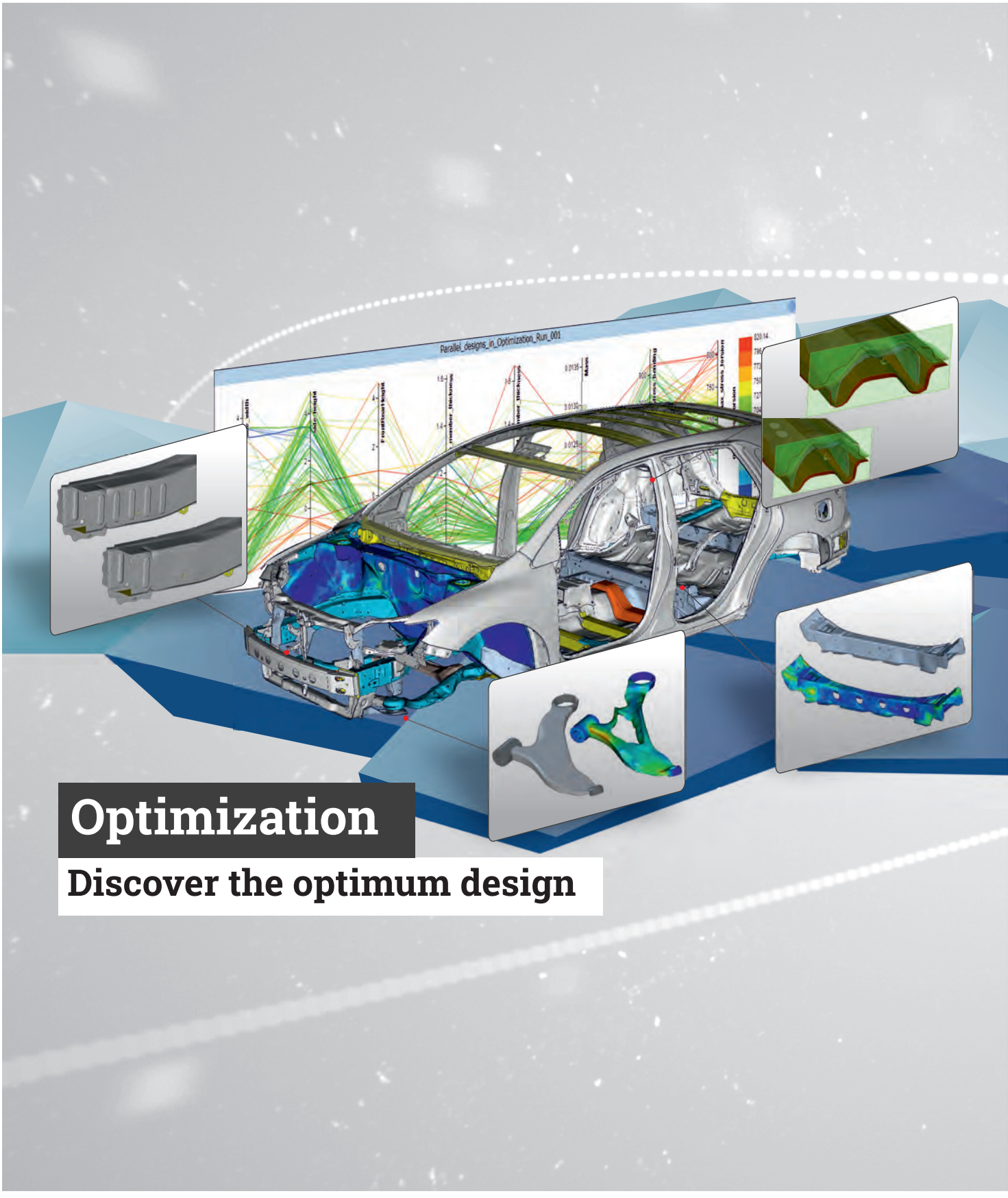
BETA
SIMULATION SOLUTIONS

physics on screen



Optimization

Discover the optimum design

Unleash the benefits of optimization minimizing set-up time in a common approach for any optimizer

ANSA's Optimization tool provides complete tool for optimization applications. A workflow that combines ANSA pre-processor, supported Solvers, META post-processor, Response Surface Models, and several Optimization Algorithms, allows for the efficient definition and execution of optimization studies.

From concept design to final testing, the Optimization Tool package brings enormous performance and versatility to the optimization problem set-up. It offers a unique way to massively parametrize ANSA model values, and model shape using ANSA Morphing, including complicated tasks such as batch meshing, model checks and mesh improvement.

Seamless Optimization of Parametric models

The Optimization Tool facilitates the set-up of the optimization sequence. Design variables are defined and connected to any Morphing Parameter, controlling the shape modifications of the model. In a similar manner, Design variables control any parameter of ANSA entities (shell thickness, material density etc.). Furthermore, complicated actions, such as features creation and treatment, parts replacement, connections realization and mesh quality improvement are added to the process and driven by design variables. Additionally the workflow of the optimization tool offers:

- The ability to animate and visualize the model shape modifications for different combinations of design variable values, before running the optimization study.
- Video recording of the animated model.
- Automatic mesh improvement and other model checking and fixing during the DOE or Optimization loops.
- Solver definition in the workflow, to setup and run the entire process automatically.
- Enhanced Design Of Experiments allowing for the exploration of the design space. Automatic generation of designs via numerous algorithms.
- Optimization studies via various available algorithms.
- Definition of full model reports during the optimization process, checking model validity.
- Automated Post Processing using META's automated sessions to collect and present the results.

Optimization Algorithms

Optimization Studies can be defined within ANSA's Optimization tool utilizing one of the following embedded optimization algorithms.

- The **Simulated Annealing (SA)** optimization algorithm is a probabilistic algorithm, inspired by the metallurgy process .The problems solved by the SA algorithm involve an objective function of many variables, subject to several constraints.
- The **Differential Evolution (DE)** algorithm is a metaheuristic optimization algorithm inspired by the processes of Natural selection and mutation during biological evolution.
- The **Conjugate Gradient (CG)** algorithm, is a gradient-based optimization algorithm used to solve single-objective unconstrained optimization problems.
- The **IPOPT (Interior Point OPTimizer)** can be used for large scale nonlinear optimization.
- The **NSGA-II/DE-IDEA** algorithm supports either unconstrained or constrained multi objective optimization and is able to find the various fronts of solutions, with the first front considered the optimal Pareto front of the problem.
- **Sequential Quadratic Programming (SQP)** is a classical and powerful algorithm of nonlinear optimization, especially suited for constrained single-objective optimization studies.
- **Nelder-Mead**, is a classical derivative-free optimization algorithm for nonlinear, unconstrained optimization problems.

All optimization algorithms are able to run either Response Surface Model (RSM) based optimization studies exploiting the state-of-the-art Machine Learning functionality or Direct optimization studies based on direct connectivity with an FE solver.

Coupling with other Optimizers

The Optimization tool also allows for the direct coupling with LS-OPT, modeFRONTIER, OPTIMUS, Isight, HEEDS, OptiSLang, DAKOTA, and SmartDO optimization software, without the need of additional scripting.

Optimization Results processing

The Results tab in the Optimization tool offers several options of charts and histograms to process and evaluate the DOE or Optimization results.

- 2D and 3D point charts, line charts and histograms can be used to facilitate the presentation of results.
- Additionally, correlation matrix, main effect and interaction effect charts can be created showing the relation between variables (design variables or responses).
- A parallel coordinates chart can be created assisting in results presentation and filtering.

Features

- Ÿ Direct and RSM Optimization of parametric models in ANSA
- Ÿ DOE generation with various algorithms
- Ÿ Automatic mesh improvement after morphing
- Ÿ Process automation
- Ÿ Scripting

Set up for:

- Ÿ Shape and Parametric optimization
- Ÿ Composite material optimization
- Ÿ Spotweld optimization
- Ÿ Multidisciplinary optimization
- Ÿ ANSA&META nodes in modeFRONTIER , LS-OPT and OPTIMUS interface
- Ÿ TOSCA Structure integrated interface
- Ÿ EPILYSIS & NASTRAN SOL200 &

Benefits

- Ÿ Seamless optimization process with Integrated optimization algorithms in ANSA
- Ÿ Common approach in coupling with any optimizer
- Ÿ Fast and flexible optimization sequence set up using the massive definition of design variables
- Ÿ Fast definition of Size, Shape, Topology, Bead and Topometry optimization studies for various solvers

Spotweld optimization

- Parametrization of welds and easy handling from the Optimization Tool.
- Control parameters such as spotweld density, number of spotwelds, spotwelds' diameter, connections' properties or materials, and alternative connections representation types.

Multidisciplinary optimization

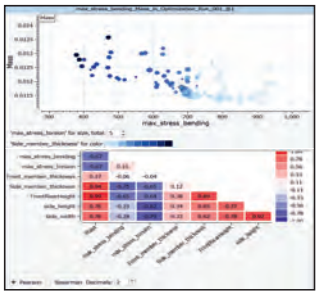
- A defined optimization sequence can be applied on different representations of the same model and prepared for different solvers and analysis scenarios for the set-up of multidisciplinary optimization problems.
- The use of common Optimization Task and Morph Boxes in different analyses ensures the identical shaping.

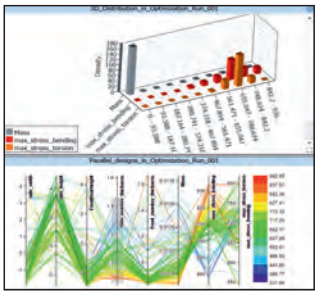
Post-processing

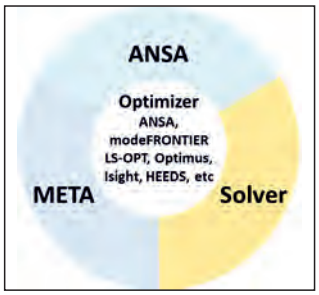
- A special tool in META offers a flexible way for the responses and histories extraction, from the solvers result files.
- Responses extraction from the 3D model and the 2D Plot.
- The automatic definition of post-processing sessions to participate in the optimization loop, and the calculations upon solvers results, are only a few of META's powerful capabilities.

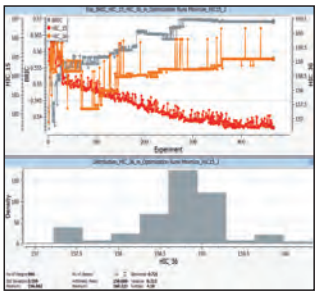
Size, Shape, Topology, Bead, Topometry

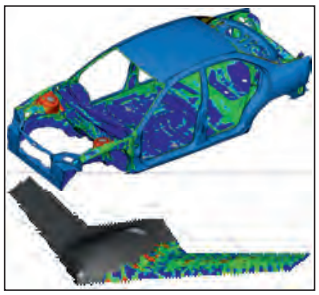
- Integrated predefined workflows for Size, Shape, Bead, Topology and Topometry Optimization of EPILYSIS, Nastran, Optistruct and TOSCA.
- Dedicated plugin tools for Manufacturing constraints evaluation and automatic update of the model based on the optimization results.
- Automatic mesh quality improvement of the optimum and definition of validation run after the optimization.
- Topology results handling tools allow for creation of smoother surfaces and also the possibility to create and export Subdivision surfaces back to CAD.
- Continuous Support of the major keywords for topology, topometry and bead optimization.

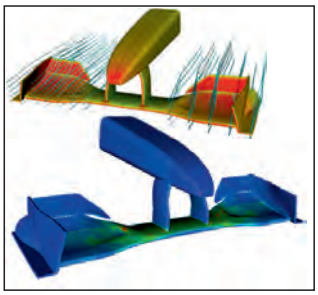


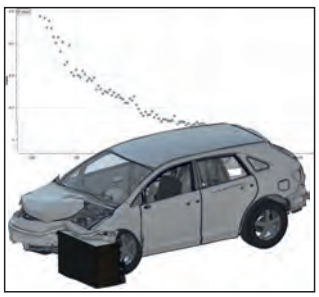












BETA
SIMULATION SOLUTIONS

physics on screen

www.beta-cae.com