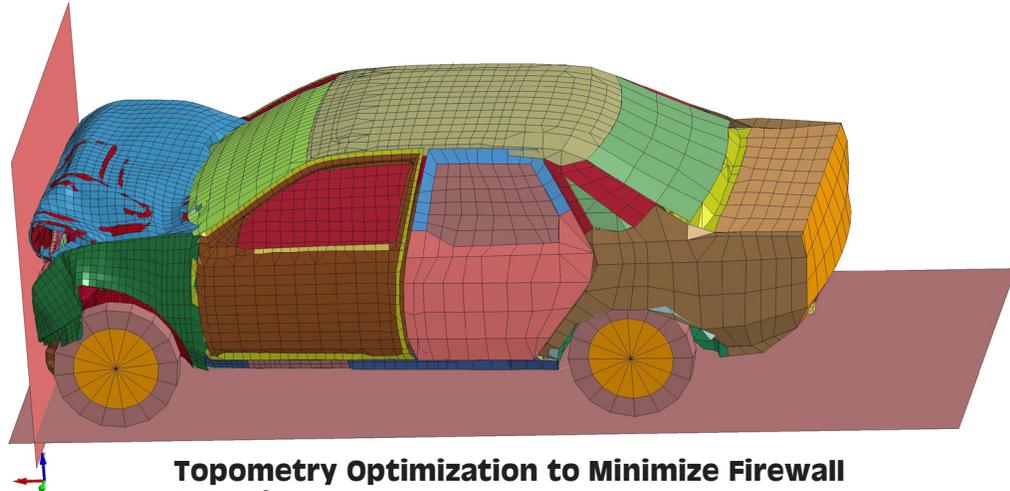# ESLDYNA

Optimization Software that Couples GENESIS to
*LS-DYNA Nonlinear Structural Analyses*

ESLDYNA is based on the Equivalent Static Loads (ESL) method to perform optimization based on a nonlinear finite element analysis with GENESIS as the structural optimization program. ESLDYNA takes advantage of the capability of GENESIS, a linear structural optimization program, to solve large scale optimization problems based on the responses from a nonlinear finite element analysis. It also helps to significantly reduce the design time by identifying high performance designs with five to ten nonlinear analyses.

Vanderplaats Research & Development, Inc. (VR&D) provides ESLDYNA which uses LS-DYNA, a product of the Livermore Software Technology Corporation, for the nonlinear analysis. Most of the different types of design optimization techniques in GENESIS are available to the user for designing the nonlinear model. Multiple loading conditions in the nonlinear analysis, using several LS-DYNA input files, can be analyzed simultaneously to achieve optimal solutions. The available plug-in to Design Studio, a design pre- and post-processor, provides an easy to use interface with seamless integration between GENESIS and LS-DYNA.
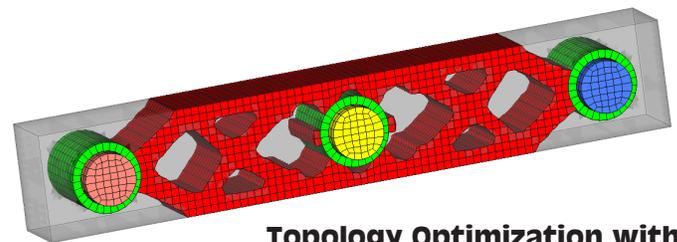
**Topometry Optimization to Minimize Firewall Intrusion**
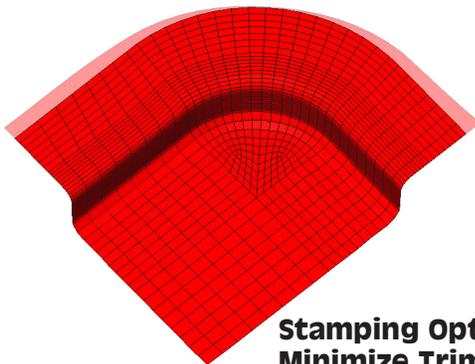
Stamping Optimization to Minimize Trimming Waste

**Topology Optimization with Fabrication Constraints**

Highlights

- ESLDYNA Optimization can handle a very large number of design variables
- Reduced computational cost
- Ease of use enhanced by the Design Studio plugin
- Seamless integration between LS-DYNA and GENESIS
- Easy implementation of Shape, Sizing, Topology, Topometry, Topography, and Freeform design changes
- Multiple loading conditions

VR&D
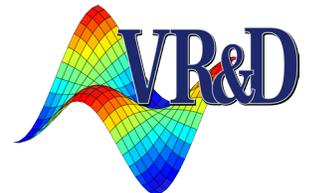
ESLDYNA Methodology

ESLDYNA is an implementation of the ESL method for coupling a nonlinear analysis with a linear optimization software for designing the nonlinear model. ESLs are defined as a set of static loads that produces the same response field as obtained in the nonlinear analysis. These loads are used to perform the optimization on the linear model. Optimization results are updated in the nonlinear analysis and a new response field is generated. This process is repeated until design convergence. In case of a transient nonlinear analysis, the time domain is discretized and applied as multiple loadcases on the linear model.
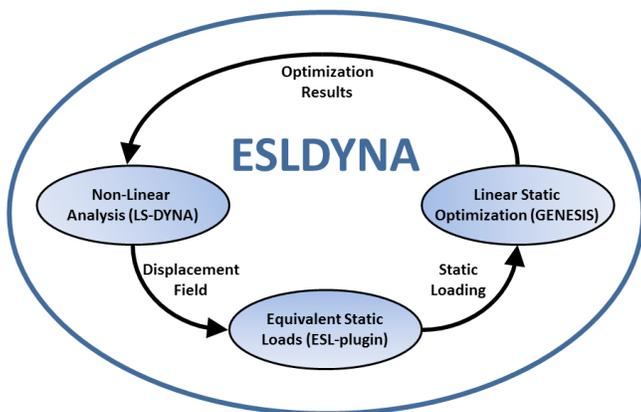
Multiple loading conditions from the nonlinear analysis can be simultaneously considered for the optimization. Each loading condition would be applied as separate loadcases on the linear structural model. ESLDYNA facilitates simultaneously running multiple LS-DYNA analyses to reduce overall design time. Most of the optimization features that are available in GENESIS can be used in ESLDYNA.

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Other VR&D Products

GENESIS – Structural Analysis & Optimization

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

Design Studio for GENESIS – Graphical Pre/Post Processor

Design Studio allows users to display finite element models, easily create GENESIS design data, and post-process optimization results.

SMS – Fast 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 are required for a system with many degrees of freedom. Benchmark studies and user experience show 2-10 times speedup. 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 linear and nonlinear optimization problems. If you require only an optimization engine to incorporate into your design software, DOT will serve that purpose.

BIGDOT – Very Large Scale Optimizer

BIGDOT is intended to solve very large, linear or nonlinear, constrained problems where gradient information is available. BIGDOT is capable of solving continuous, discrete/integer or mixed variable problems. Problems in excess of three million design variables have been solved by BIGDOT.

VisualDOC – Multidisciplinary Design Opt.

VisualDOC is a software system that simplifies adding optimization to almost any design task. It uses powerful, intuitive graphical interface, both gradient based and non-gradient based optimization, response surface (RS) approximate optimization, and design of experiments (DOE) methods. VisualDOC interfaces easily to your own code or third-party analysis programs.