GENESIS

Structural Analysis and Optimization

New Features and Enhancements

Version 10.1

December 2008

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1 Introduction

This document describes the new and enhanced features added to Genesis in version 10.1.

Support for the Equivalent Static Load Method. This version of Genesis includes a new feature aimed at supporting the Equivalent Static Load method for optimization with nonlinear analysis. Displacements produced by other codes can be read into the program and the program will automatically calculate equivalent static loads that produce the same displacements. To use this functionality you need to obtain a special reader for the code of interest. Please contact VR&D for more information on how to obtain readers.

More efficient modal frequency response calculations. Genesis now avoids unnecessary calculations, resulting in reduced runtime and disk space requirements.

Faster solvers. All solvers are now faster on Linux systems with Intel Pentium4/Core2/Xeon processors. Up to a 40% speed increase has been observed in some problems.

More efficient handling of rigid element and MPC constraints.

Updated formulation for RBE3 element.

Random response optimization for all types of optimization. Root mean square displacement, velocities and acceleration can be used as objective or as constraints.

A new fabrication constraint for topography optimization. This new fabrication constrain (BEADFR) usually results in clearer bead patterns and less variability in the results.

Design variable selection. A new data entry (DSELECT) asks the optimizer to select the best set of design variables to move to their upper bound and the rest to their lower bound. This new capability allows easy formulation of optimization problems such as selecting the best locations of welds or selecting among candidate designs.

Enhanced minimum member size fabrication constraints. Topology optimization now accepts minimum member size without the need to specify any other fabrication constraints. Minimum member side can still be mixed with all appropriate existing fabrication constraints.

Performance improvements for topology. Several opportunities to eliminate I/O were identified in topology optimization. Many problems will run faster due to reduced disk access

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2 Analysis Enhancements

1. More efficient modal frequency response calculations. Previously, Genesis recovered the entire dynamic displacement vector for all loading frequencies. However, for many problems, the user is only interested in the dynamic displacement/velocity/acceleration at a very small number of grids. Now Genesis will recover the dynamic displacements only for grids required by output requests or response data. This change can dramatically reduce disk space requirements as well as run time for many modal frequency response problems.

2. Faster solvers. All solvers are now faster on Linux systems with Intel Pentium4/Core2/Xeon processors. Up to 40% speed increase has been observed in some problems.

3. More efficient handling of rigid element and MPC constraints. Now if there are no shape optimization variables that change rigid element grids, then the constraint equations are processed only once and the results saved for use in later cycles.

4. Updated formulation for RBE3 elements. Now weights on rotation dofs are scaled by the square of the average distance of the Gi grids to the REFGRID. Note that this may change the results if nonzero weights on rotation dofs are present (but the results should more closely match other codes). DIAG=791 will revert to the old (v10.0 and lower) behavior.

   Bulk Data Statement - RBE3

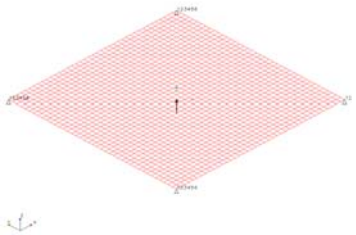
5. Updated SMS version. The latest version of SMS includes key robustness improvements.

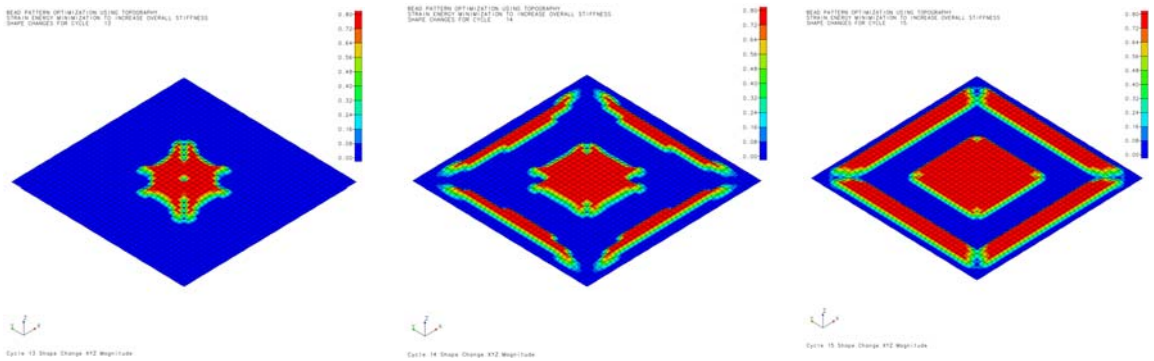
   Bulk Data Statement - EIGR, SMS option

3 Shape, Sizing, Topometry and Topography Optimization Enhancements

1. A new fabrication constraint is now available for topography optimization. The BEADFR option limits a fraction of grids allowed to move in the final result. This option usually results in clearer bead patterns and less variability in the results.

   Bulk Data Statement - DTGRID (BEADFR optional continuation line)





2. Random response optimization. Now certain responses can be selected in DRESP1 to be uses as objective or constraints.

   Bulk Data Statement - DRESP1 (RMSDISP, RMSVELO & RMSACCE)

3. New DSELECT data statement. This entry asks the optimizer to select an optimal subset from a list of design variables. The selected variables are moved to their upper bounds, while the remaining variables are moved to their lower bounds. One application is to simplify formulating problems that need to select among candidate designs. This entry can also help to get less variability in the results.

   Bulk Data Statement - DSELECT

4. Now built-in response were added to DRESP3.

   Bulk Data Statement DRESP3 (SAVG1, SAVG2, SAVG3, SAVG4, ASAVG1, ASAVG2,ASAVG3 & ASAVG4,)

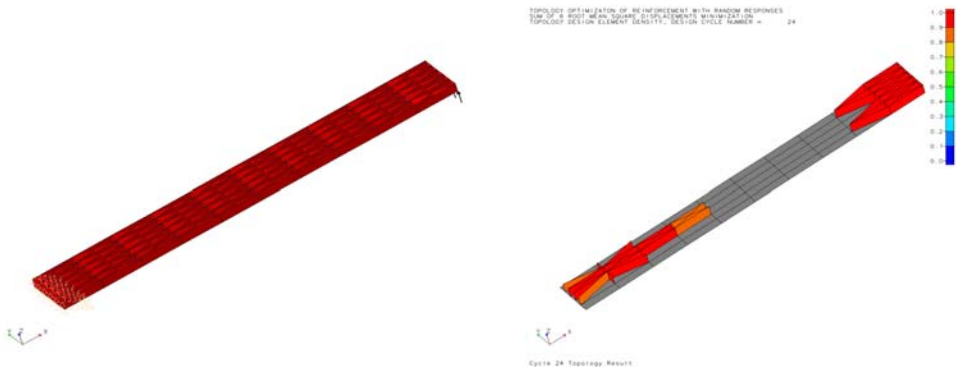
4 Topology Optimization Enhancements

1. Enhanced minimum member size fabrication constraints. Topology optimization now accepts minimum member size without the need to specify any other fabrication constraints. Minimum member side can still be mixed with all appropriate existing fabrication constraints.

   Bulk Data Statement - TSYM1, TSYM2, TSYM3.

2. Random response optimization. Now certain responses can be selected in TRESP1 to be uses as objective or constraints.

   Bulk Data Statement - TRESP1 (RMSDISP, RMSVELO & RMSACCE).



3. Performance improvements for topology. Several opportunities to eliminate I/O were identified in topology optimization. Many problems will run faster due to reduced disk access

5 Overall Enhancements

1. The existence of the restart file “*.RST” file is now checked in an earlier stage. This change prevents wasting run time doing an analysis only to discover that optimization cannot be restarted due to a missing file.

2. Include file names now can be up to 256 characters long. Additionally, long file names can now be broken across several lines in the input data.

6 Output Enhancements

1. Comments from the input data are now collected into a “*.comments” file. This file is automatically included in all “*UPDATExx.dat” files written by Genesis. This is intended to transfer any pre/post-processor meta-comments into the updated input file.

7 New Input Data

7.1 Executive Control

ESLDISP	Specifies an external “Equivalent Static Load” reader shared object/DLL and associates it to an id number.
ESLCONF	Defines data to configure an “Equivalent Static Load” reader.

7.2 Solution Control

ESLOAD	Equivalent Static Load selection.

7.3 Bulk Data

DSELECT	Select fraction of listed design variable to move to their upper bound. The rest of the listed variable in DSELECT will be moved to their lower bound.

7.4 New Design Parameters

RPERT1	Controls the relative value of the cut off perturbation. This value allows to ignore perturbations (used in shape optimization) with relative small values. If RPERT1 = 0.0, the program will ignore this cut off.
RPERT2	Controls the absolute value of the cut off perturbation. This value allows to ignore perturbations (used in shape optimization) with small values. If RPERT2 = 0.0, the program will ignore this cut off.

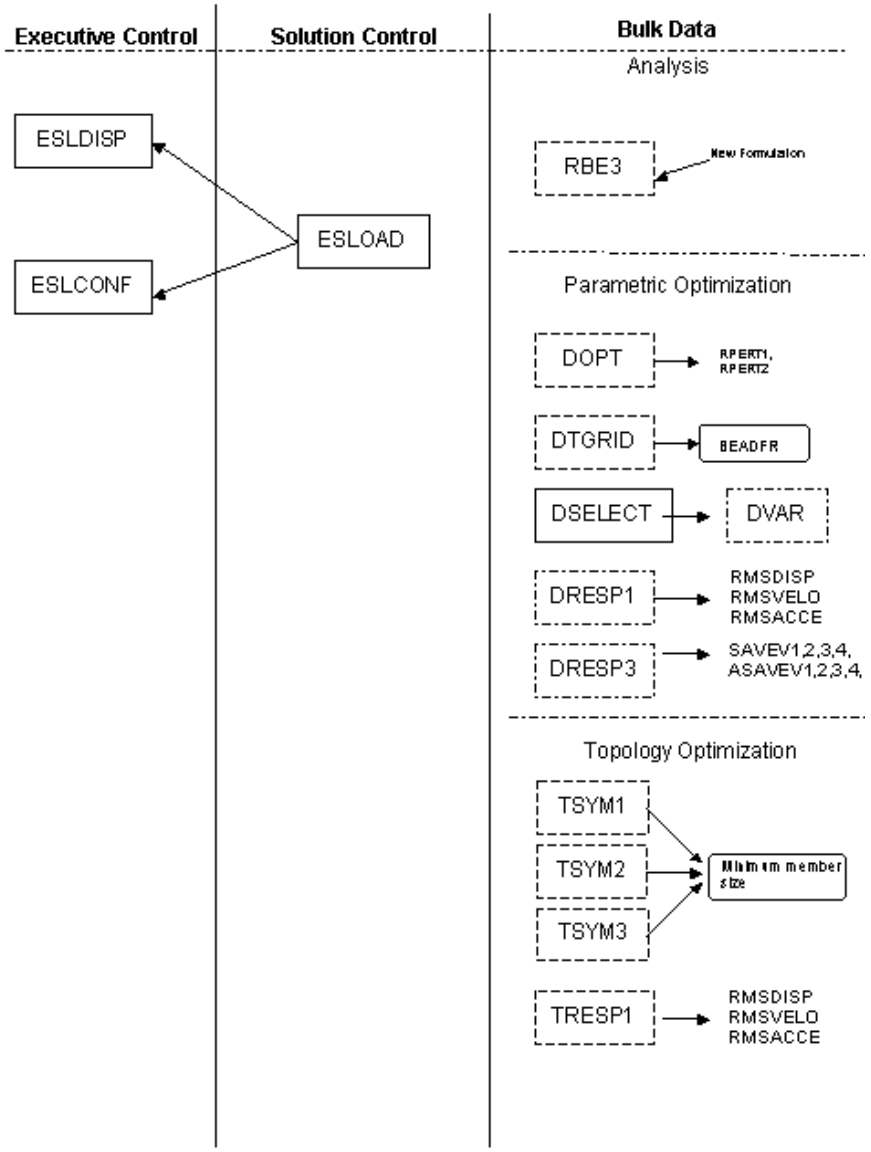
8 Enhanced Data

8.1 Bulk Data

DOPT	Calculation associated to RCOMPAPP are now more precise. RCOMPAPP was introduced in 10.0 to speed up optimization problems with composite forces and/or FINDEX constraints.
DTGRID	Now accepts following data type: BEADFR.
DRESP1	Now accepts following data types: RMSDISP, RMSVELO and RMSACCE
DRESP3	Now accepts following data types: SAVG1, SAVG2, SAVG3, SAVG4, ASAVG1, ASAVG2, ASAVG3 and ASAVG4.
TRESP1	Now accepts following data types: RMSDISP, RMSVELO and RMSACCE
TSYM1	Now accept minimum member size with or without the use of any fabrication constraints
TSYM2	Now accept minimum member size with or without the use of any fabrication constraints
TSYM3	Now accept minimum member size with or without the use of any fabrication constraints

9 New and Enhanced Data Relationships

The following figure shows the relationships of the new Genesis data enties.



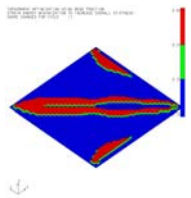
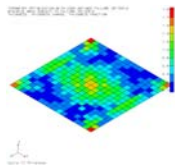
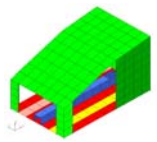
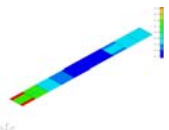
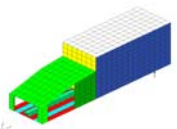
10 GENESIS Manual Updates

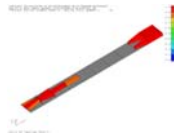
All GENESIS manuals have been updated to reflect the new features, as well as the new and modified data entries.

Manual Title	Filename	Status
GENESIS: Analysis Manual	volume1.pdf	Updated to reflect all improved and new features
GENESIS: Design Manual	volume2.pdf	Updated to reflect all improved and new features
GENESIS: Analysis Examples	volume3.pdf	Updated. One new examples was added
GENESIS: Design Examples	volume4.pdf	Updated. Six new examples were added
GENESIS: Quick Reference Manual	quickref.pdf	Updated to reflect all changes and new data entries
GENESIS: New Features and Enhancements	newfeat.pdf	This document

11 New Example Problems

The following table describes new examples and their corresponding input file names. The listed files are provided with the installation

Name	Problem	Special Features	Figure
A038.dat	Random Response of a Cantilevered Plate	Use of Random response analysis	
D075.dat	Topography Optimization Using BEADFR and Mirror Symmetry Constraints	Use of bead fraction (BEADFR) option to control the grids movements. BEADFR allows to get more clear beads.	
D076.dat	Design Using User-Defined Composite Failure Equations	Use of the FINDEX equations	
D077.dat	Spot Weld Location Optimization Using Topometry and DSELECT	DSELECT data entry is used to automatically create constraints that enforce the selection of a certain number of elements from a pool of candidates.	
D078.dat	Topometry Optimization of a Plate with Random Responses.	Use of Random root mean square velocities (RMSVELO) with DCONS.	
D079.dat	Sizing Optimization of a Truck with Random Responses.	Use of Random root mean square velocities (RMSVELO) with DCONS.	

T022.dat	Topology Optimization of Reinforcement with Random Responses	Use of Random root mean square displacements (RMSDISP) with TINDEX.	

12 Changes in Version 10.1 with Respect to Version 10.0

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Problems that contain RBE3 might show some numerical differences if nonzero weights on rotation dofs are present (but the results should more closely match other codes). DIAG=791 will revert to the old (v10.0 and lower) behavior.