

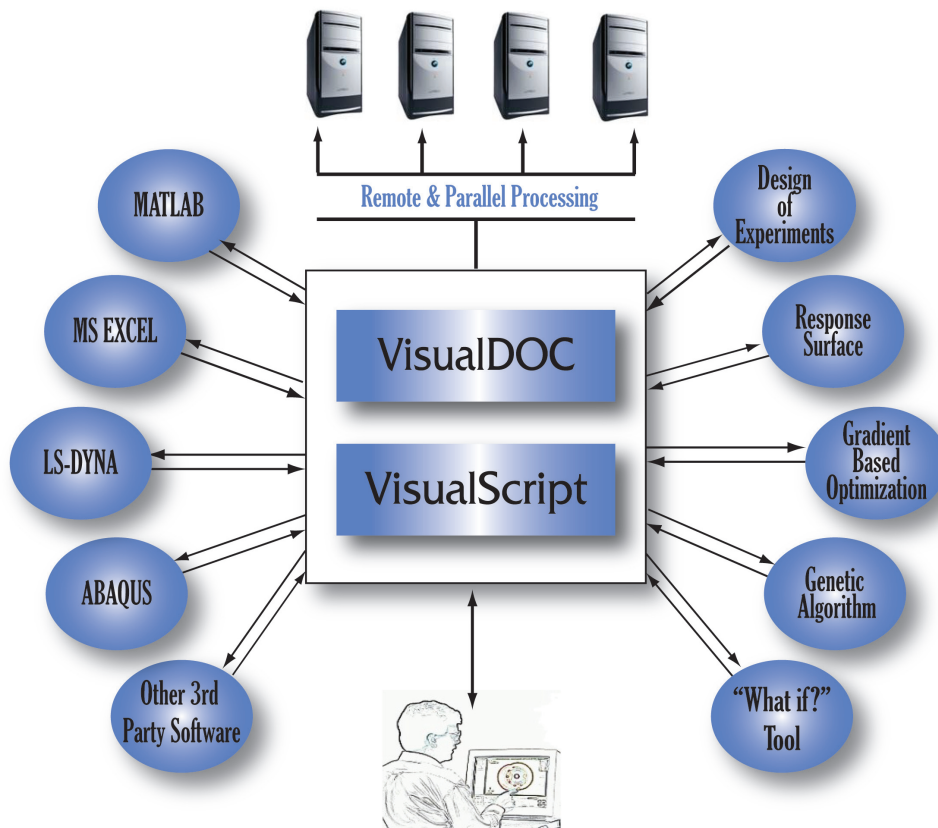
VisualDOC

Design Integration & Optimization Software System

VisualDOC is a software system that simplifies adding optimization to almost any design task. It uses a powerful, intuitive graphical user interface along with state-of-the-art optimization algorithms to setup, solve, and post process your design.

VisualDOC solves design problems by calling the optimizer to modify design variables and then calling simulation codes to evaluate responses. After the design parameters are specified by the user, VisualDOC automates the design process and performs all optimization tasks.

VisualDOC provides gradient, non-gradient and response surface based optimization algorithms along with Design of Experiments. VisualDOC can be used to solve any design problem since the user directs VisualDOC by defining the parameters (design Variables) that can be changed, the measures of design quality (responses), and simulation programs. Alternatively, developers can also embed VisualDOC components within their own applications.



Increase efficiency

- Automate your processes
- Reduce design cycle time
- Increase product reliability

Used by engineers worldwide

Get your products to market faster

- From concept, preliminary and/or detailed design, to manufacture

Share and leverage design data

- Share information and data for better decision making

Combine data from multiple disciplines

- Perform trade-off studies
- Identify important design parameters

Work locally and/or remotely in distributed and parallel computing environments



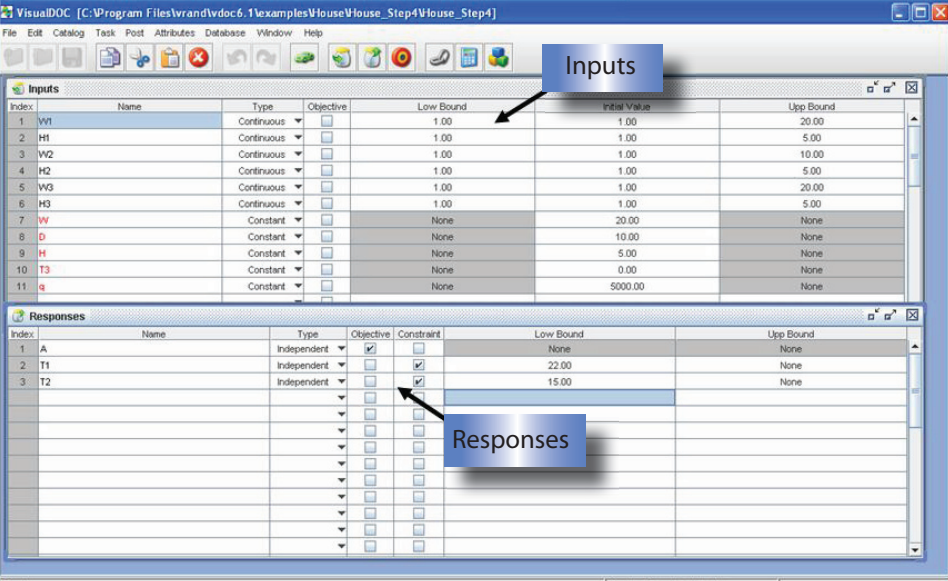
CAPABILITIES

Graphical User Interface

VisualDOC incorporates an intuitive GUI for defining design optimization problems. This helps users to evaluate and post-process design alternatives by using data visualization, reporting, plots, charts, and real-time solution monitoring. VisualDOC also allows users to import experimental data for design exploration.

Analytical equations and small programs can be written within VisualDOC for specific design variables and responses. Discrete, integer, and mixed design problems can be solved easily.

The same look and feel is provided for all supported platforms.



The screenshot shows the VisualDOC software interface with two main tables: 'Inputs' and 'Responses'. The 'Inputs' table lists design variables with their types and bounds. The 'Responses' table lists objective functions and constraints.

Index	Name	Type	Objective	Low Bound	Initial Value	Upp Bound
1	W1	Continuous	<input type="checkbox"/>	1.00	1.00	20.00
2	H1	Continuous	<input type="checkbox"/>	1.00	1.00	5.00
3	W2	Continuous	<input type="checkbox"/>	1.00	1.00	10.00
4	H2	Continuous	<input type="checkbox"/>	1.00	1.00	5.00
5	W3	Continuous	<input type="checkbox"/>	1.00	1.00	20.00
6	H3	Continuous	<input type="checkbox"/>	1.00	1.00	5.00
7	VV	Constant	<input type="checkbox"/>	None	20.00	None
8	D	Constant	<input type="checkbox"/>	None	10.00	None
9	H	Constant	<input type="checkbox"/>	None	5.00	None
10	T3	Constant	<input type="checkbox"/>	None	0.00	None
11	q	Constant	<input type="checkbox"/>	None	5000.00	None

Index	Name	Type	Constraint	Low Bound	Upp Bound
1	A	Independent	<input checked="" type="checkbox"/>	None	None
2	T1	Independent	<input checked="" type="checkbox"/>	22.00	None
3	T2	Independent	<input checked="" type="checkbox"/>	15.00	None

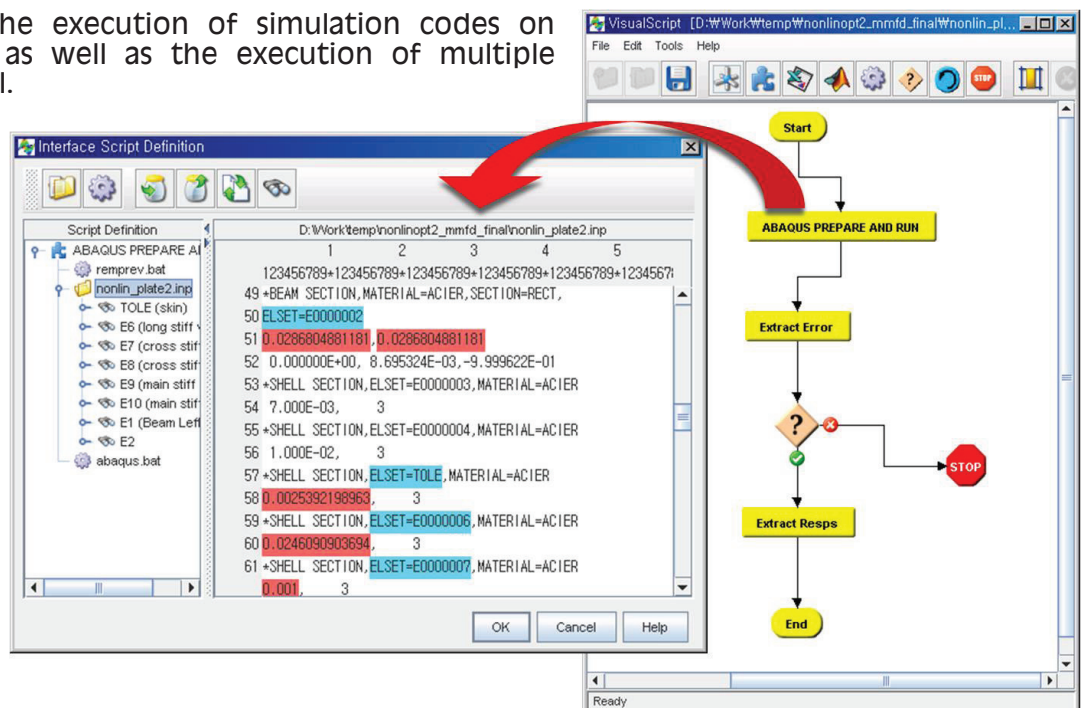
VisualScript

VisualScript is an integration tool that allows users to perform optimization on almost any analysis and simulation code.

This easy-to-use tool allows engineers to compose complex simulation processes. On an intuitive level, VisualScript incorporates loops and "if" statements in the simulation process and easily handles unexpected termination in simulations.

VisualScript has interfaces to MATLAB, Excel, and specialized simulation codes with text input and output.

VisualScript allows the execution of simulation codes on remote computers, as well as the execution of multiple simulations in parallel.



Optimization Methods Available in VisualDOC

Gradient Based Optimization

The Modified Method of Feasible Directions (MMFD) algorithm, developed by Dr. Garret Vanderplaats, is recognized by experts as the most efficient gradient-based optimization algorithm for engineering design problems. VisualDOC also provides the sequential unconstrained optimization algorithm to solve problems in excess of 100,000 design variables and constraints. In addition to these innovative algorithms, standard algorithms like SQP, SLP, BFGS, and FR are also available within VisualDOC.

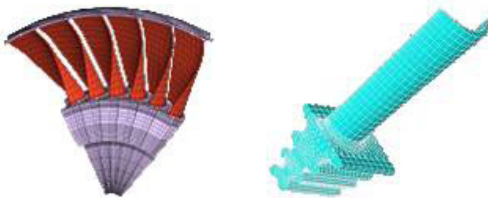
Response Surface Optimization

Response surface optimization in VisualDOC offers the capability to perform design optimization with very few simulations. This method also allows users to integrate previously obtained simulation results and/or experimental results into the design optimization process.

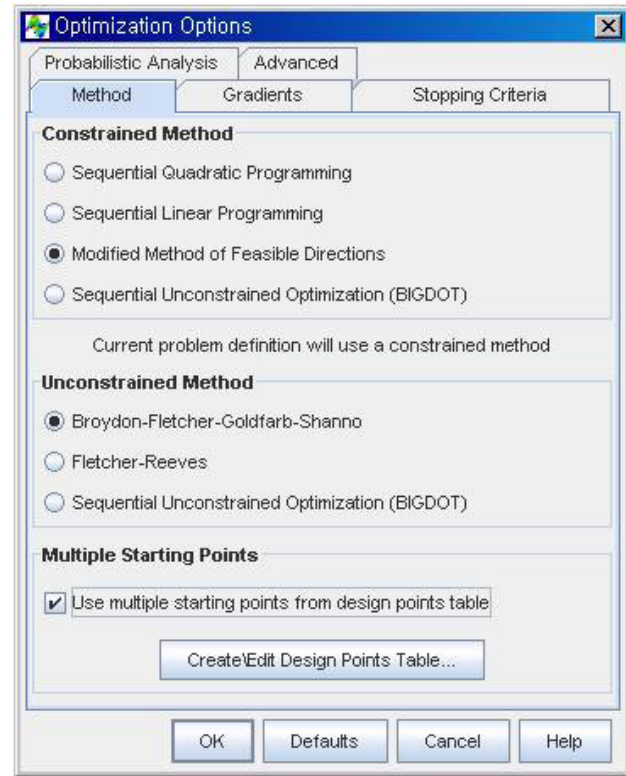
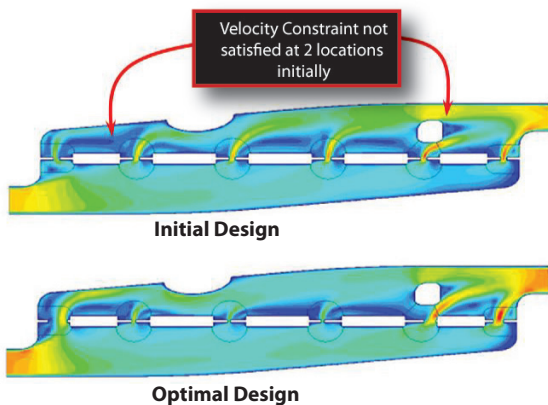
Design of Experiments (DOE)

DOE allows VisualDOC users to explore the design space for a better understanding of problem parameters and their influence. More than 10 different types of DOE are available for users including D-Optimal design and Optimal Latin Hypercube. VisualDOC also allows the user to distribute design points in non-standard design space which is defined by relationships between design variables. Approximations generated in DOE can be used later in other VisualDOC optimization methods.

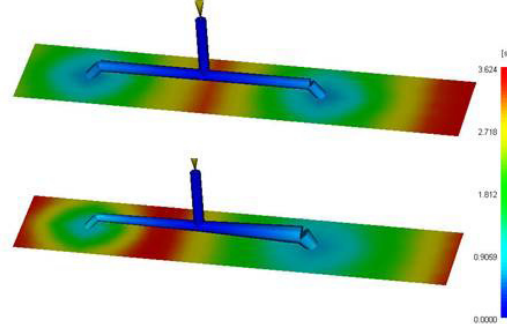
Turbo Machinery - MDO - Fluid & Structural



CFD Optimization



Injection Molding



Non-Gradient Based Optimization

VisualDOC offers two efficient and accurate non-gradient based optimization algorithms:

- Genetic Algorithms (GA)
- Particle Swarm Optimization (PSO)

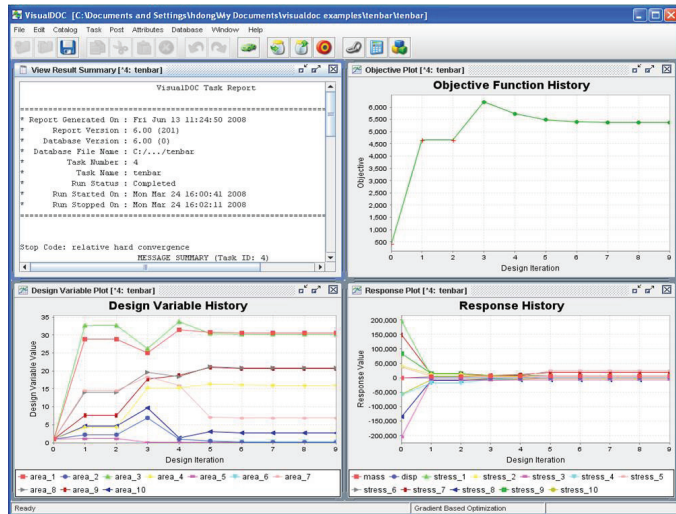
These algorithms have been completely developed by VR&D ensuring robust performance. The default parameters for these algorithms work on a majority of engineering design problems enabling the novice user to implement these algorithms without tuning them. Advanced users have access to all parameters of the GA and PSO allowing them to modify the algorithms as per their problem requirements.

Probabilistic and Robust Optimization

VisualDOC allows users to perform reliability and robust design optimization for problems with probabilistic inputs and responses. Design for Six Sigma and Quality can be achieved using the developed algorithms. Different design variable probability distributions such as Normal, Weibull and Log Normal are available within VisualDOC.

Post-Processing

VisualDOC provides extensive tools for post-processing design optimization results. Reports and plots for design variables, responses and objective functions can be easily generated.



VisualDOC also provides a "What-If" tool to study the sensitivities of optimum responses to deviations in input parameters.



System Capabilities

Remote Run: VisualDOC allows computationally expensive analyses to be run on remote computers to speed up the process of optimization.

Simultaneous Analysis: Users can run multiple independent simulation codes simultaneously on the same or different machines to reduce overall optimization time.

Other VR&D Products Available

GENESIS - Structural Analysis & Optimization software

GENESIS is a fully integrated finite element analysis and design optimization software package. Analyses include static, normal modes, direct and modal frequency analysis, heat transfer and system buckling. Shape, sizing, topography, topometry and topology optimization are the design options available to the user. Typically the optimization requires less than ten detailed finite element analyses, even for large and complex design tasks.

SMS Eigensolver

The SMS eigensolver may be added to existing NASTRAN installations to offer significant performance advantages over the default method when a large number of eigenmodes is required for a system with many degrees of freedom. Benchmark tests and user experiences have seen solutions times anywhere between 2 - 5 times faster when using SMS. SMS may also be embedded into your product/software.

DOT - Design Optimization Tools

DOT is a general purpose numerical optimization software library which can be used to solve a wide variety of nonlinear optimization problems. If you require only an optimization engine to incorporate into your design software, DOT will serve that purpose.

BIGDOT

BIGDOT is intended to solve very large, nonlinear, constrained problems where gradient information is available, and function and gradient evaluation is efficient. BIGDOT is capable of solving continuous, discrete/integer or mixed variable problems. Problems in excess of 100,000 variables have been solved by BIGDOT.

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