ACP-OpDesign: Optimal Design Gateway: Reveal the Path to Optimized Products

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Abstract

ACP OpDesign is an intuitive and process-guided optimization desktop environment. With its optimization oriented and highly specialized user interface, based on the process depicted as a diagram in the tool, it offers the user the capability to take advantage of an efficient, direct interaction to:

- *ANSA's powerful morphing and parametrization functionality*
- *custom-designed META Post-processor tools*
- *Topology and parametric optimization Software (LS-TaSC™ and LS-OPT®)*
- *FEA solvers (LS-DYNA®)*

ACP OpDesign features a list of tools designed and developed in the context of actual optimization projects.

Following step-by-step the various phases of the ACP process, these tools and capabilities of the software (ACP-OpDesign, ANSA and META) are demonstrated by means of examples.
Starting from a product design space, we apply various loads for a topology optimization analysis. The results are interpreted and transformed into a low fidelity model, which is then validated under the same loads.

It is then parametrized regarding its geometry (3D shape, position, cross section), its material and thickness, and a parametric optimization takes place. The results of this analysis are post-processed and evaluated.

Introduction

ACP OpDesign revolutionizes the product design and development process through a holistic, process driven method. It orchestrates the phases of product development, evaluating multiple design concepts, under multi-disciplinary loads, based on topology, and parametric geometry, grade, gades (3G) optimization. ACP OpDesign is based on BETA CAE Systems' software products: the SPDRM and the ANSA/EPILYSIS/META suite. Capturing ETA's Accelerated Concept to Product (ACP) process, it delivers a streamlined optimization-led design path. With the ACP OpDesign you can: create new products from concept, optimize existing designs, evaluate numerous design concepts under multiple load conditions, optimize shape material, thickness, and consider manufacturability alternatives.

Optimization driven product development creates new challenges

The recent upsurge of optimization driven product development has created new needs and issues to be solved:
- Models need to be evaluated under multiple loads for numerous disciplines in order to develop optimum solutions in terms of mass and cost reduction without jeopardizing, if not improving, performance.
- Process definition and data handling have become an obstacle that consumes considerable amount of time and resources and thus needs to be streamlined.
- The use of Topology Optimization during the recent years, although it offered considerable benefits, especially in the early stages of the product development, it further increased data handling and resources needs.
- There is not an effective "umbrella" to combine in a streamlined process and in one database, Topology and Parametric Optimization along with manufacturing alternatives.

To address those issues ETA and BETA CAE Systems deliver the ACP OpDesign. Exploiting the ACP process and the software of BETA CAE Systems –the SPDRM process management software and the ANSA/EPILYSIS/META suite- the ACP OpDesign reveals the path to optimized products.

The ACP process

The Accelerated Concept to Product process is a performance driven, holistic product design development method based on optimization. It orchestrates the phases of product development, evaluating multiple design concepts under multi disciplinary loads, based on topology, and geometry, grade, gauge, gades (3G) optimization. It acts as an optimization suite or led by design optimization, provides the tools to design products from concept.

The process is arranged in three phases. The Concept, the Low Fidelity 3G, and the Decoupling & High Fidelity 3G (see Figure 1). You can either apply the process starting from Concept or seperately using legacy designs to optimize.
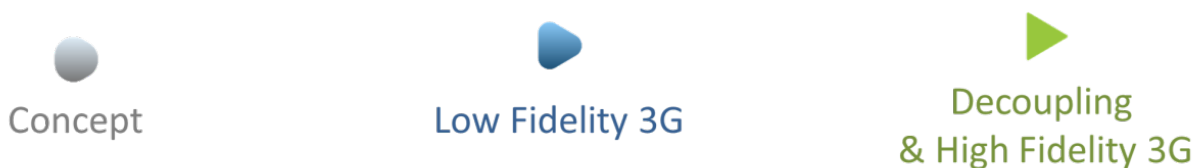
| Concept	Low Fidelity 3G	Decoupling & High Fidelity 3G
Starting from concept, the available design space is defined and set-up for topology optimization under Multidisciplinary loads (static and dynamic). The shell geometry from the results is generated by allocating material where is needed to withstand the loads.	Continuing from Concept Design or starting from existing designs the LF3G step focuses on the optimization of the Geometry, Grades, and Gauges. This step optimizes the position of important parts, the width and height of cross sections, the types of material and its grades.	Important load carrying sub-systems are "decoupled" for detailed design, based on alternative manufacturing design solutions. These sub-systems are further optimized for the optimal design solution under multiple load cases. Further, the system is fully reintegrated and gauges optimized if required.

Each of the phase consists of certain sub tasks (see Figure 2).
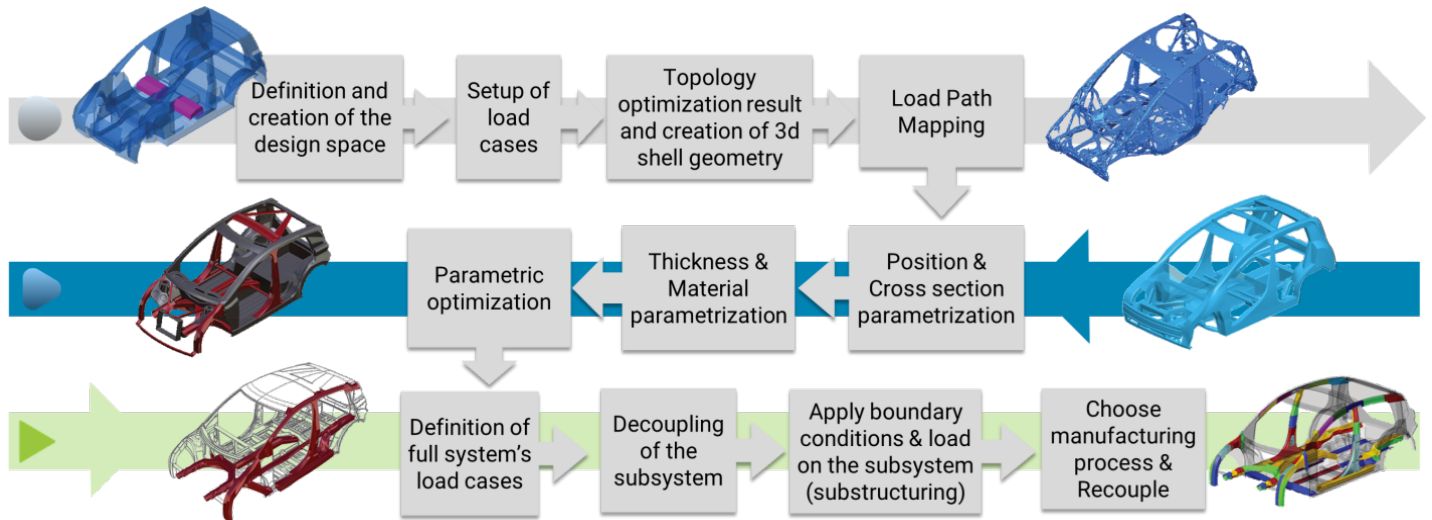
The ACP OpDesign architecture

The ACP OpDesign is a client developed to band with the advanced management software SPDRM and the ANSA/EPILYSIS/META suite, both products of BETA CAE Systems. Mapping ETA's ACP Process, it cooperates with all mainstream optimizers and solvers to complete even the most demanding optimization task. The architecture that makes this process possible is shown in Figure 3.
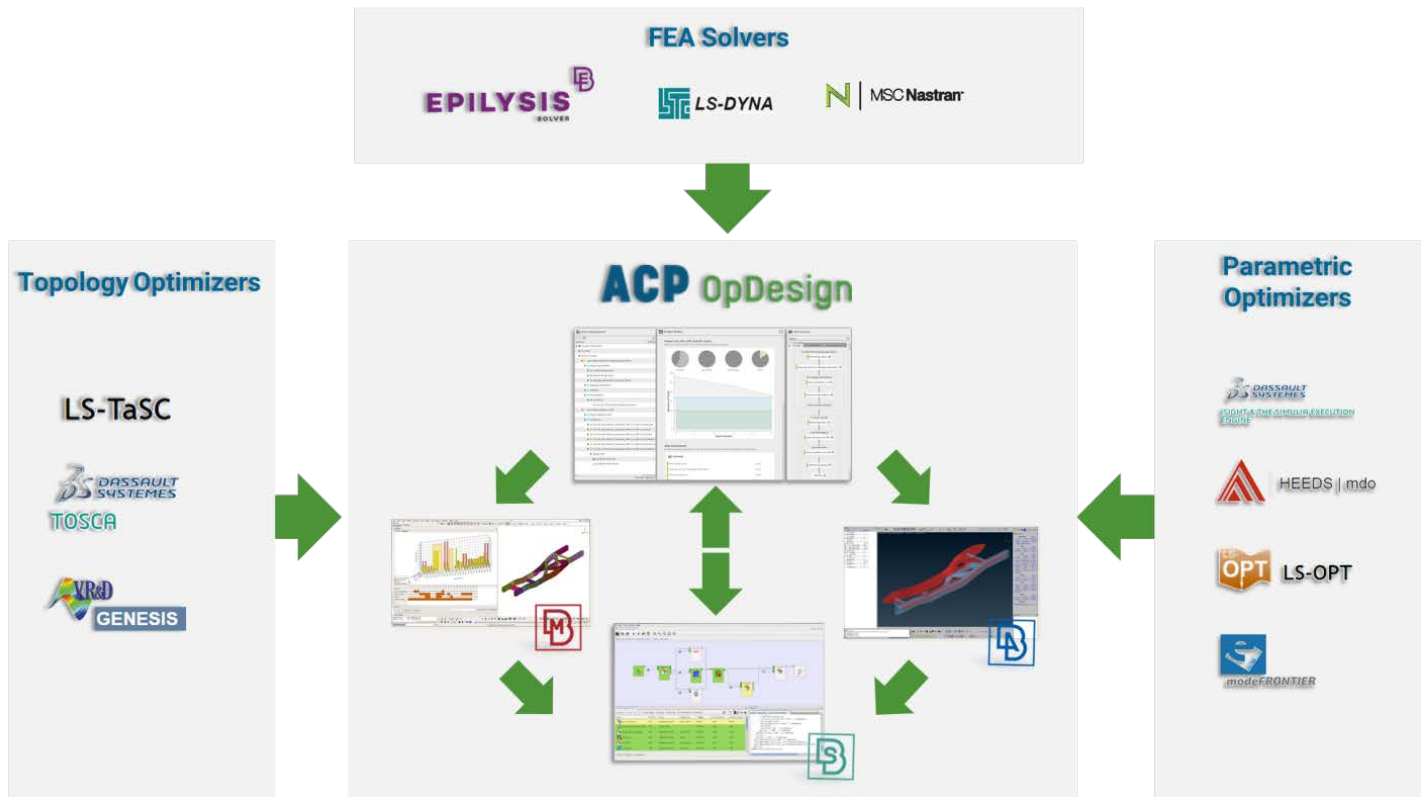
The ACP OpDesign: The Optimal Design Gateway

With an intuitive user interface, the ACP OpDesign helps you move forward in your optimization processes having a clear image of the required tasks to be performed in each phase of the ACP process. The data management capabilities incorporated in the ACP Opdesign makes sure that you will work with your data effortlesly. All required tasks and modelling processes can be either completed within ACP OpDesign or by calling the required tool from within the software. (See figure 3: ACP Opdesign GUI design)

On the data tab, you can save and retrieve data from the system's database.
You can connect directly in a process orientated and "human easy to read" way.

The middle tab offers the tools needed for each task or calls for the required actions in ANSA pre-processor.

Process progress and tasks tab on the right is arranged according to the three phases of the ACP Process

Dedicated tools highlights.

In addition to the industry proven pre existing tools, used to realize the ACP process, the ACP OpDesign features a list of tools designed and developed in the context of actual optimization projects. Such tools include:

The Load Case Manager:

The load case manager lets you create Static (NASTRAN, LS-DYNA Implicit), or Crash Load Cases (LS-DYNA Explicit) which will be used during the process. Loads, BCs, Barriers, Velocities can be defined within the tool with the aid of ANSA.
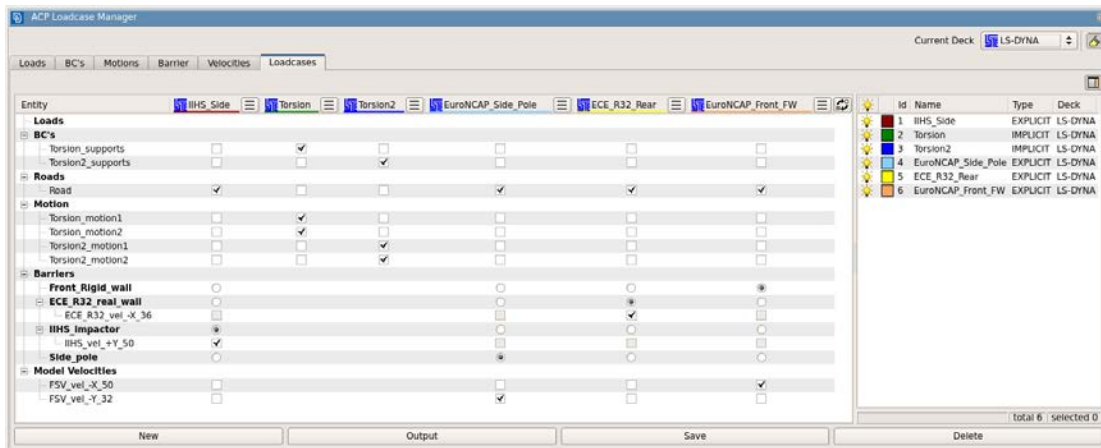

"Skinning":

With Skinning, you can easilly create the geometry of the final skeleton from topology optimization results during the Concept phase . It offers an easy and fast way not only to create the geometry based on the selected cross section, but also to automatically treat the connected geometries.
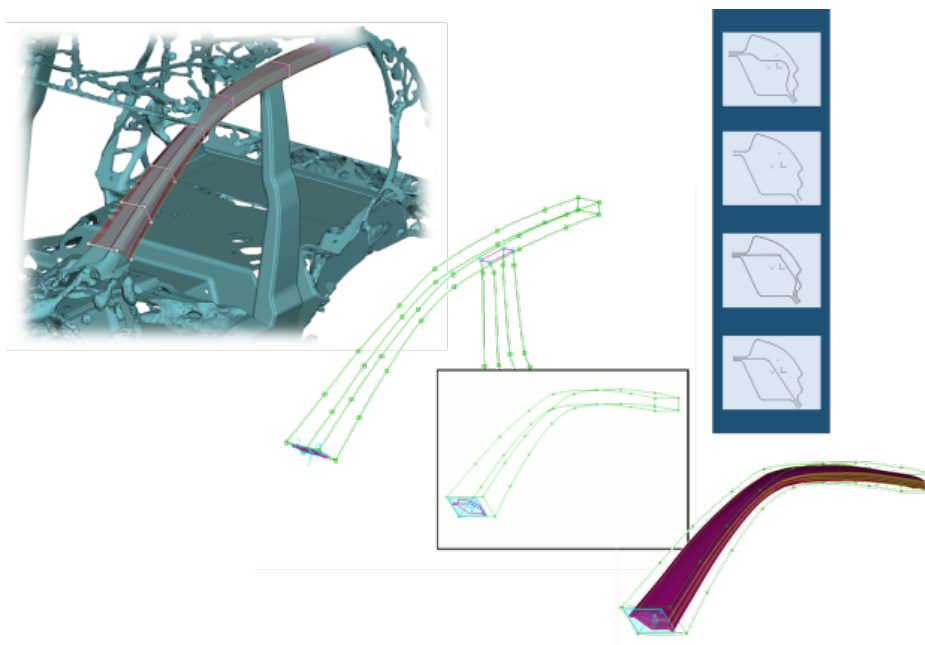
The Simulation Manager:

The Simulation manager lets you monitor your job's status. Through this tool you can modify significant solution parameters, such as, memory, CPU number, and which Machine. It offers a tool with all actions related to simulation. The simulation jobs that have to be submitted during the process are prepared in the LC Manager and fed automatically to the Simulation Manager.
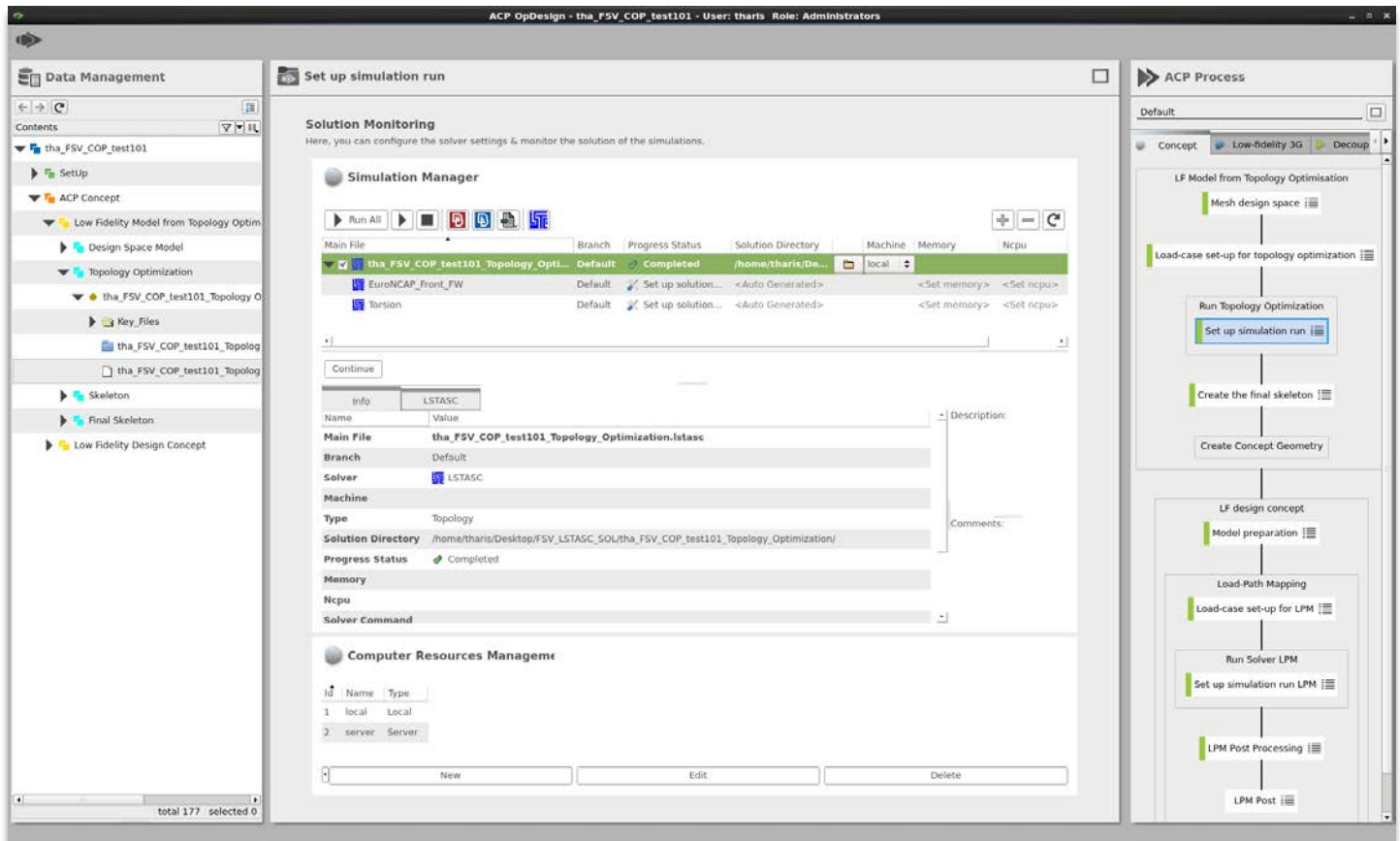
"Substructuring" and Manufacturability:

With the aid of dedicated tools you can "decouple" important load-carrying subsystems easilly to further optimize their design. Taking under consideration also the manufacturing alternatives the best solution is then "recoupled" into the original system.