportunities. Data mining is becoming an increasingly important tool to transform this data into information. It is commonly used in a wide range of applications such as manufacturing, marketing, fraud detection and scientific discovery etc.



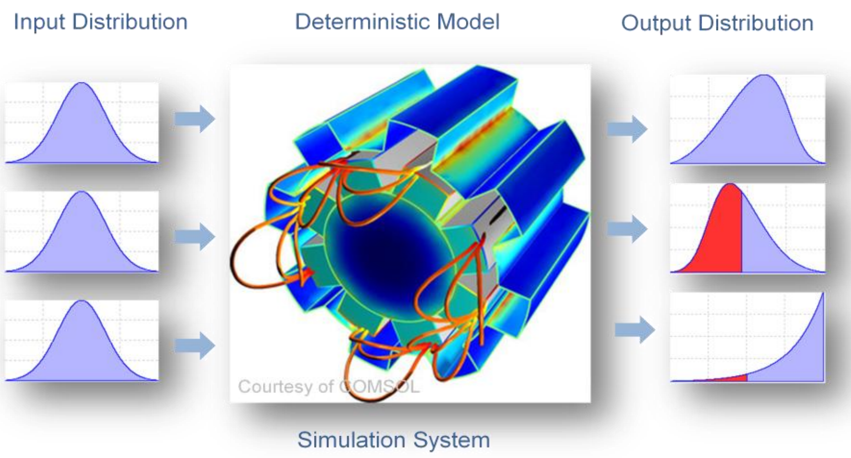
Sensitivity Study

Local sensitivity as correlation coefficients and partial derivatives can only used, if the correlation between input and output is linear. If the correlation is nonlinear, the global sensitivity analysis has to be used based on the variance-relationship between input- and output-distribution as Sobol index. With sensitivity analysis, the system complexity can be reduced and the cause-and-effect chain can be explained:

- Which model parameters contribute the most to output variability and, possible, require additional research to strengthen the knowledge base, thereby reducing output uncertainty?
- Which parameters are insignificant and can be eliminated from the final model?
- Which parameters interact with each other?

Probabilistic Simulation

The variability, uncertainty, tolerance and error of the technical systems play an important part by the product design process. These cause by manufacturing inaccuracy, process uncertainty, environment influences, abrasion and human factors etc. They are characterized by a stochastic distribution. The deterministic simulation cannot predict the real system behaviors due to the input variability and uncertainty, because one model calculation shows only one point in the design space. The probabilistic simulation has to be performed. Thereby, the output distributions will be calculated from input distributions based on the deterministic simulation model by any simulation system. The realistic system behaviors can be derivate from these output distributions.



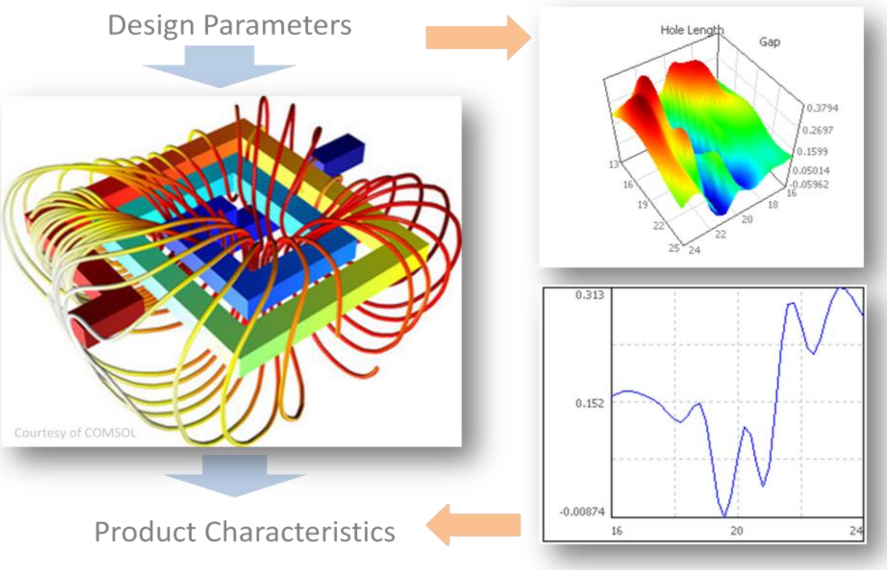
Reliability Analysis

The variability of parameters causes often a failure of the system. Reliability analysis investigates the boundary violation of output due to input variability. The failure mechanisms of components are known in the specification for the product development. They are identified by measurement, field data collection, material data, customer-specifications etc. In the simulation, the satisfaction of all product specifications is defined as constraints of the simulation results. The system reliability is given, if all constraints scatter insight the defined boundaries. Although a nominal parameter simulation shows that all values of the constraints are located in reliable boundaries, the system reliability however cannot be warranted due to input variability. A part of the constraints variability, which violates the defined boundaries, is called the failure probability of the solution. Reliability analysis computes the failure probability of the single components and also of the total system at a given time point.

Meta-Modeling

Meta-modeling or surrogate-modeling is a process to win the mathematical relationship between design parameters and product characteristics. For each point in the parameter space, there is a corresponding point of the design space. Many model calculations should be performed to show the relationship between input and output systematically (Full Factorial Design). For a high computing effort of the product model, it is practically infeasible. Adaptive response surface methodology can be used to solve this problem. First of all, predefined support points in the parameter space are calculated by the original model. Then, a response surface will be build using interpolation between these support points. Based on this response surface, new support points in the parameter space will be suggested and calculated by the original model. Closely, a new response surface will be build by all existing support points. This adaptive process will be continued, until either a defined accuracy of the response surface or a defined number of model calculations have been reached.

The mathematical relationship between design parameters and product characteristics presents a new dimension of the simulation results and it is so-called meta-model. Based on this meta-model, a virtual optimization or test of the virtual design can be performed very fast to evaluate and to improve the design under real conditions. The meta-model can be exported into C-, Visual Basic-, Modelica-, or Matlab-code for further using as surrogate model in system simulation (Matlab/Simulink, SimulationX, Dymola etc.)



Single and Multi-Objective Optimization

In development process of technical products, there are frequently design problems with many evaluation goals or criteria as low cost, high quality, low noise etc. Design parameters (continuous, discrete or binary) have to be found to minimize all criteria. The total objective function summates classically from weighted criteria. In contrast to a single optimization, there is another order structure between parameter and criteria spaces at a multi-objective optimization. Criteria conflict each other. Trying to minimize a criterion, other criteria may be maximized. There is not only one solution, but also a Pareto optimal solution frontier. Multi-objective optimization finds all Pareto solutions automatically with a single run. The multiple decision making support tool is also available to select one best suitable solution from them.

Robust Design Optimization

Variability, uncertainty and tolerance have to be considered for design process of technical systems to assure the highly required quality and reliability. They are uncontrollable, unpredictable and cause the uncertainty satisfaction of the required product specifications. The design goal is assuring of the specified product functionalities in spite of unavoidable variability and uncertainty. Winning customers and saving the product image, great efforts are done in the industry with extremely high effort and cost. Design of experiment with many prototypes is performed. Cost-intensive product changing during pre-series-production, even in the series-production is frequently the case. The new, innovative and cost-effective approach solving this problem is robust design of the product parameters in the early design process. Thereby, optimal product parameters should be found. Within, the system behavior is robust and insensitive in spite of unavoidable variability. E.g. the consistent variability und uncertainty leads only to the smallest variability of the product characteristics. So, the required product specifications will be always satisfied. This process is so-called robust design optimization. There are different optimization goals:

- Reliability based optimization: the objective function is the failure probability of the product characteristic distribution
- Variance based optimization: the objective function is the variance of a probability distribution.
- Mean based optimization: the objective function is the mean value of a probability distribution.
- Cost optimization: the tolerances have to be maximized to reduce the manufacturing cost.

Specifications

Stochastic Distributions
- Normal Distribution
- Uniform Distribution
- Generalized Lambda Distribution
- Fitting of any Distribution by statistical Moments or MS Excel-Data

Optimization Methods
- Hooke-Jeeves
- Grid-Search
- Adaptive Response Surface
- Evolution Strategies
- Genetic Algorithms
- Pareto Strength Evolutionary Algorithm
- Fast Optimization with Surrogate Model

Design of Experiment
- Full Factorial Design
- Center Composite Design
- Monte-Carlo-Sampling
- Latin-Hypercube-Sampling
- Sobol-Sampling
- Response Surface
- Adaptive Gaussian Process
- First and Second Order Moment Method
- Taguchi Design
- User Design

Approximation Methods
- Polynomial in any Order
- Taylor Series in first or second Order
- Gaussian Process/Kriging (Exponential, Matern Class, Rational Quadratic)

Import / Export
- Data-Import / Export via Excel (any Format)
- Graphics-Export in BMP-, JPEG-, TIF- and PNG-Format
- Export of Surrogate Model in C, Visual Basic, Modelica or Matlab

Report
- Automatic Report in MS Word®

Post-Processing
- Table
- 1D-, 2D- and 3D-Diagram
- Parallel Chart
- Set-Selection (All Steps, Pareto, Filtered Pareto)
- 2D- and 3D-Scatter-Plot
- Section Diagram
- 3D-Response Surface
- Coefficient Chart
- 0D- and 1D-Residual-Plot
- 0D- and 1D-Histogram
- Correlation Matrix
- 0D- and 1D-Probability Density
- Cumulative Distribution
- 0D- and 1D-Sensitivity Chart
- Interaction Chart
- Taguchi N/S Ratio

Interfaces
- Generic ASCII-File-Interface (DOS-Batch, VBScript, JScript)
- Generic .NET / COM-Interface (Visual Basic, C#)
- Intern Script (Visual Basic, C#)
- Matlab / Simulink®
- SimulationX®
- MapleSim ®
- CST Studio Suite®
- NI AWR Design Environment®
- MS Excel®
- CATIA®
- PTC Creo®
- SolidWorks®
- Autodesk Inventor®
- JMAG Express®
- Ansys Workbench®
- FEKO®
- more ...

Requirement
- PC with min. 2GHz Processor and 4 GB RAM
- OpenGL 3D Graphics Card
- Operating System: Windows 7 with .NET Framework 4.6 or later

OptiY GmbH
Friedrich-Bergius-Ring 15
D-97076 Würzburg
Germany

Phone: +49 (9305) 988 - 9425
Fax: +49 (9305) 988 - 9427

E-Mail: info@optiy.eu
Internet: www.optiy.eu