5th ANSA & µETA International Conference

New Techniques to Improve Modelling, Design and Optimization of Complex Thermoplastic Components

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BASF Engineering Plastics

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Presentation Summary

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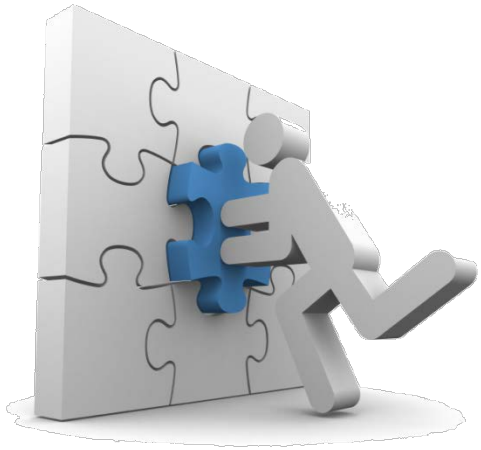
- Typical Applications Utilizing Plastic Materials
- CAD Data for FEA Modeling – Use of Spaceclaim
- ANSA to Moldex3D Interface Enhancement
  - Exporting solid element models
- CAE Simulation Optimization Tool Workflow
  - Demonstrator part development
  - CAE Optimization process workflow



- Acknowledgements: This presentation would not have been possible without the expert contributions of Daniel Dubiel, Jim McGuire and Rodrigo Orozco of BASF Engineering Plastics CAE team

Typical Plastic Applications

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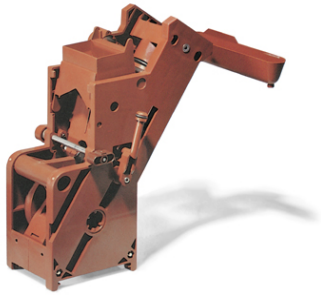



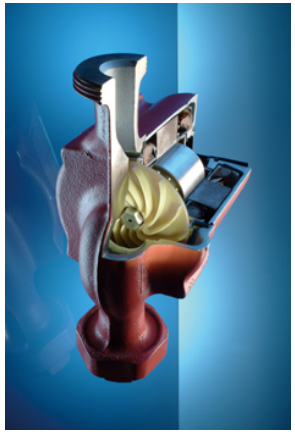

FEA/Molding Simulations Require Modeling of Complex Parts

ANSA & SpaceClaim
Benefits & Commonly Used Features

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Benefits of using ANSA & SpaceClaim:

- Reduce ANSA pre-processing time by defeaturing CAD data
- Improve mesh quality from simplified geometry
- A tool for **modifying** geometry easily without access to the native CAD files

Most commonly used tools:

- Pull: for simplifying or modifying CAD
- Fill and Rounds: for eliminating fillets
- Repair tools

SPACECLAIM CORPORATION

ANSA & SpaceClaim Examples

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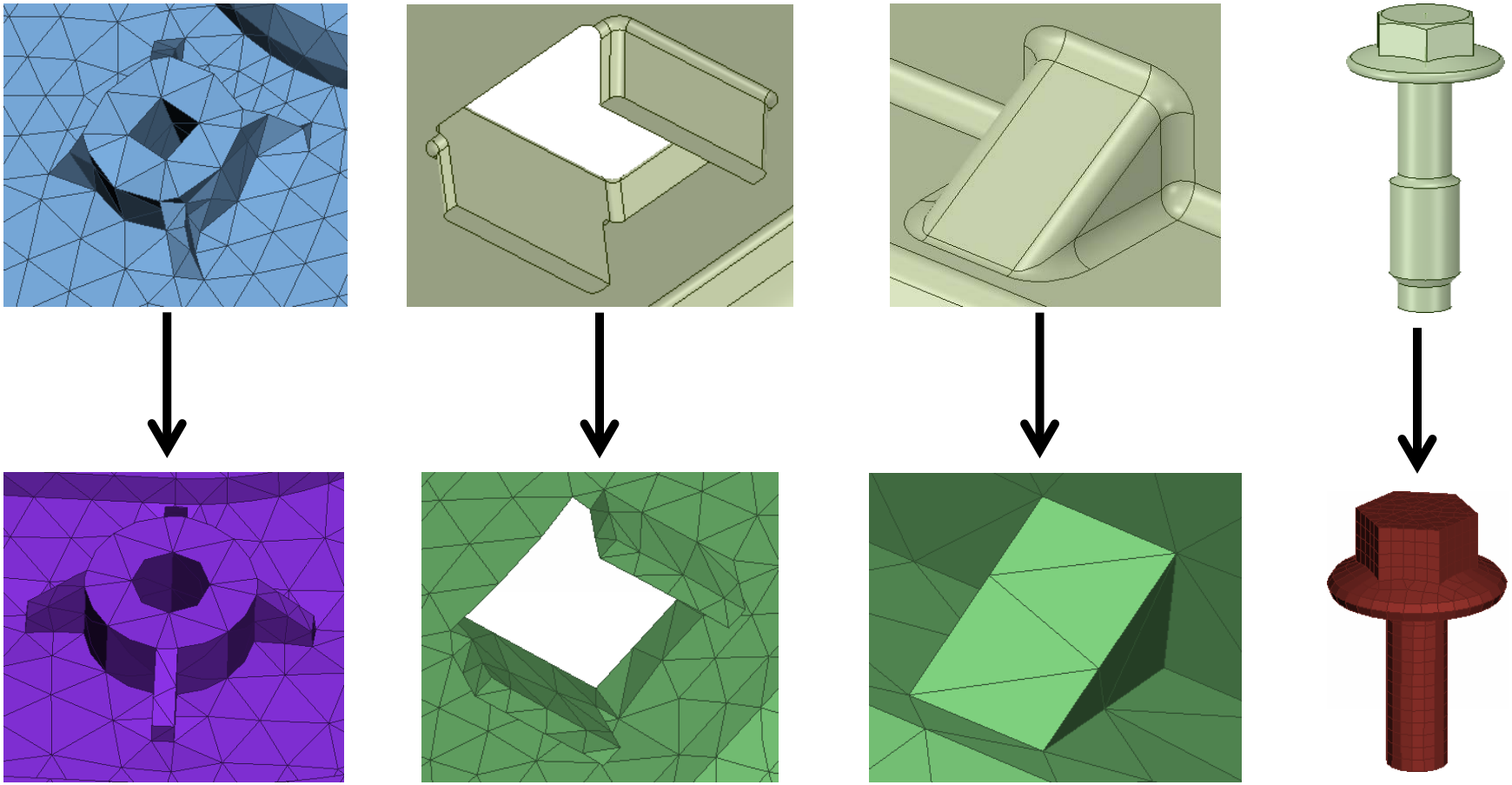
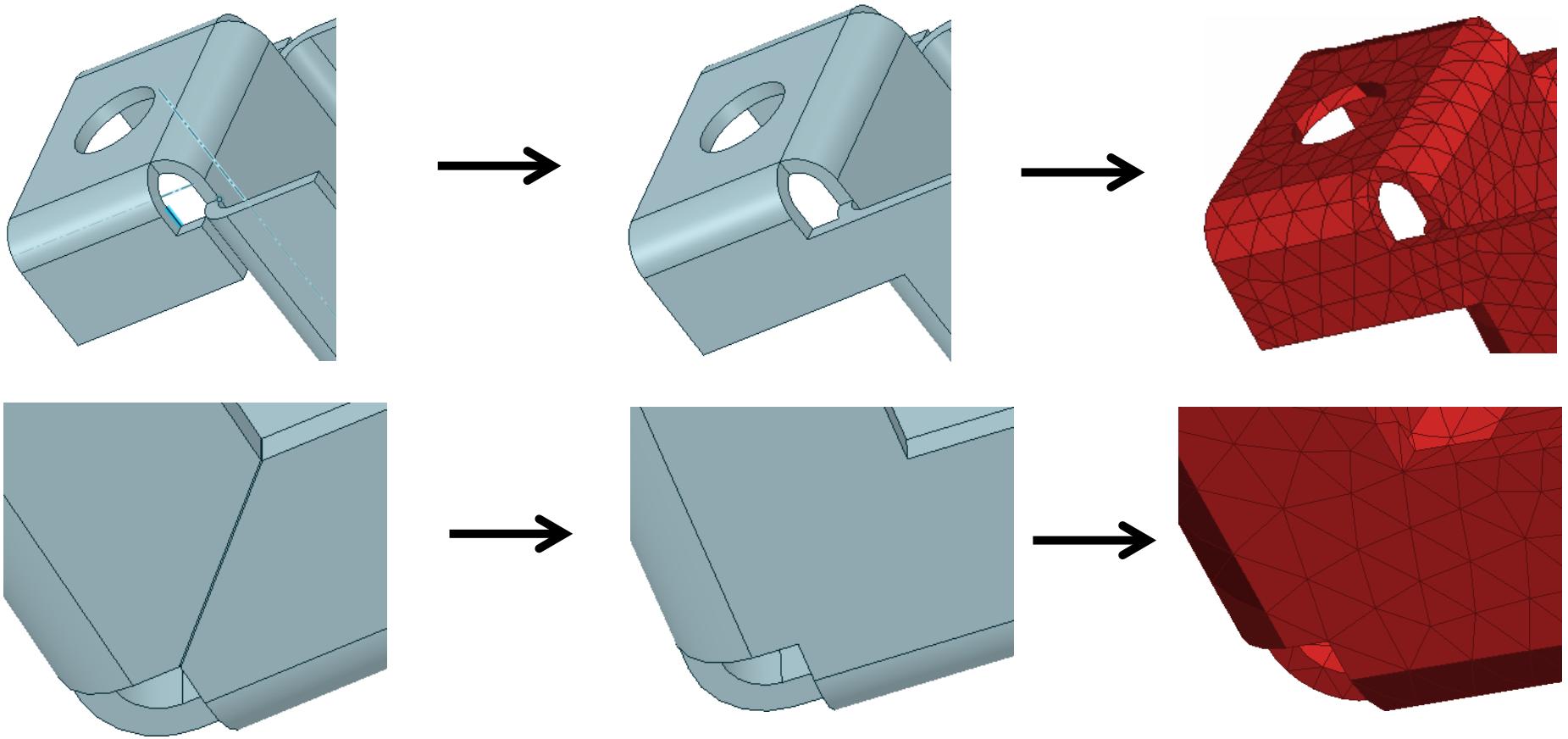
Defeaturing of CAD data yields better quality elements, models:



ANSA & SpaceClaim Examples

Eliminating, simplifying geometry of CAD data:



ANSA to Moldex3D Interface Enhancement
Exporting Solid Element Models

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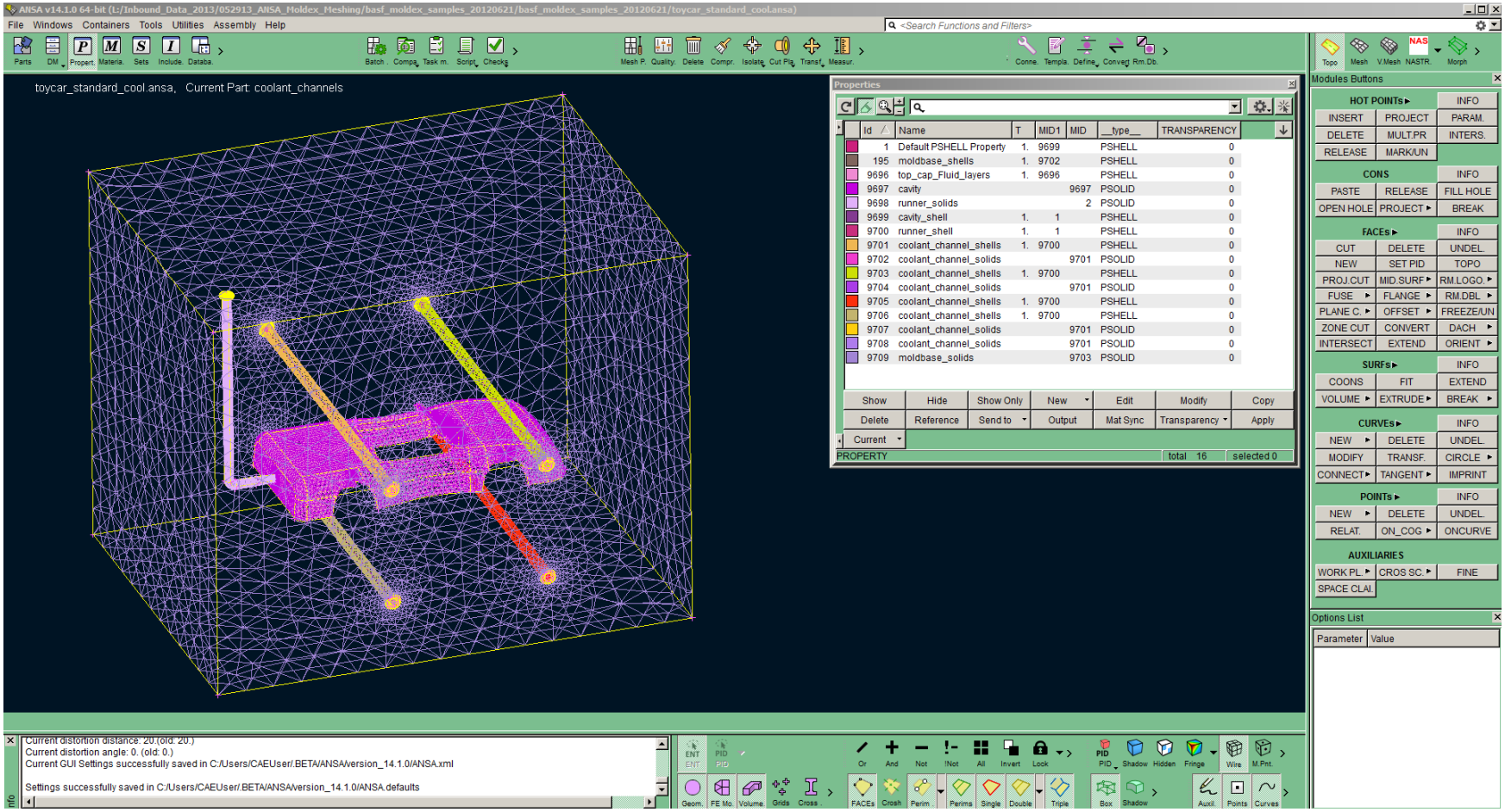
Modeling of parts for injection molding simulations



Sample problem provided by Coretech (Moldex3D)

Moldex3D
MOLDING INNOVATION

ANSA to Moldex3D Interface Enhancement Export Solid Elements

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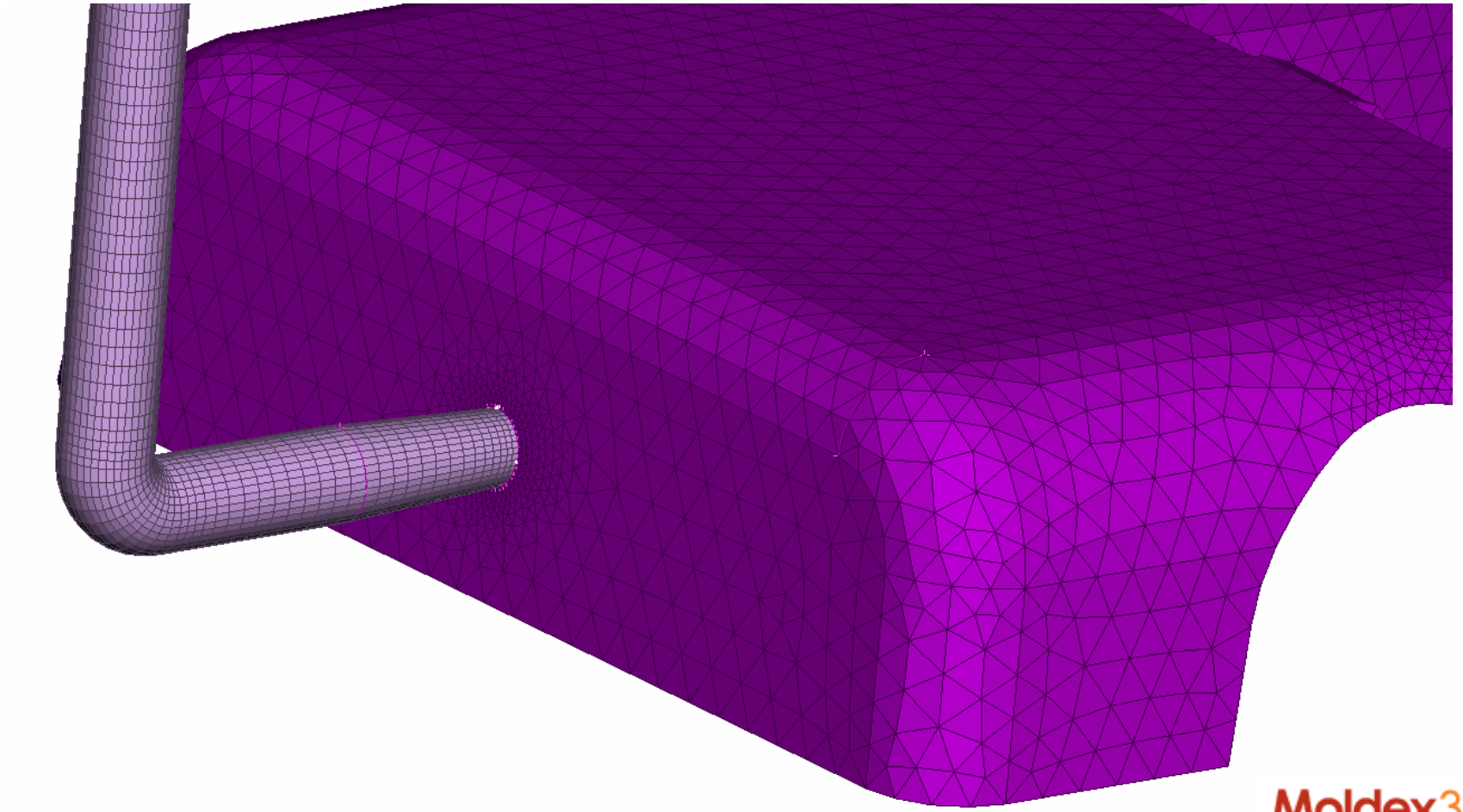
Details of an FEA model with runner system



Moldex3D
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ANSA to Moldex3D Interface Enhancement
Export Solid Elements

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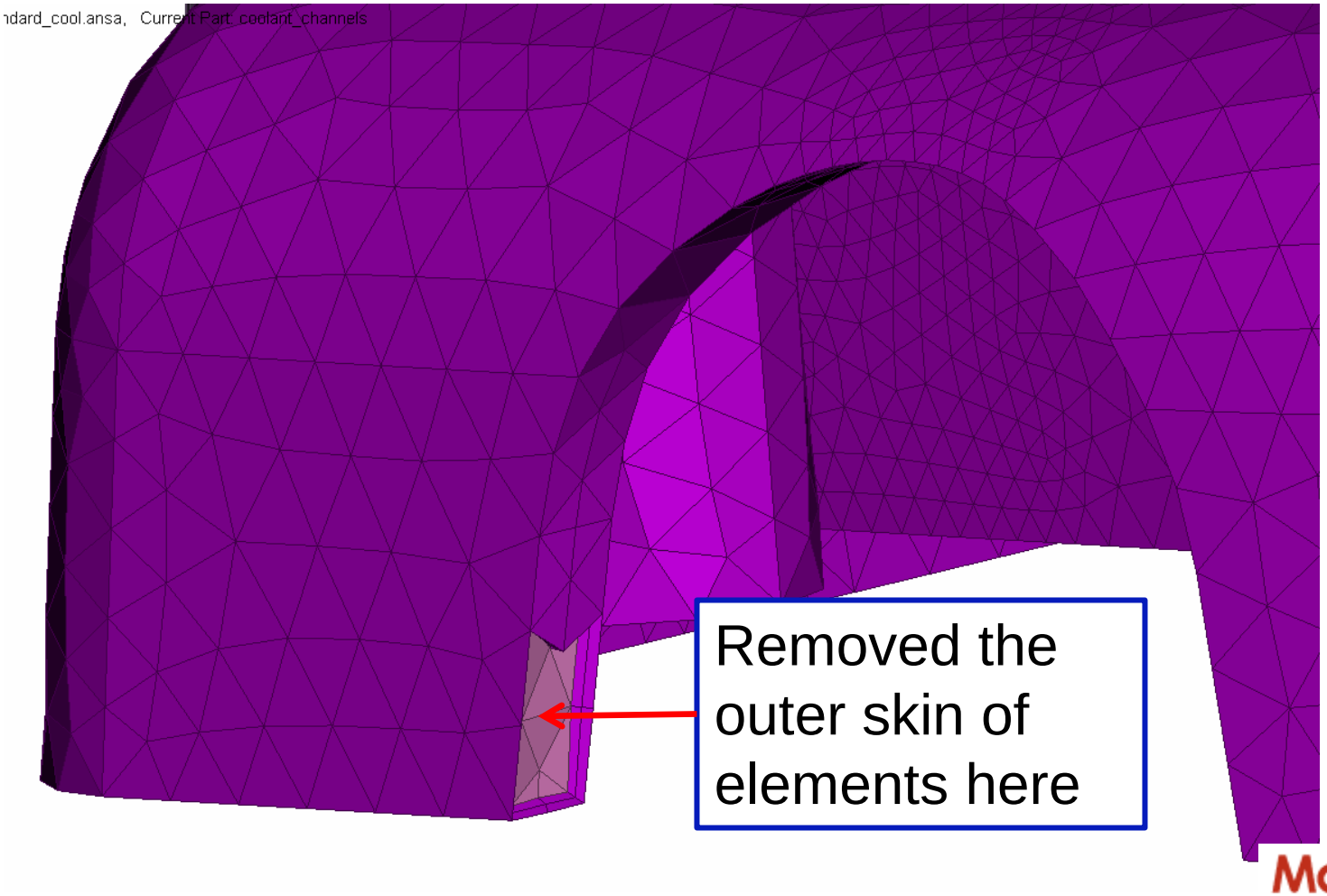
Model cleanup within ANSA prior to exporting to Moldex3D



Moldex3D
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ANSA to Moldex3D Interface Enhancement Export Solid Elements

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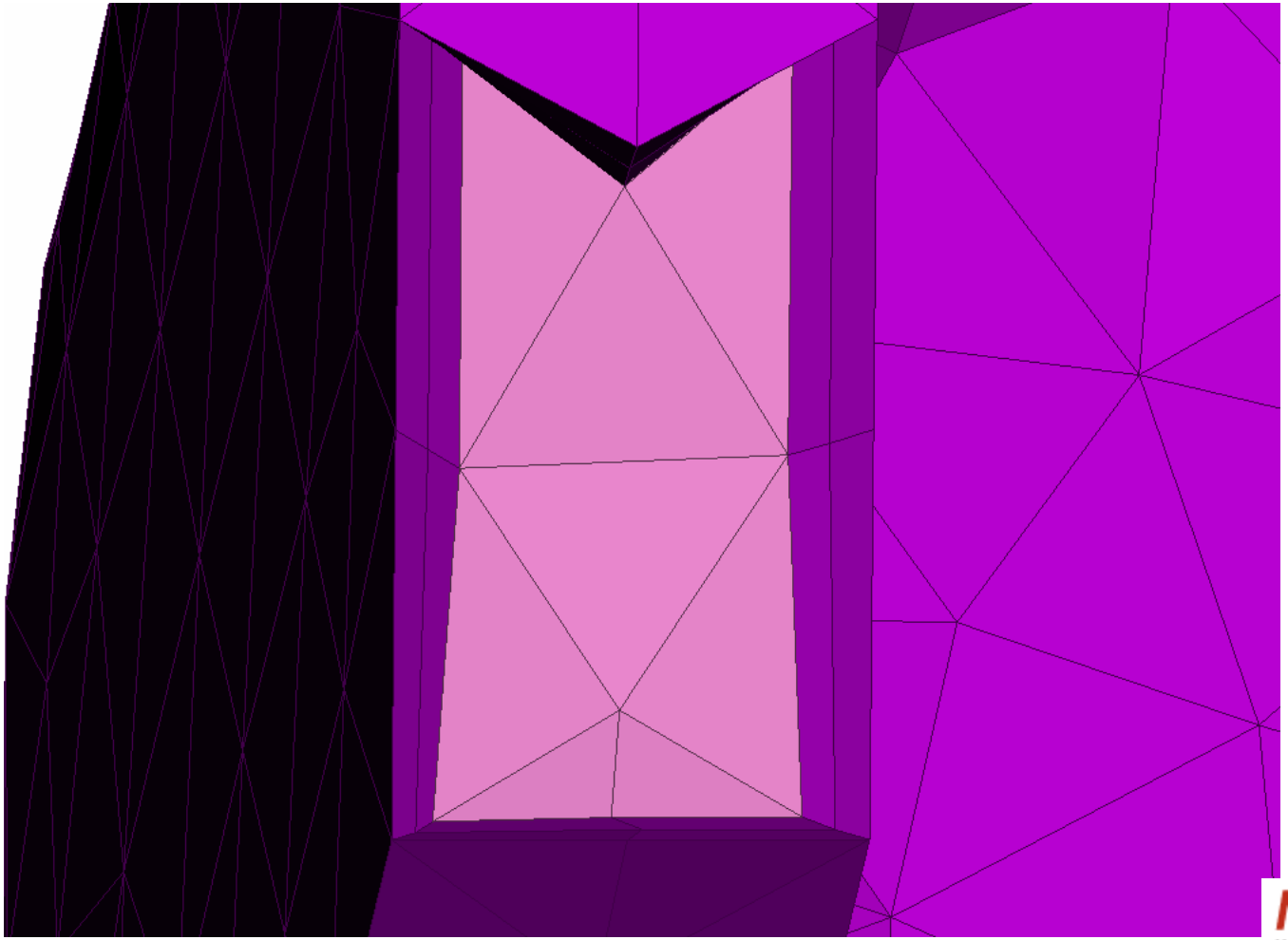
Details of Moldex3D model specific changes using ANSA



Moldex3D
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ANSA to Moldex3D Interface Enhancement
Export Solid Elements

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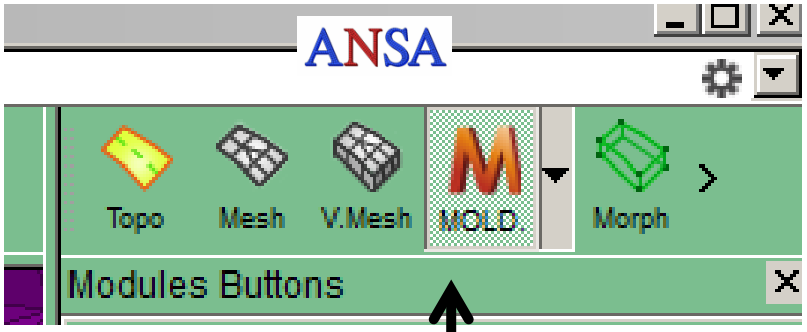
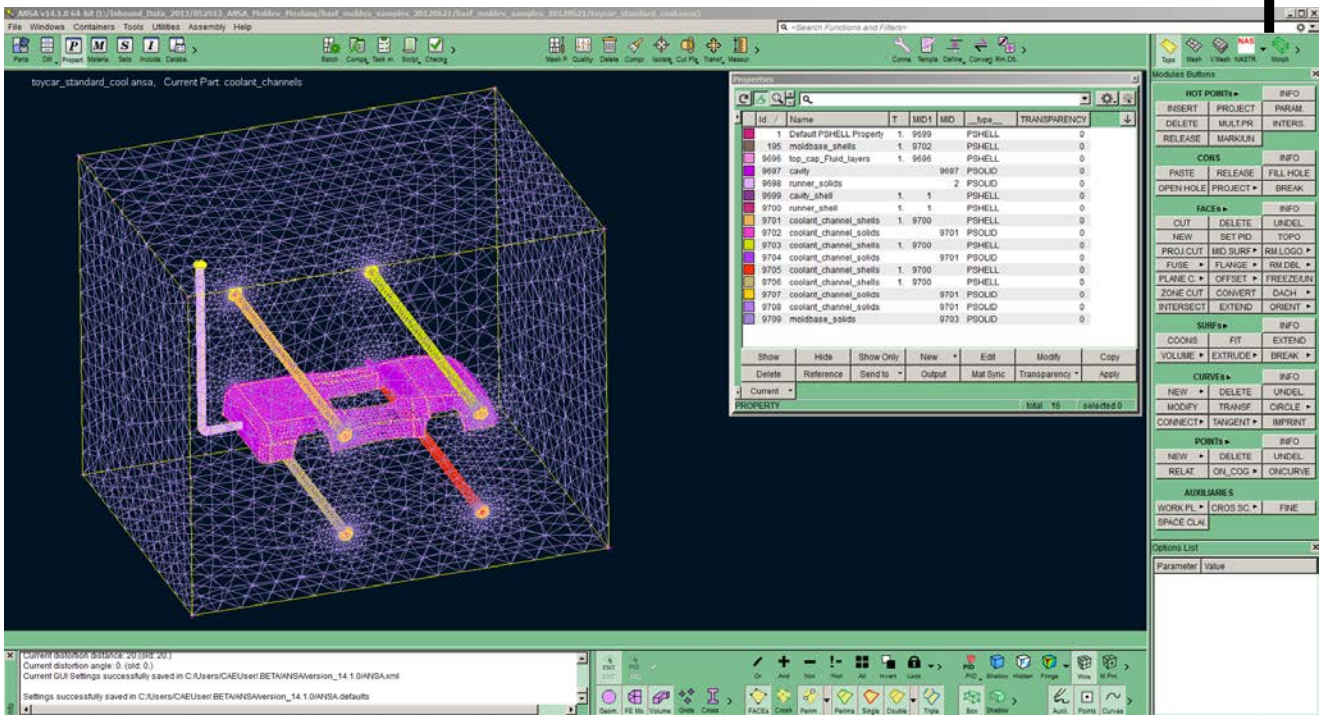
Set the deck type to Moldex3D





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ANSA to Moldex3D Interface Enhancement
Export Solid Elements

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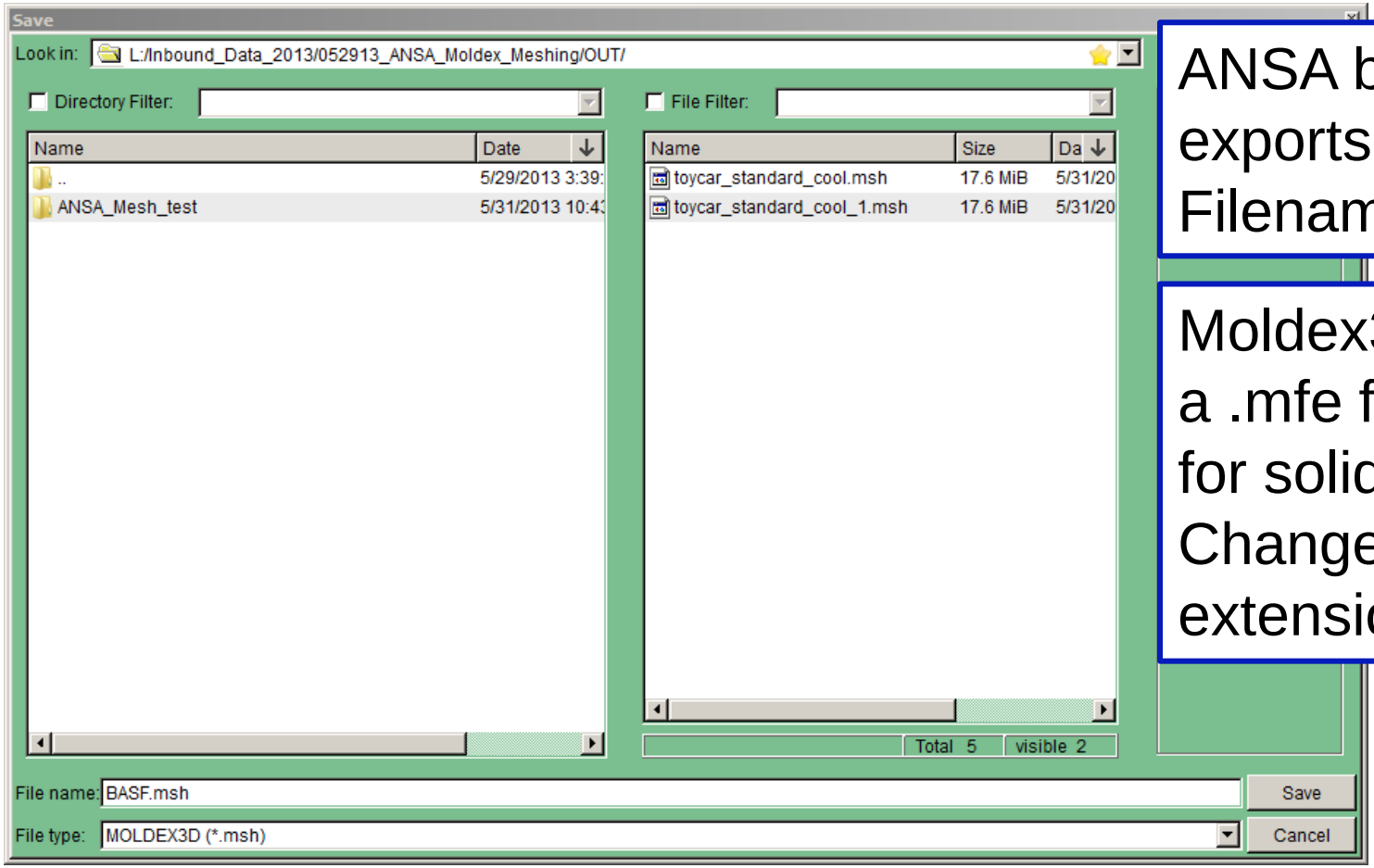
Some simple changes required for the current interface to work



ANSA by default exports mesh as Filename.msh

Moldex3D requires a .mfe file extension for solid elements. Change the file extension to .mfe

Moldex3D
MOLDING INNOVATION

ANSA to Moldex3D Interface Enhancement Export Solid Elements

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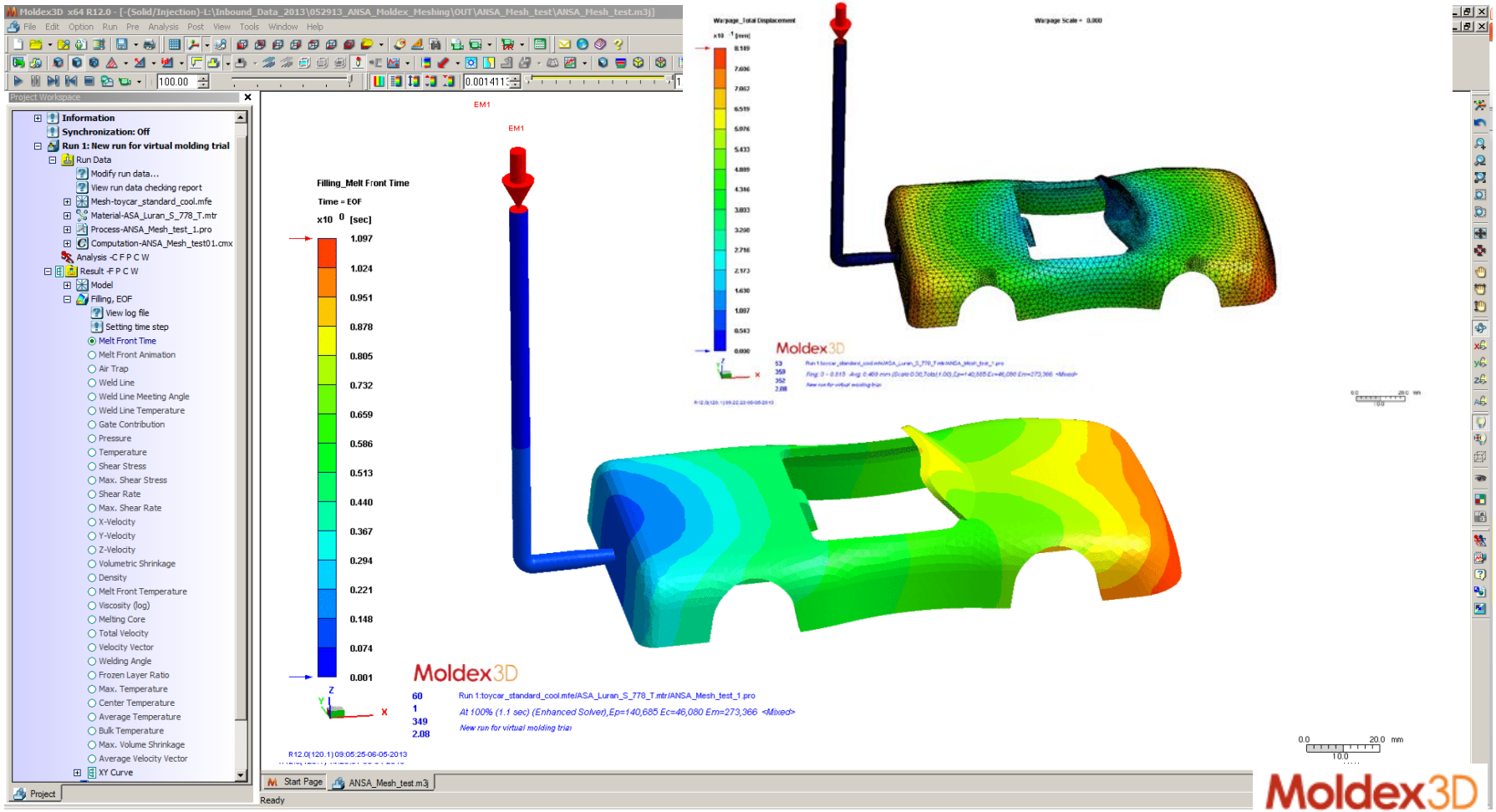
Injection molding simulation using Moldex3D software



ANSA to Moldex3D Translator Comments & Summary

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- Install the latest version of ANSA (14.1.0). This is the release which now supports export of solid elements to Moldex3D
- Install Moldex3D release 12.0
- Export the solid element mesh from ANSA. ANSA offers the file extension .msh as default at the present time, which Moldex3D uses for 2.5D, shell element type mesh. For solid element type model extension of file should be .mfe. Renaming the file extension resolves issue.
- File with a .mfe extension, does read correctly into Moldex3D. Only simple analysis performed at present without any issues!

CAE Optimization Tool Workflow

Ansa Morphing and BASF's ULTRASIM®

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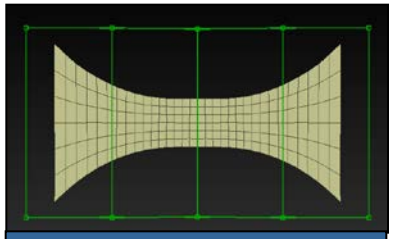
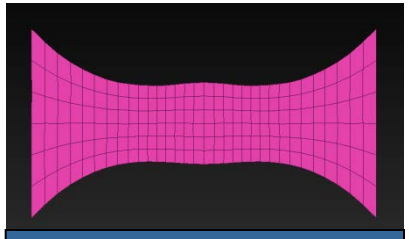
Objective: Use a multi-disciplinary optimization tool for predicting optimum part shape for structural loading

Software Used by LSOPT:
1. ANSA
2. Moldflow
3. ULTRASIM®
4. Abaqus
5. Meta

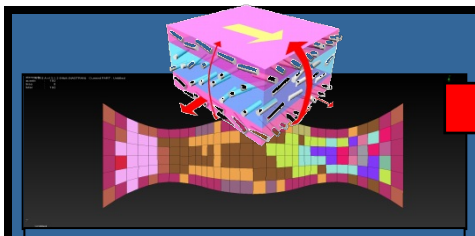
Results:
Automated design prediction looks promising for use in customer projects where shape changes could improve fiber orientation and structural performance



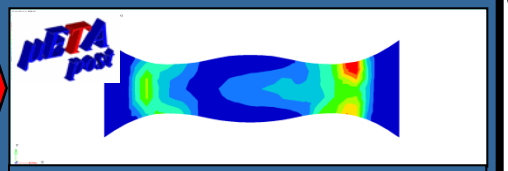
Start with original geometry



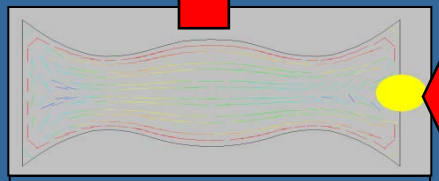
Generate Optimized Geometry



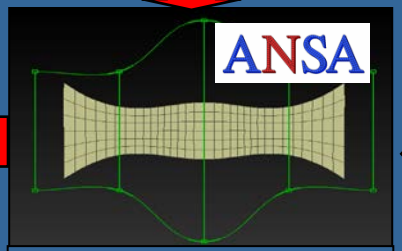
#3- Build structural model based on fiber orientation using ULTRASIM®



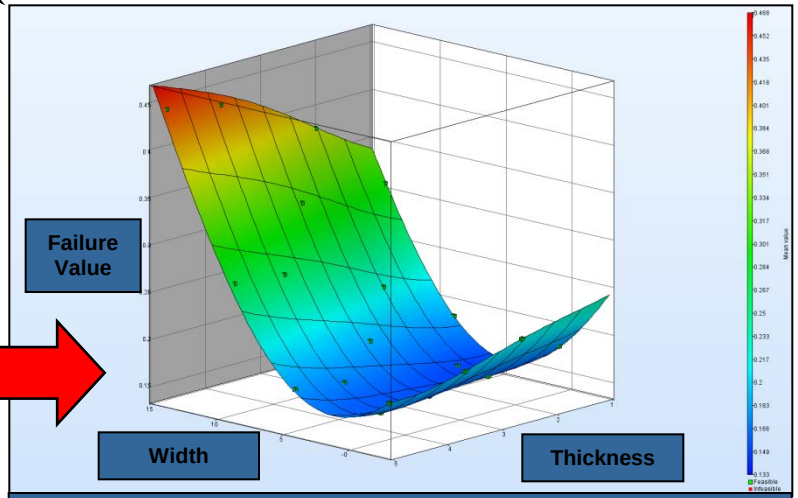
#4- Analyze part for failure under tensile load



#2- Predict fiber orientation using mold filling analysis



#1- Change part shape using ANSA morphing features



Predict Best Shape for Lowest Failure Value

Demonstrator Test Part Development

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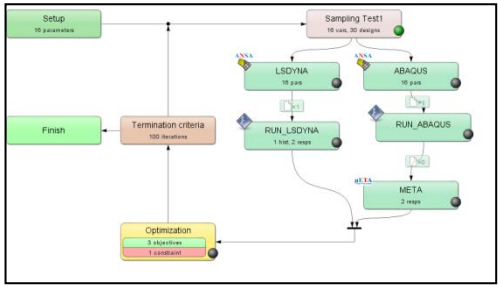
Objective: Use optimization tools to design a customer demonstrator part using energy absorption and static stiffness as objectives and mass as constraint.
Analysis Type: Multidisciplinary Optimization (Crash and Static)
Material: B3WG6 Polyamide 6 Glass Fiber Reinforced Plastic

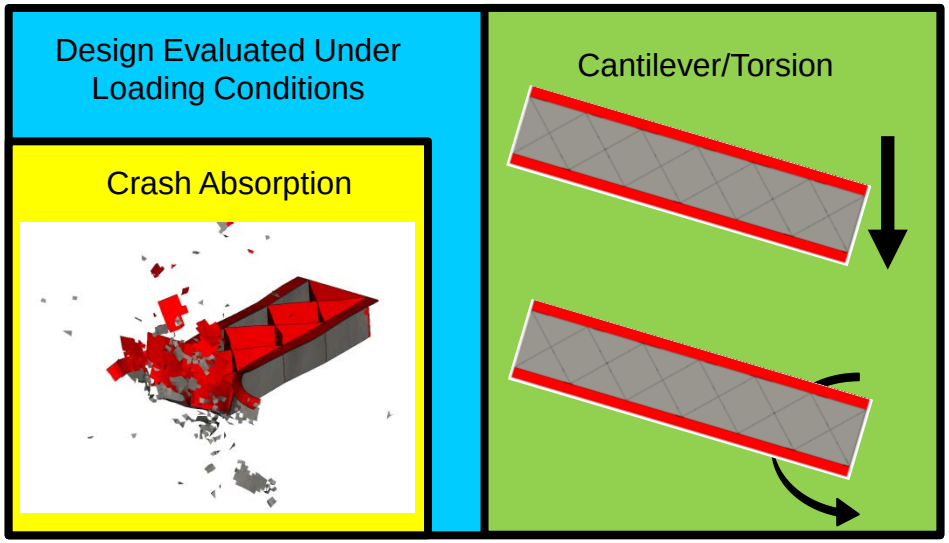
Objective:
Perform **multidisciplinary optimization** to achieve design for crash and static loading scenarios.

Reduce mass while static stiffness and energy absorption are combined as a single objective.

ANSA morphing criteria and shell thickness are given as main variables
.
Results:
Optimization showed promising result after 4500 automated design iterations. Model converged on design that meets the mass constraint while achieving maximum energy absorption and static stiffness in torsion and cantilever bending.

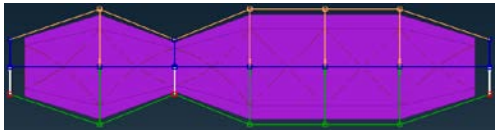
Optimization Process Loop





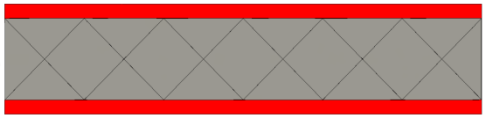
Design Morphed by ANSA

Optimum Design



4500 Analysis Runs

for convergence



Baseline Design

Demonstrator Test Part Development

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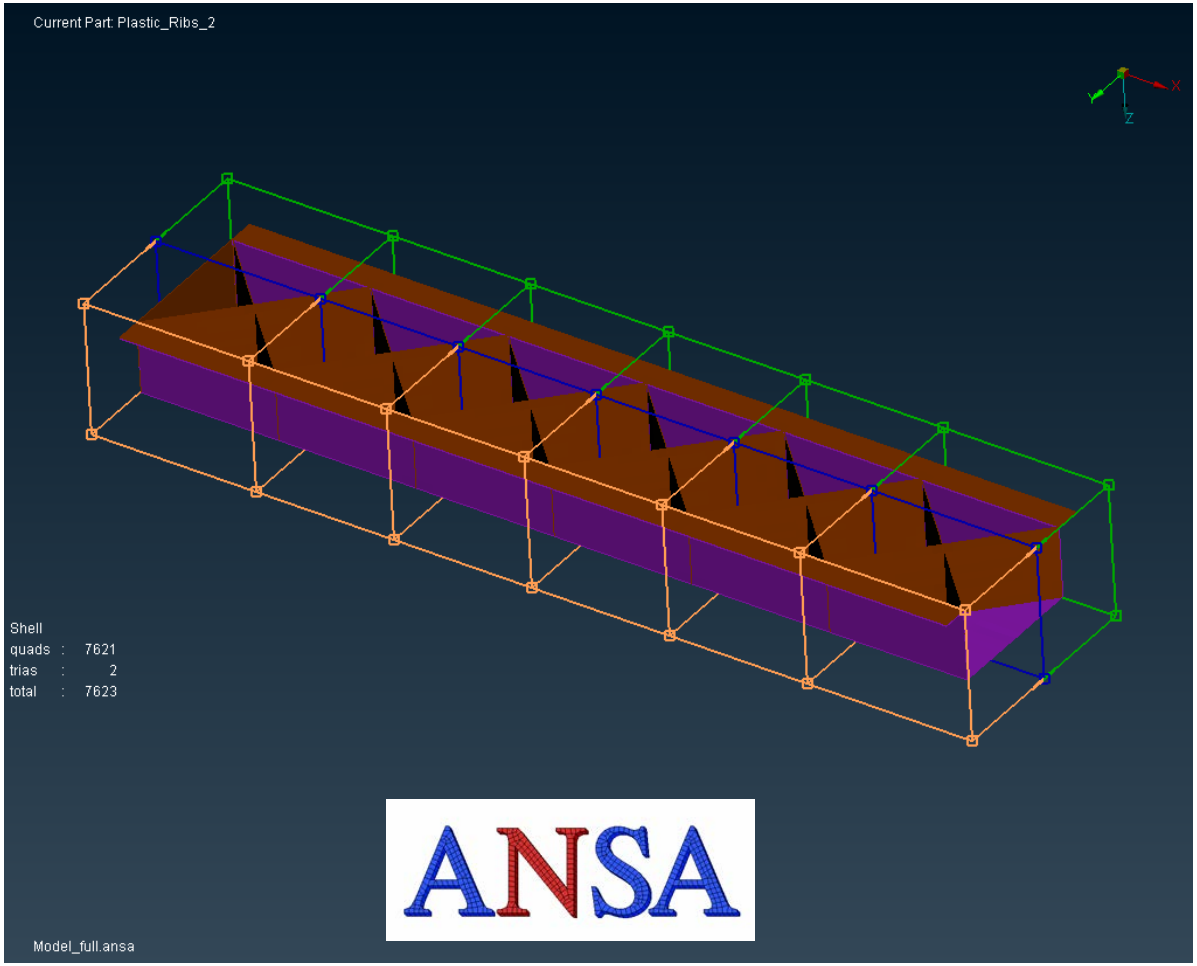
Morphing Parameters

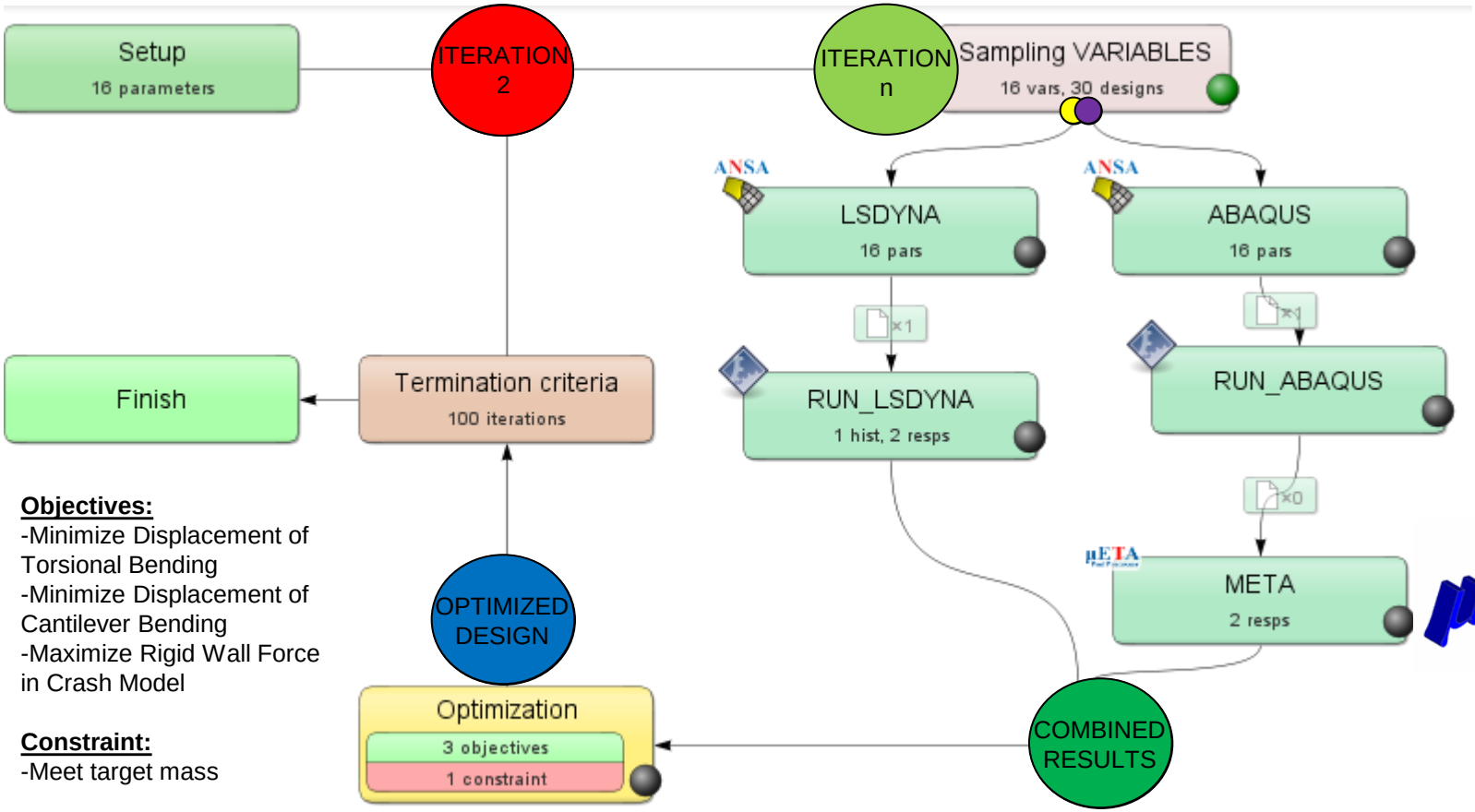


Model can be morphed along any node and corresponding lines +/-16 mm vertically and horizontally

Shell element thickness of ribs and flange can range from 1.5 to 3 mm

Model is reshaped with 3 mm quad mesh and output in LS-DYNA and Abaqus formats to be used as include files for analysis

CAE Optimization Process Workflow



Objectives:
-Minimize Displacement of Torsional Bending
-Minimize Displacement of Cantilever Bending
-Maximize Rigid Wall Force in Crash Model

Constraint:
-Meet target mass

Convergence of Optimization

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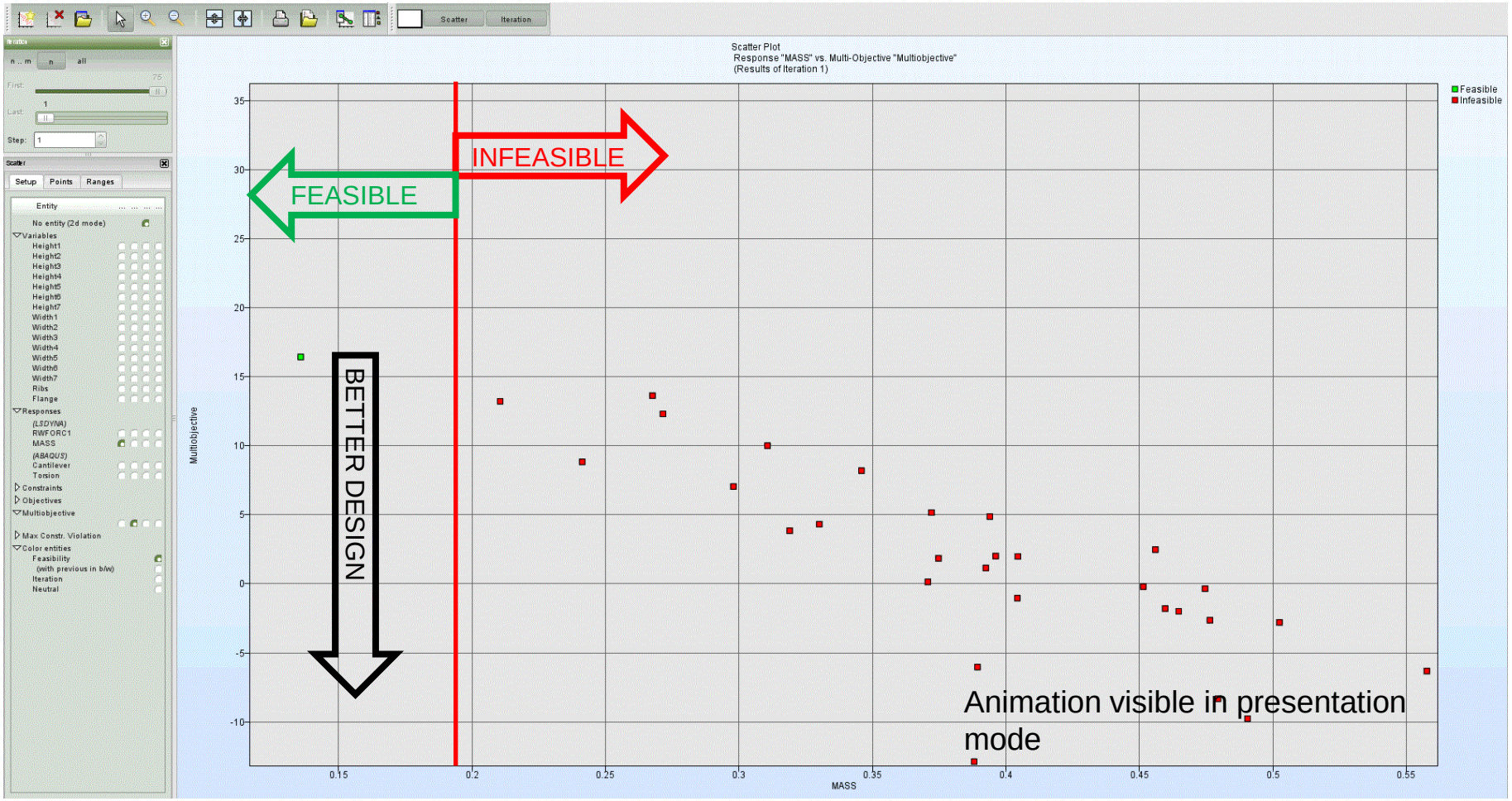

Convergence of Optimization

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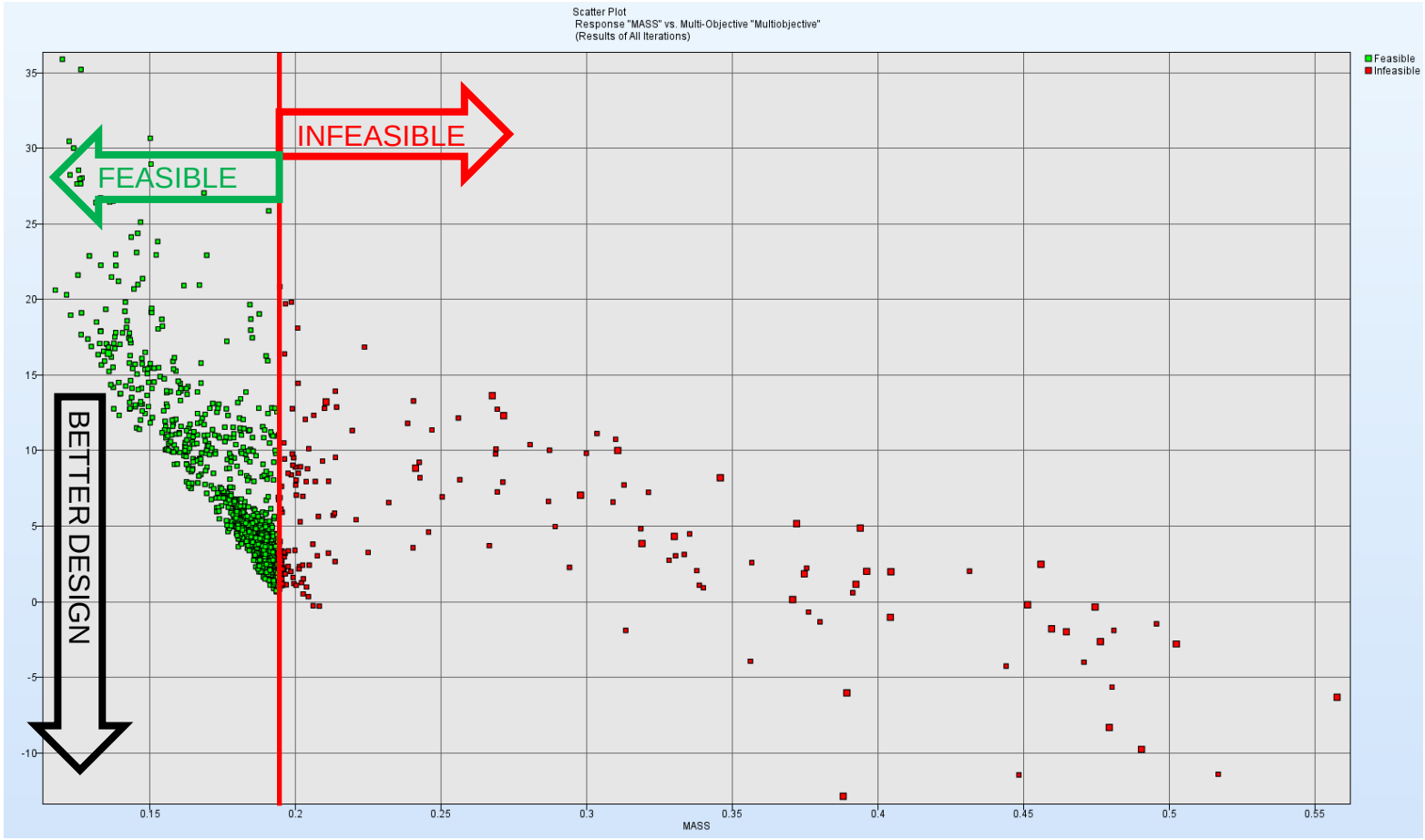

In Summary

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- **Implementation of Features & Capabilities**
  - Seamless interface within ANSA with Spaceclaim software
  - Build in interface to export shell & solid element models to Moldex3D
  - Optimization process flow
    - Utilizing µETA Post for processing of results
    - Automated morphing capability
    - Flexibility to interface with external optimizer and simulation software, such as ULTRASIM®

ANSA

µETA post

- **Benefits**
  - Efficient, high quality model building for injection molding and structural analysis simulations
  - Optimization driven capabilities to automate design workflow and yield designs otherwise not possible

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