



VR&D Winter2010 Newsletter

Index

1. Anniversaries and Awards

- 1.1 VR&D Celebrates 25 Years
- 1.2 Award Winning JSIAM Paper

2. New Distributors

- 2.1 MET Engineering Technology Solutions - *Turkey*
- 2.2 Digital Product Simulation (DPS) - *France*

3. Recent Software Releases

- 3.1 GENESIS v.11
- 3.2 Design Studio for GENESIS v.11
- 3.3 VisualDOC and VisualScript v.6.2

4. GENESIS and Design Studio: *Tips and Tricks*

- 4.1 GENESIS - New Step-by-Step Manual
- 4.2 Design Studio - Resetting User ID Numbers

5. VisualDOC: *Tips and Tricks*

- 5.1 Search Paths in VisualDOC

6. VR&D Consulting Services

- 6.1 Consulting Services Offered
- 6.2 Example – Full Vehicle Topology Optimization

7. Training Classes and Workshops

- 7.1 Training Classes
- 7.2 Workshops
- 7.3 Upcoming Training Classes

1

Anniversaries and Awards

1.1

VR&D Celebrates 25 Years!

Twenty five years ago the founder of our company, Dr. Garret (Gary) Vanderplaats, started a small company he called Engineering Design Optimization (EDO) which eventually became Vanderplaats Research and Development. During the past twenty five years VR&D has been actively developing new technologies and software that is used in the automobile, aerospace and other industries. Among the programs VR&D has developed over the years are: DOT, BIGDOT, GENESIS, VisualDOC, Design Studio and SMS. VR&D has also helped many other companies add optimization to their software offering. On the service side of our business, the company has worked directly with multiple companies to help them produce better, more economical and lighter products.

The Plaque Reads as Follows: In recognition of your exceptional contributions in the area of optimization that have not only influenced our company, software and clients, but have also shaped our industry. Special thanks from all VR&D employees for your leadership, numerous technical and software contributions, and many talents that have allowed the company to produce not only the best products but also to grow engineering and service talent that has affected, and will continue to affect, the optimization field and the industries where optimization is applied for many years to come. From all of the employees at VR&D and our families.

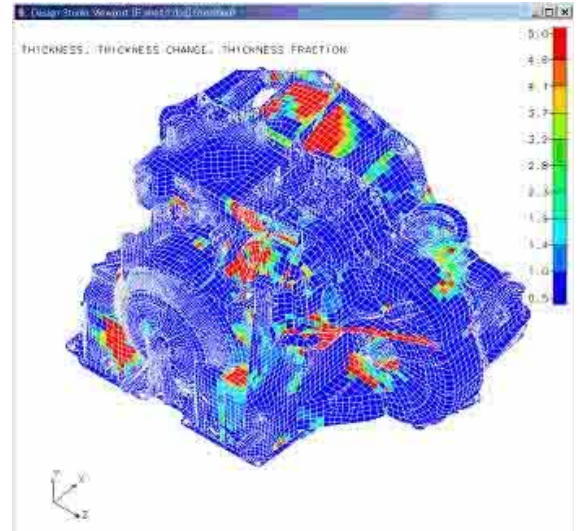


Please join us in congratulating Gary Vanderplaats on this 25 year milestone!

Award Winning JSIAM Paper

We are happy to announce that Dr. Takanori Ide from Aisin AW, co-authored with Mr. Yohei Kitamura from AW-Engineering, and Dr. Iku Kosaka from VR&D recently won the Best Authors Award for their paper, "*Improvement of NV Performance for Automatic Transmission using Large Scale Optimization*," (in Japanese) from the Japan Society for Industrial and Applied Mathematics, Industrial Materials Division.

This paper was published in JSIAM - Vol.18 No.2 June 2008 pp.66-70. If you are interested in reading this paper, the SAE paper 2008-01-0869 has similar content and is written in English. The abstract is as follows, "A design process to improve noise and vibration (NV) performance for automatic transmissions of vehicles is presented. The proposed process uses a newly developed large-scale optimization technique (available in GENESIS) to solve large-scale analysis problems. Additionally, useful and/or necessary techniques including Topometry optimization, beta method, and modal contributions are described and used to solve modal dynamic optimizations. As a demonstrative problem, the process is successfully applied to improve the NV performance of the AISIN AW FWD automatic transmission."



Congratulations Dr. Ide, Mr. Kitamura, and Dr. Kosaka!

New Distributors

MET Engineering Technology Solutions - Turkey



We are pleased to announce that MET CAD/CAM/CAE Engineering Technology Solutions has become a distributor of VR&D software in Turkey.

MET has been supplying design, manufacturing, and engineering solutions to defense, automotive, transportation, energy, and construction companies in Turkey and nearby areas since its founding in 1999.

VR&D welcomes MET to its family of distributors around the world. For more information on MET, please visit their website: <http://www.metbil.com.tr>.

Digital Product Simulation (DPS) - France

We are pleased to announce that Digital Product Simulation (DPS) has become our distributor in France. DPS was founded in 1997 and its employees have extensive experience on integrating analysis and simulation in the design process of industrial products. DPS has competency centers with unique expertise and is staffed with highly skilled engineers that will help VR&D promote and sell optimization products in France.

VR&D welcomes DPS to its family of distributors around the world. For more information on DPS, please visit their website: <http://www.dps-fr.com>.



Recent Software Releases

GENESIS v.11

GENESIS is a fully integrated finite element analysis and design optimization software. It can perform sizing, shape, topology, topography and topometry optimization. We recently released a new version. Below is a list of some of the key new features and enhancements.

- **Freeform Optimization** - This new type of shape optimization capability adds great variability to the design without requiring a lot of user input. The capability allows the user to easily impose fabrication constraints, and control coarseness and variability.
- **New Mesh Smoothing** (algorithms for shape optimization) - The mesh smoothing algorithms have been completely redesigned to be more robust.
- **Anti-distortion Constraints** (for shape optimization) - A new procedure has been put in place that will prevent shape optimization from producing a distorted mesh. When combined with the new freeform optimization and the new mesh smoothing, this procedure makes it very easy to run robust shape optimization of solid element components.
- **Visualization Support for Sizing/Topometry Optimization** - The new SIZING command prints all results of sizing and/or topometry optimization in the OPOST post-processing file. In the past, only the thickness distribution of CQUAD4/CTRIA3 elements was available. Now, spring stiffnesses, rod areas, bar cross section dimensions, etc. can be visualized.
- **Weld Element** - A new connector element (CWELD) can connect shell properties even when the grids are not aligned. Also, by virtue of referencing MAT1 data, this element can also be designed with topology optimization, allowing, for example, determination of the optimum locations for welds.



GENESIS v. 11 continued.....

- **New Mass Matrix Types** - Lumped mass and coupled mass matrix formulations have been added to the 10-node CTETRA, 9-21 node CHEXA and the CTRIAX6 elements. Tests have shown that the new default coupled mass matrix produces more accurate eigenvalues.
- **Relative Constraint Bounds** - New data entries (DCONS2 and TCONS2) use bound values that are scale factors of initial response values.
- **New User Supplied Equations for Topology** - A new data entry (TRESP2) allows creation of synthetic responses for topology by writing equations.
- **New User Supplied Subroutines for Topology** - A new data entry (TRESP3) allows creation of synthetic responses for topology by using built-in functions or external subroutines loaded from a dynamic link library.
- **New Design Variable Definition for Topology** - A new data entry (TVAR) adds extra design variables to the topology problem.

Release Date: November 2009

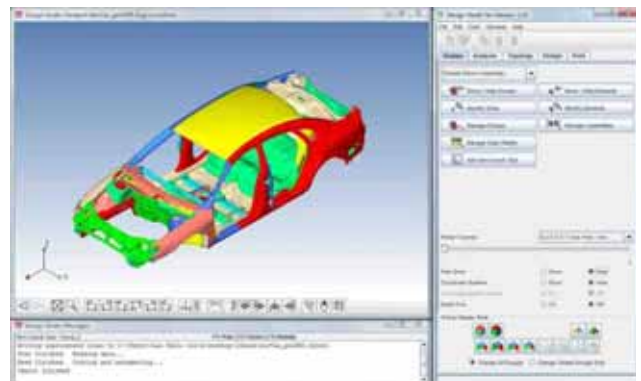
3.2

Design Studio for GENESIS v.11

Design Studio for GENESIS is a design oriented pre- and post-processor graphical interface for the GENESIS Structural Analysis and Optimization Software.

Partial list of Design Studio improvements in 11.0:

- Interface to all new features of GENESIS 11.0
- New user interface configuration to reduce mouse travel
- New mouse-button view control options
- Enhanced domain list find filter
- Model cutaway view
- Improved flat shaded viewstyle
- Create and edit frequency response data
- Create mirror copies of elements or domains
- Bias factors for nonuniform mesh generation
- Option to automatically create new domain group when creating domains
- Generate perturbations normal to surfaces or edges
- Show topology region on top of isosurface display
- Animate sequences of isosurface plots
- Color displacements by the component normal to the surface
- Displacement component coloring now uses the general coordinate system
- Option to query element results by group
- Option to import newly created post-processing files after running GENESIS
- Improved 64-bit version to allow very large post-processing result sets
- Option to adjust y-axis range on design history plots



A new Design Studio examples manual provides step-by-step instructions and includes over 100 examples.

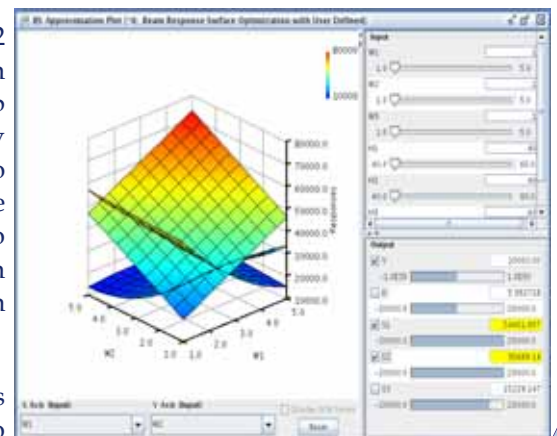
Release Date: November 2009

VisualDOC and VisualScript v.6.2

VisualDOC is a general-purpose optimization tool that allows the user to quickly add design optimization capabilities to almost any analysis program. All optimization settings and integration with analyses are completed through the graphical interface, so in general it is not necessary to do any programming. Visual Script is a companion program to VisualDOC used for process integration.

New Features and Enhancements include:

- **A New Multi-Objective Evolutionary Algorithm (MOEA)** - This new MOEA, referred to as Non-dominated Sorting Genetic Algorithm (NSGA-II) in the literature, is added to the list of available optimization algorithms. NSGA-II is one of the most widely used genetic algorithms for multi-objective optimization. With NSGA-II, the user does not need to convert the multi-objective optimization problem to a single objective problem. NSGA-II gives the Pareto-optimal set in a single simulation of the algorithm. This algorithm can work with continuous, discrete, and integer variable representation.
- **Pareto Front Generation for Multi-objective Problems using a Single-objective Optimization Algorithm** - In VisualDOC 6.2, the user can easily generate a Pareto front with any optimization method such as gradient-based method, RSA, PSO etc. VisualDOC performs a systematic scalarization using methods such as weighted-sum, ϵ -constraint, or compromise programming to convert the multi-objective problem into a single-objective problem. The user can control the number of points desired as well as the intended distribution by setting up suitable scalarization parameters via the combinatorial variables.
- **2D and 3D Scatter Plot** - VisualDOC 6.2 includes scatter plot capability in two and three dimensions for an optimization task. The user can rotate/zoom using the mouse and also annotate the plots as desired. The user can also export the plotted data in tabular form to a text editor or save it as an image file (in png format).
- **Parallel Coordinates Plot** - For higher dimensional data analysis and visualization, the user has the option to plot a parallel coordinates chart. The user can annotate the chart as desired. This chart allows the user to select/highlight the desired solution(s) using single click or click-and-drag to select a region. The user can also perform Boolean (union/intersection/difference) operations on the selected data sets to identify/study the solution(s) with desired properties.
- **3D Approximation Viewer for DOE Approximation and RSA Optimization** - The new 3D Approximation Viewer in VisualDOC 6.2 is a powerful tool that allows the user to visualize the response surface approximation from DOE and RSA optimization. It is very flexible and provides many features for intuitive and comprehensive exploration of the design space. Any number of responses can be visualized simultaneously. The user can also modify the plots interactively using different slider bars which adjust the value of the design variables in real time. The approximation can also be directly compared with the actual simulation data for error analysis and visualization.
- **Improved Performance on Multi-core/Processor Systems** - VisualDOC 6.2 is optimized for parallel computation and its performance on multi-core/processor systems is improved. Both, the parallel job scheduling and file I/O are modified to improve the performance of VisualDOC 6.2.
- **New Backup Strategy and Advanced Options** - VisualDOC 6.2 provides the user the option to selectively include/exclude certain folders and files during the copy/backup operation. The backed-up folders and files are organized in a more structured way especially for parallel/remote simulations which allow the user to conveniently revisit all the designs evaluated during the optimization process. The user can also specify the folders/files to backup that are generated by external analysis software. This option is useful if the user wants to analyze/reuse intermediate design points for computationally intensive simulations.
- **Enhanced Examples and Documentation** - VisualDOC 6.2 includes several new examples that demonstrate its new features. It also includes new examples that demonstrate how to interface VisualDOC with third party software such as LS-DYNA and PAM-CRASH.



Release Date: September 2009

GENESIS - New Step-by-Step Manual

If you have installed GENESIS v11.0, take advantage of the new step-by-step manual provided. This manual has over 100 examples that show how to perform different types of optimization.

Some of the chapters included in the manual are as follows:

- Sizing Optimization Examples
- Shape Optimization Examples
- Topology Optimization Examples
- Topometry Optimization Examples
- Topography Optimization Examples
- Freeform Optimization Examples
- Composite Optimization Examples
- Frequency Response Optimization Examples
- Test-FE Correlation Using Design Optimization
- User Supplied Responses

Design Studio - Resetting User ID Numbers

Almost all data entities in a GENESIS input file are identified by an integer ID number that must be unique with respect to other items in its category. When creating data in Design Studio, unique ID numbers are automatically generated. While most categories also allow you to give names to items, in many post-processing files, the items are identified only with the ID number. It can therefore be useful to assign a memorable ID number to a particular item. Design Studio 11.0 provides this capability for certain categories through the Reset ID Trail. The Reset ID trail is an alternative to the normal Modify item trail. It is started by holding the Shift key down while selecting the Modify item Edit Menu item or while clicking the Modify item edit toolbar button. When the Reset ID trail is Finished, all selected items will be renumbered sequentially, starting with the given Starting ID. If the given Starting ID is invalid, 1 will be used instead. If a selected item is renumbered to the same ID that another item is already using, that other item will also be renumbered to a new unique ID. The Reset ID trail is available for Grids, Elements, Group Properties, Loadcases and Design Variables.

VisualDOC: Tips and Tricks

Search Paths in VisualDOC

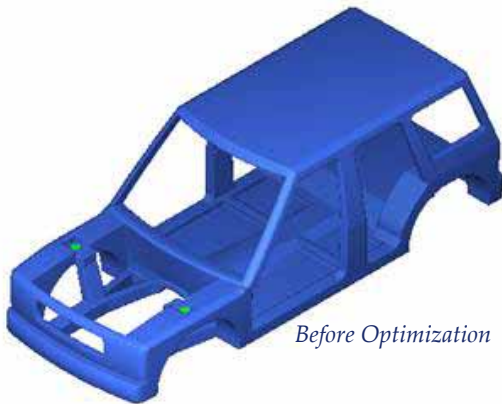
To locate an analysis program (if the complete path is not specified), VisualDOC searches the current working directory and the directory paths specified by the system **PATH** variable. If the executable is not in the current working directory and you do not wish to specify the complete path to the executable (for portability reasons) and also do not wish to modify the system **PATH** variable, then you can prepend additional search paths in VisualDOC.

To prepend additional search paths, go to the File menu and select the Path Browser option. You can now use the Path Browser dialog to add/remove/edit additional search paths. The additional search path option is useful when the analysis module (e.g. some CAE analysis software) is installed at different locations on different machines. The additional search paths are not stored with the VisualDOC model (but with the VisualDOC software so they are system specific).

6.1

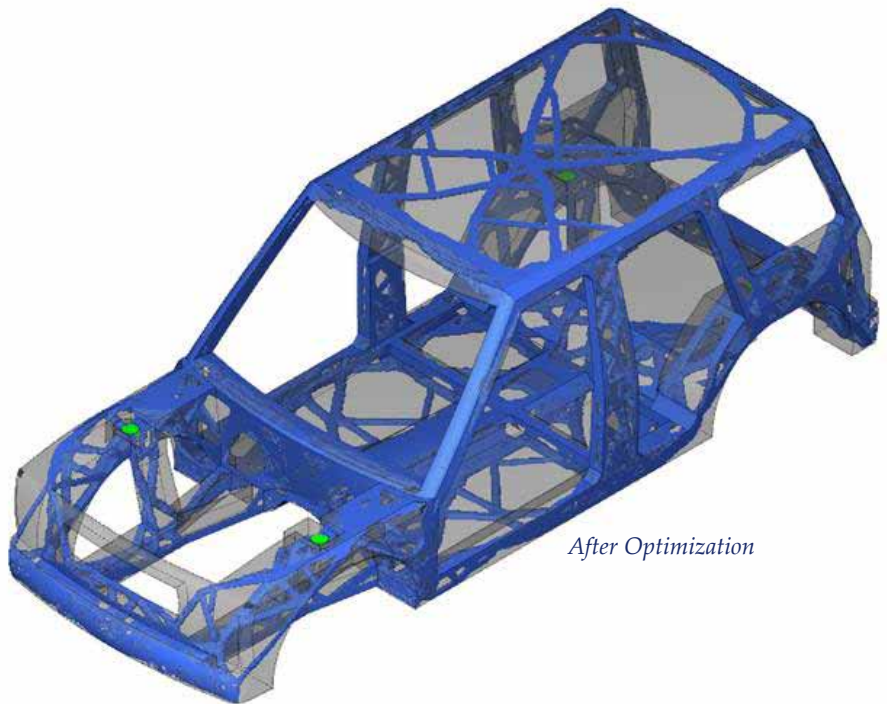
Consulting Services Offered

VR&D can provide the technology and manpower for project specific design optimization tasks. We are expert at applied design optimization using topology, topometry, topography, shape, and sizing techniques. If your company is interested in discussing how VR&D engineering services can help with your project, please contact one of our offices.



Before Optimization

For a video demonstration of this project click [here](#).



After Optimization

6.2

Full Vehicle Topology Optimization on BIW FEM Design Volume Subjected to Ten Load Cases

For example: GENESIS Topology optimization is used to find the optimal distribution of a specified amount of material in a given space based on all applied loading conditions. Material will be removed from the topology region in such a way that the remaining elements provide the stiffest structure possible for a specified total mass. The topology results will provide a conceptual design that emphasizes efficient load paths. When taken into account during further design refinements these results will help determine the most lightweight and stiffest body design for the applied loading conditions.

7.1

Training Classes

In 2007, VR&D opened a new training room in our Novi office. The training room has multiple computers that allow us to offer hands-on classes and training to engineers who want to learn optimization. We now offer several new classes, among them:

- **Advanced Topology Optimization** - This training is intended to provide a comprehensive understanding of topology optimization concepts. Students will work with several hands-on exercises and learn how to interpret and use topology optimization results. During the class, students will be exposed to industrial applications and examples.
- **Advanced Sizing and Topometry Optimization** - This course covers in detail the techniques involved in sizing and topometry optimization. Several hands-on exercises are solved by the students. This course also goes through how to interpret and use topometry optimization results.
- **Advanced VisualDOC integration** - This course goes in depth to cover the details of integrating VisualDOC with different types of analysis programs. Each of the ways of integrating VisualDOC with analyses are covered. Students will understand the different integration methods, the benefits, and even how to embed VisualDOC in their analysis using the VisualDOC API.
- **Design of Experiments (DOE)** - This short course is intended to introduce students to techniques for Design of Experiments (DOE). DOE techniques are useful for planning studies in which inputs to a system/process can be varied and the outputs are observed. This course begins with DOE fundamentals and moves to advanced concepts, principles and requirements. Different techniques are explored for determining which inputs have statistically significant effect on outputs. This includes analysis of variance, full and fractional factorial experiments, etc.

We will continue offering on-site classes and custom-made classes. Check our website for information on all our classes and schedules: <http://www.vrand.com/Training.html>. You can also email us for more details at: training@vrand.com or call (248) 596-1611 x101.



Workshops

If you do not have time for our training classes we offer one-day workshops. These workshops are intended to give attendees a brief overview about the software capabilities and features. Please contact us for more information or watch for our announcements to be sent to your e-mail address. Currently we offer two workshops:

- **Structural Optimization (GENESIS and Design Studio)** - This workshop is designed to demonstrate the ease of running optimization using Design Studio and GENESIS. The workshop covers topology, sizing, shape, topography, topometry and freeform optimization problems. Hands-on exercises will be solved by the attendees.
- **General Optimization (VisualDOC)** - This workshop is designed to highlight how VisualDOC can be used to add design optimization capabilities to an existing analysis. Attendees will get an overview of the features present in the software and learn several analysis integration techniques. Attendees will have the chance to solve example problems to gain better understanding of the software.

For more information on VR&D's workshops, download the course information sheets here:

[Structural Optimization](#)

[General Optimization](#)

Upcoming Training Classes

VisualDOC Training, February 22-23, 2010 – Novi, MI

This course introduces students to the concept of optimization and its practical applications. Students will learn the basic ideas behind various optimization procedures as well as practice using these procedures on example problems. Students will learn how to couple optimization with any analysis/simulation program. Students will become familiar with Response Surface optimization, Multidisciplinary Design optimization (MDO), optimization with uncertainty, Six Sigma design, Global Optimization, Design of Experiments and other procedures. The class is highly interactive and students can optionally bring their own problems. *Cost is \$300.00 per day.* To download the course information sheet click [here](#).

GENESIS Training, February 24-26, 2010 – Novi, MI

The focus of the course is on structural optimization. Students will learn optimization concepts and will work over a dozen hands-on exercises for shape, sizing, topology, topography, topometry and freeform optimization. Students will learn how to interpret and use the optimization results. The first two days of the course will introduce students to GENESIS and Design Studio. The third day of the course goes through some advanced features available in GENESIS which include frequency response optimization, optimization of composites, etc. During the class, students will be exposed to industrial applications and examples. The class is highly interactive and students can optionally bring their own problems. *Cost is \$300.00 per day.* To download the course information sheet click [here](#).

..... Contacting VR&D



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