GENESIS

Structural Analysis and Optimization

New Features and Enhancements

Version 12.2

September 2012

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1 Introduction

This document describes the new and enhanced features added to Genesis in version 12.2. Key enhancements include the following:

New Surface Definitions: Surfaces composed of faces of solid elements and/or shell and composite elements can be defined. New bulk data entries BSURFE, BSURFM and BSURFP have been added.

New Glue Connection: A glue connection enforces compatible displacements between two surfaces. This is most useful to connect components modeled with non-conforming meshes. The new bulk data entry CGLUE has been added.

New Shifted Response Types: Shifted responses allow easy creation of constraints which have bounds that are frequency dependent. Shifted responses are now available for all element dynamic responses. This includes stresses, strains and forces.

New Skin Elements: Nonstructural skin elements can be created to simplify using topography with solid element meshes. Skin elements do not have stiffness, mass or any physical property, and therefore do not affect any analysis results. By adding topography to a skin property, it becomes easy to design the surface of a solid element mesh. Skin elements are created using the existing CQUAD4, CTRIA3, CQUAD8 and CTRIA6 entries referencing the new PSKIN property entry.

New Synthetic Response Capablility: Now synthetic responses (DRESP2, DRESP3, TRESP2 and TRESP3) can be created that take as input the values calculated by other synthetic responses.

Analysis Improvements: The midside stress of the 10-node CTETRA element has been improved for cases when the element is distorted. Solid elements can now be used with cylindrical or spherical coordinate systems to define material directions. The sparse matrix solver has been enhanced to handle the huge frontal matrices that can occur with very fine solid element meshes.

Performance Improvements: Domain and freeform preprocessing have been updated to run faster and require far less memory. The SMS eigensolver has received several enhancements to further improve performance. The sensitivity module has been parallelized. Sizing sensitivity has been enhanced to handle topometry more efficiently. The frequency response analysis module has updated to reduce I/O in many cases.

2 Analysis Enhancements

1. Surfaces. Surfaces composed of faces of solid elements and/or shell and composite elements can be defined. Surfaces can be used together with the new Glue Connection to bond non-conforming meshes in a compatible way.

   Bulk Data Statements - BSURFE, BSURFM, BSURFP

2. Glue Connection. A glue connection enforces compatible displacements between two surfaces. This is most useful to connect components modeled with non-conforming meshes.

   Bulk Data Statement - CGLUE

3. SMS Eigensolver Performance. Several changes to the SMS eigensolver result in improved performance.

   Bulk Data Statements - EIGR, EIGRL

4. Solid Material Coordinate System. Solid elements can now be used with cylindrical or spherical coordinate systems to define material directions. This could be useful, for example, to orient anisotropic material properties in a cylindrical structure. To properly model this case in previous versions required constructing a correctly oriented rectangular coordinate system for every element.

   Bulk Data Statement - PSOLID

5. CTETRA Midside Stress. The midside stress of the 10-node tetrahedral element has been improved for cases when the element is distorted.

   Solution Control Commands - GSTRESS
   Bulk Data Statement - CTETRA

6. Huge Frontal Matrices. The sparse matrix solver has been updated to allow for 64-bit addressing into the frontal matrices. This allows Genesis to solve models with very fine solid element meshes that lead to potentially huge frontal matrices.

   Bulk Data Statement - PARAM,SOLVER,1

7. Frequency Response Performance. The frequency response module has been updated to reduce I/O requirements for many common cases. Reduced I/O will result in a faster run time for typical problems.

   Solution Control Commands - FREQ, DLOAD

3 Shape, Sizing, Topometry and Topography Optimization Enhancements

1. Chained Synthetic Responses. Now synthetic responses (DRESP2 and DRESP3) can be created that take as input the values calculated by other synthetic responses.

   Bulk Data Statements - DRESP2, DRESP3

2. Easy Solid Mesh Topography. Nonstructural skin elements can be created to simplify using topography with solid element meshes. Skin elements do not have stiffness, mass or any physical property, and therefore do not affect any analysis results. By adding topography to a skin property, it becomes easy to design the surface of a solid element mesh. Skin elements are created using the existing CQUAD4, CTRIA3, CQUAD8 and CTRIA6 entries referencing the new PSKIN property entry. Using PSKIN instead of thin PSHELL elements has a side benefit of potentially improving analysis time by not adding rotation degrees of freedom to the surface grids of the solid mesh.

   Bulk Data Statements - PSKIN, DTGRID

3. Shifted Element Responses. Shifted responses allow easy creation of constraints which have bounds that are frequency dependent. Shifted responses of element dynamic stresses, strains and forces are now available to be used as objectives or constraints. The new response types for DRESP1 are: DSTRS, DSTNS and DFORCES.

   Bulk Data Statements - DSHIFT, DRESP1

4. Preprocessing Performance. Domain and freeform preprocessing have been updated to run faster and require far less memory.

   Bulk Data Statements - DOMAIN, DSHAPE.

5. Sensitivity Performance. The sensitivity module has been parallelized. When multiple threads are selected with the executive control command THREADS, the sensitivity module will now also run faster. In addition, changes to the sensitivity module have greatly improved efficiency for the case when there are many sizing design variables (i.e., topometry).

   Executive Control Commands - THREADS

   Bulk Data Statements - DSPLIT

4 Topology Optimization Enhancements

1. Chained Synthetic Responses. Now synthetic responses (TRESP2 and TRESP3) can be created that take as input the values calculated by other synthetic responses.

   Bulk Data Statements - TRESP2, TRESP3

5 Output Enhancements

1. Unlimited Loadcase Labels. Previously, Genesis would only read labels for the first 20 loadcases. Now all loadcase labels are read and stored, improving the identification of results in output and post-processing files.

   Solution Control Command- LABEL

6 New Input Data

6.1 Bulk Data

BSURFE	Create a surface from listed element faces.
BSURFM	Create a surface from listed materials.
BSURFP	Create a surface from listed properties.
CGLUE	Create a glue connection between two surfaces.
PSKIN	Creates a skin property for use with topography.

7 Enhanced Input Data

7.1 Solution Control

LABEL	All loadcase labels are now read in.

7.2 Bulk Data

PSOLID	CORDM field can now reference any defined coordinate system.
DRESP1	Can now accept new shifted responses (DSTRS, DSTNS and DFORCES).
DRESP2	Can now use “DRESP2” continuation keyword to list arguments calculated by other DRESP2 or DRESP3 entries
DRESP3	Can now use “DRESP2” continuation keyword to list arguments calculated by other DRESP2 or DRESP3 entries
TRESP2	Can now use “TRESP2” continuation keyword to list arguments calculated by other TRESP2 or TRESP3 entries
TRESP3	Can now use “TRESP2” continuation keyword to list arguments calculated by other TRESP2 or TRESP3 entries
DTGRID	Can now reference PSKIN properties

7.3 DRESP1- RTYPE Enhancements

DSTRS	Selects shifted dynamic element stress.
DSTNS	Selects shifted dynamic element strain.
DFORCES	Selects shifted dynamic element force.

8 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. Two new examples was added
GENESIS: Design Examples	volume4.pdf	Updated.
GENESIS: Quick Reference Manual	quickref.pdf	Updated to reflect all changes and new data entries
GENESIS: New Features and Enhancements	newfeat.pdf	This document

9 Changes in Version 12.2 with Respect to Version 12.1

Genesis 12.2 should run any problem that was successfully running in version 12.1 with no changes.