

Steel Processing Properties and their Effect on Impact Deformation of Lightweight Structures

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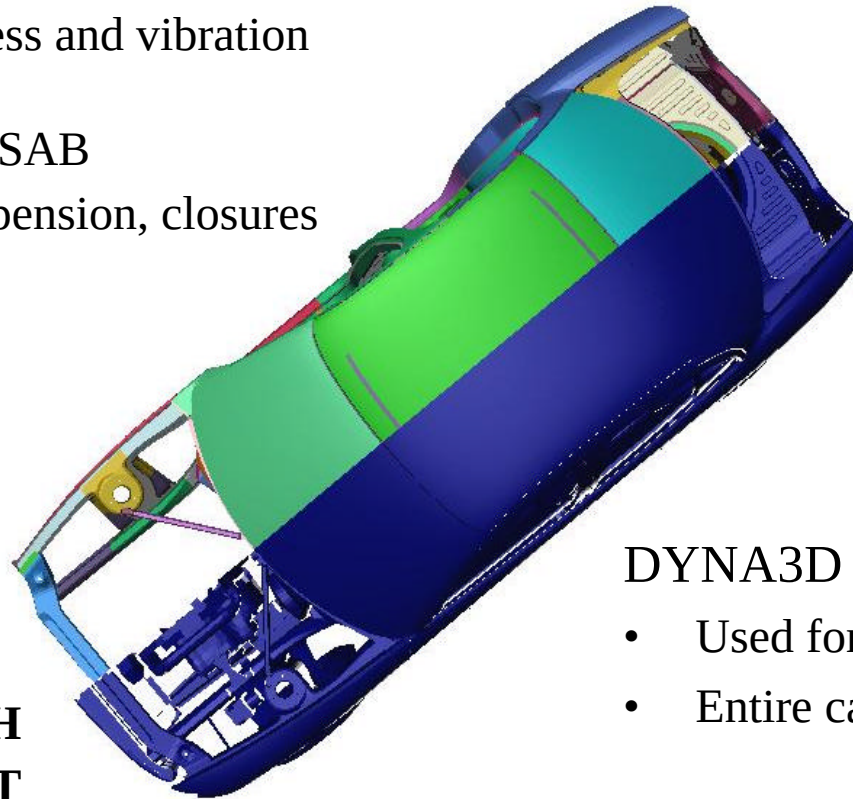
Activities Since Last Quarterly Report

- Material Forming Simulations for ULSAB Front Crash Parts
 - Performed by AISI member companies using one-step codes
 - Final geometry was based on ULSAB **Nastran** FEM model
 - Results were compiled by Jody Shaw into Excel file:
 - Element, Thickness, Plastic Strain
- Crash Simulations Using As-Formed Parts
 - Developed program for mapping elements between Nastran and crash model (**DYNA3D**)
 - Developed program for incorporation of forming data into crash model
 - Performed NCAP crash simulations with ULSAB model

NASTRAN-to-DYNA3D Mapping

NASTRAN Model

- Used for stiffness and vibration analysis
- One half of ULSAB
- No engine, suspension, closures



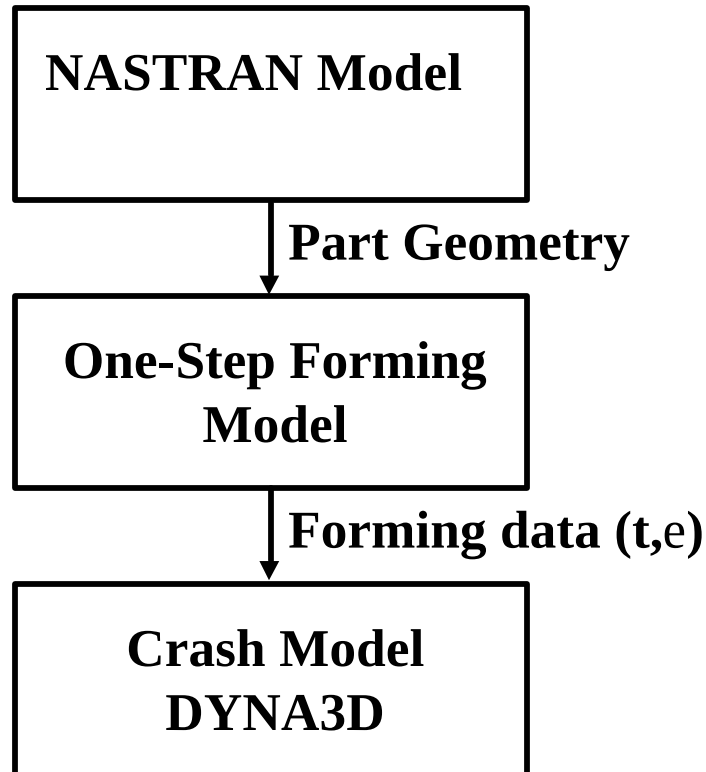
**PARTS OF MESH
ARE DIFFERENT**

DYNA3D Model

- Used for crash analysis
- Entire car is modeled

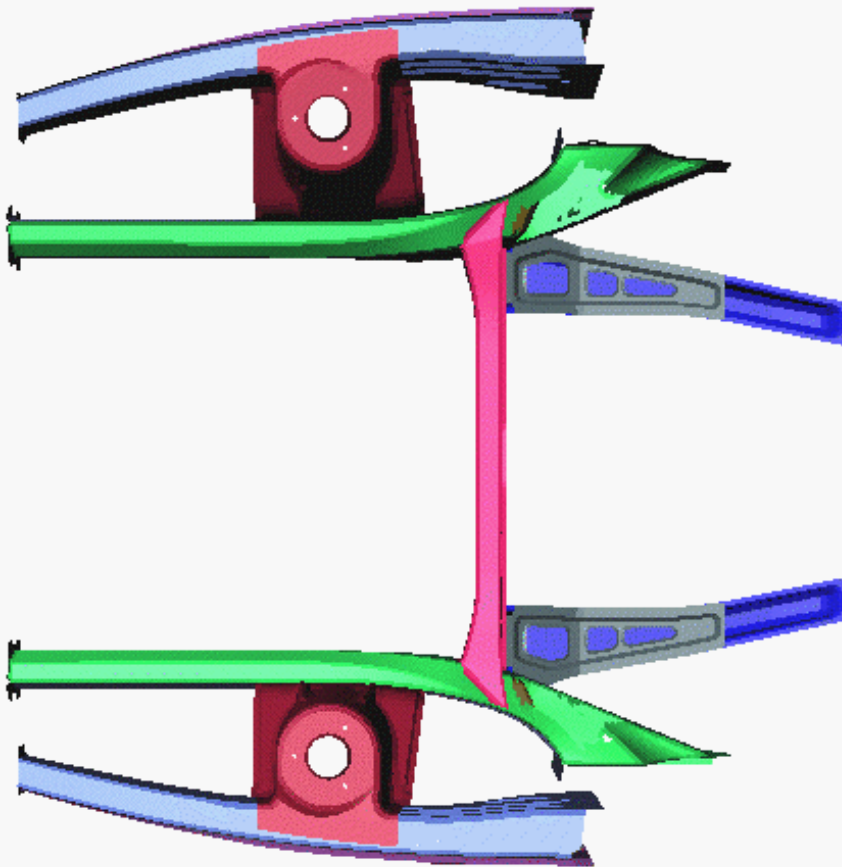
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Incorporation of Forming Data into Crash Model



- One-Step forming was done by AISI member companies
- Forming data sent to ORNL
- ORNL incorporated forming data into crash model and performed simulations

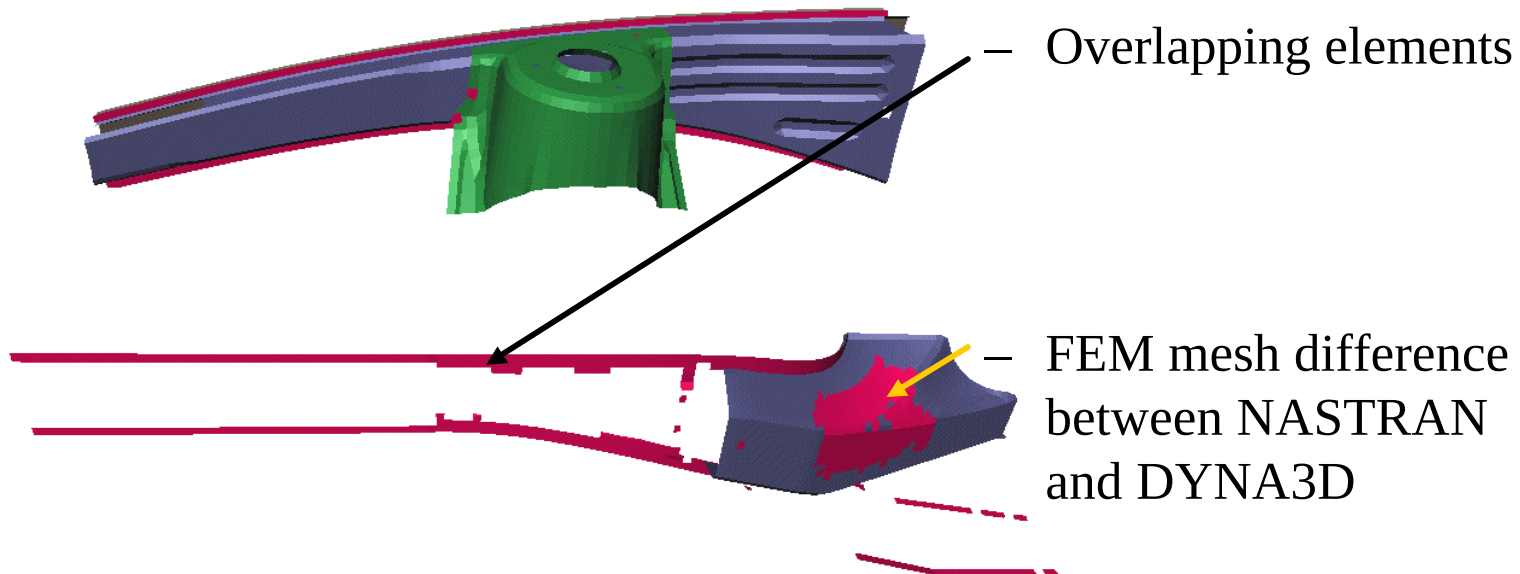
Analyzed Parts



- Main front crash structure
- Does not include subframe which has large influence on crash response
- Forming data consists of thickness change and plastic strain

FEM Model Problems

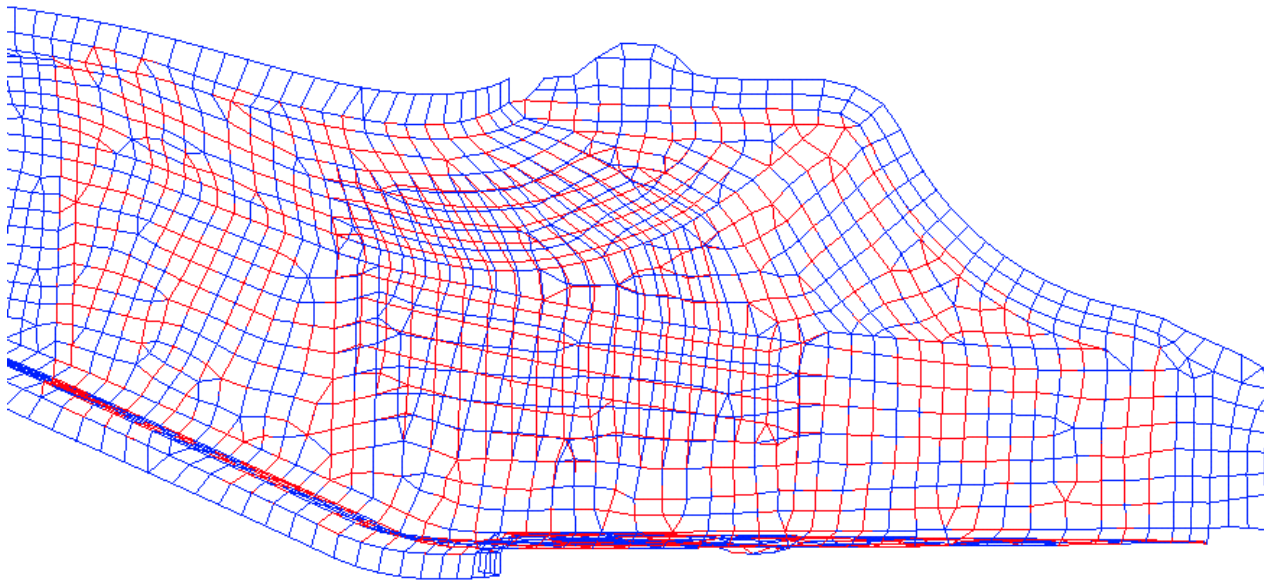
- Red color indicates problem areas
 - Overlapping elements



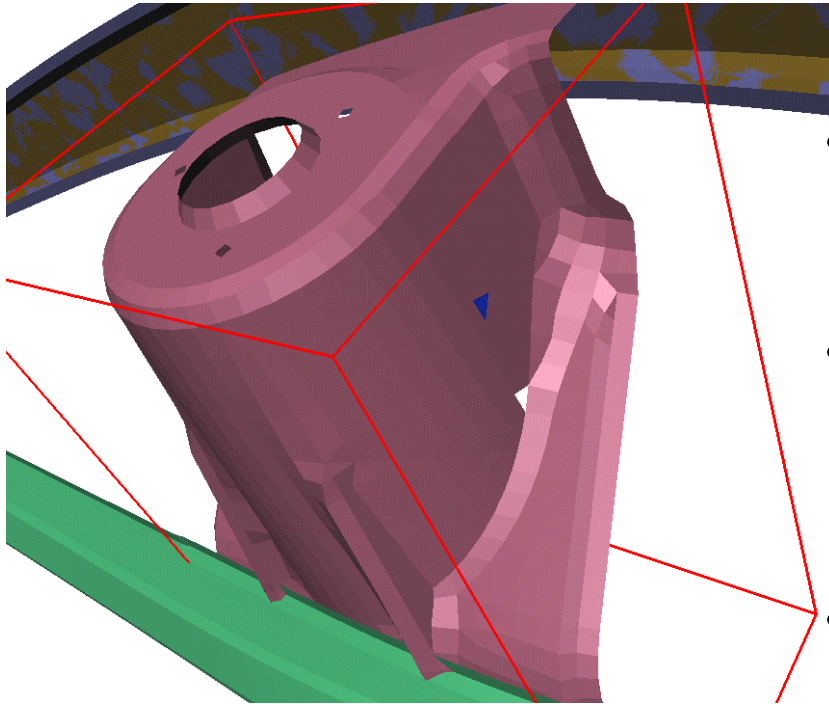
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FEM Mesh Incompatibility

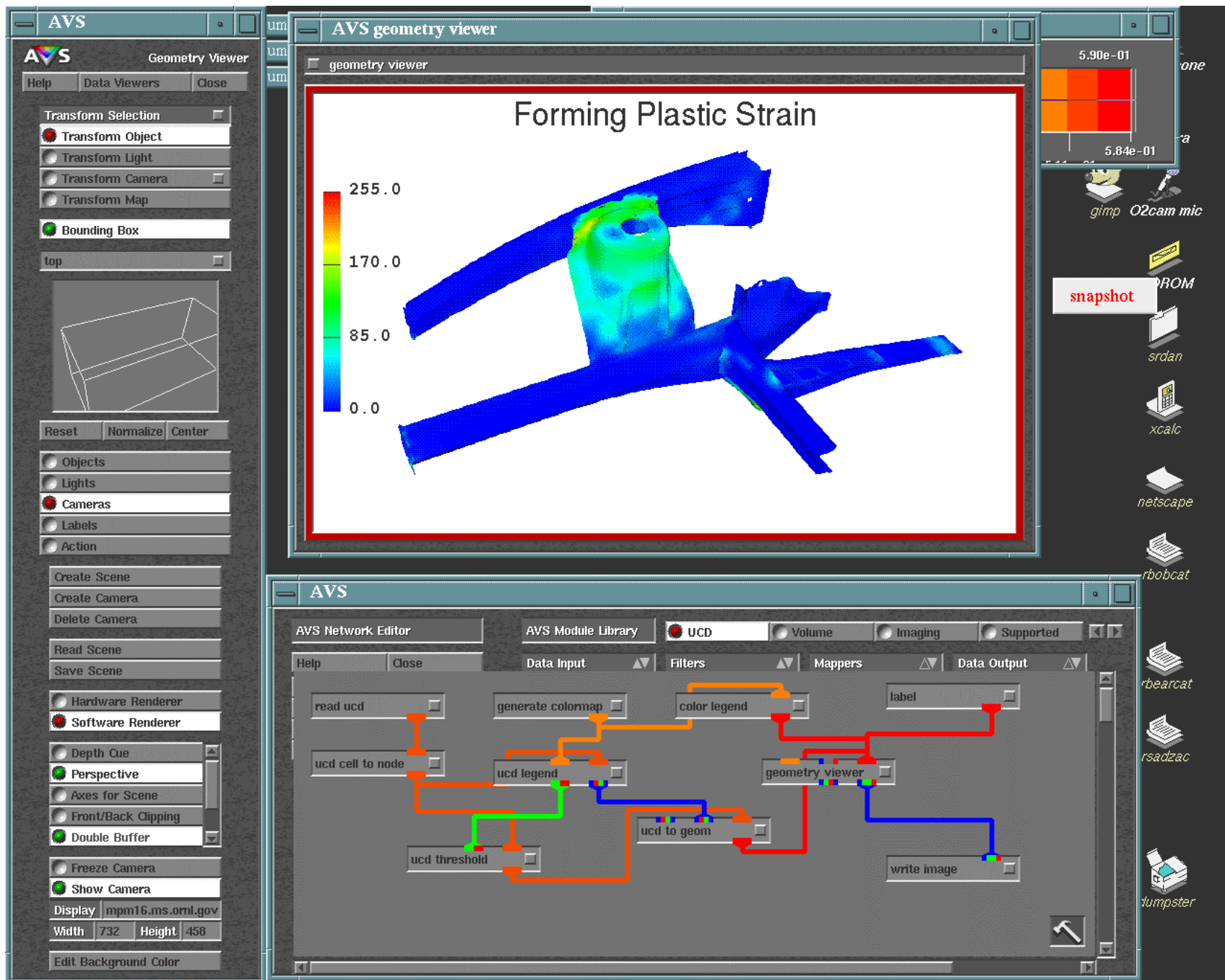
- One part was affected, base of lower rail
- Red lines – NASTRAN, Blue lines – DYNA3D
- Difference in mesh require more time for data debugging,
- Decision: Affected patch does not use forming data



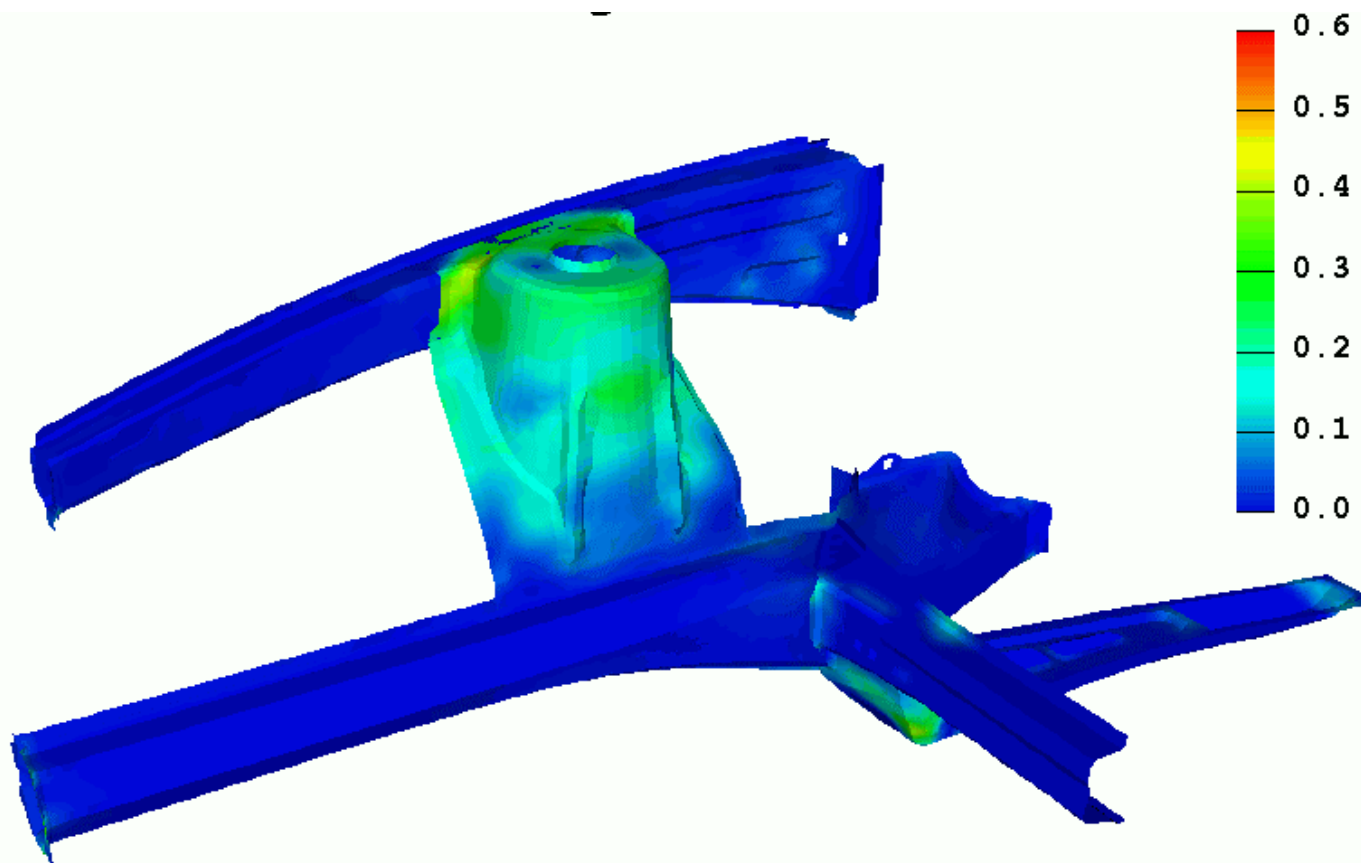
Minor Headaches



- Missing NASTRAN elements in DYNA3D
 - Decision: not use them
- Difference in left and right side on DYNA3D model
 - Decision: increase tolerance for mapping, data still good
- Visualization and debugging of data from different programs
 - Make programs as needed

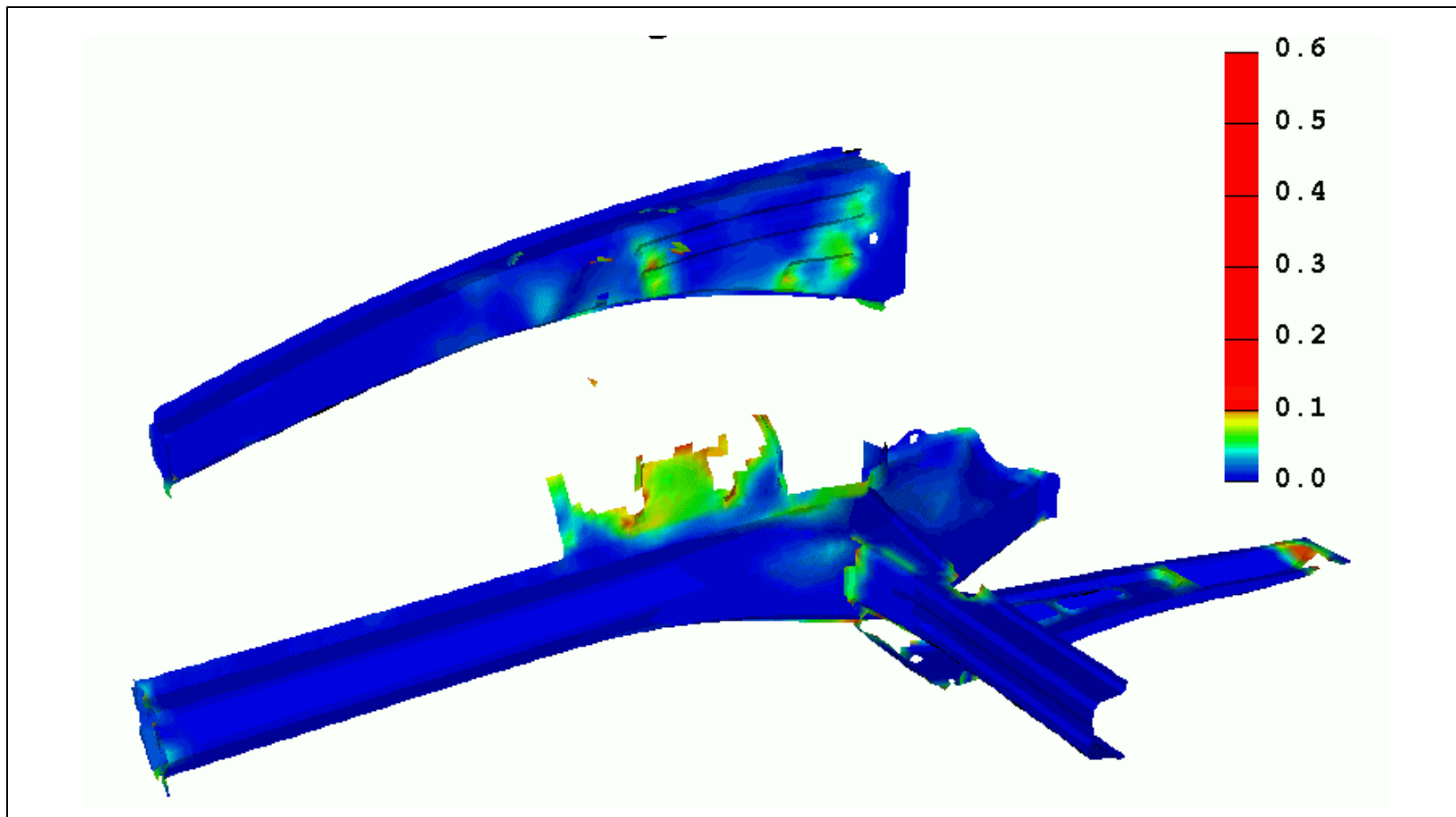


Plastic Strain after Forming [*100%]



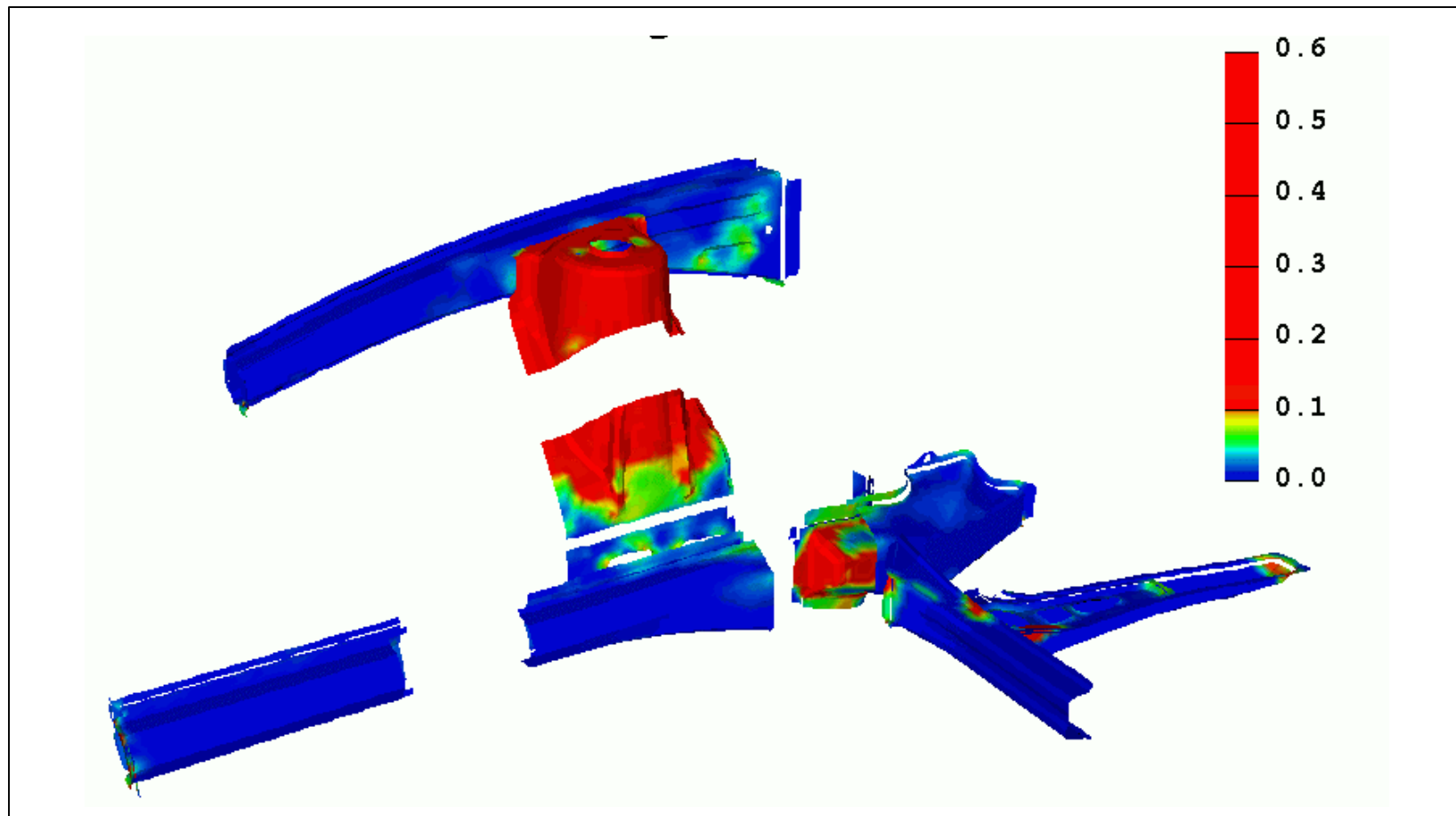
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Elements with Strain < 10%



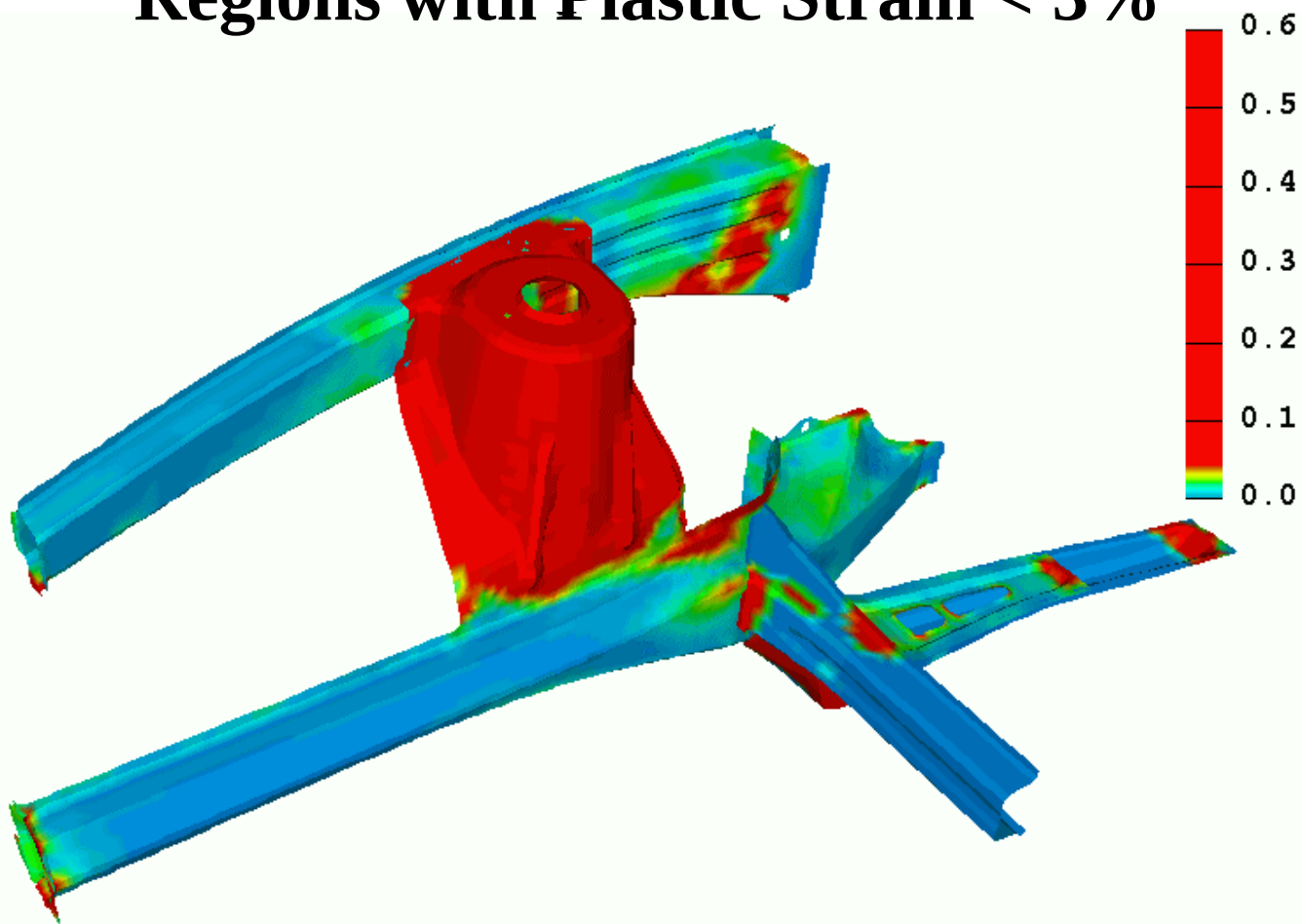
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Plastic Strain - Exploded View



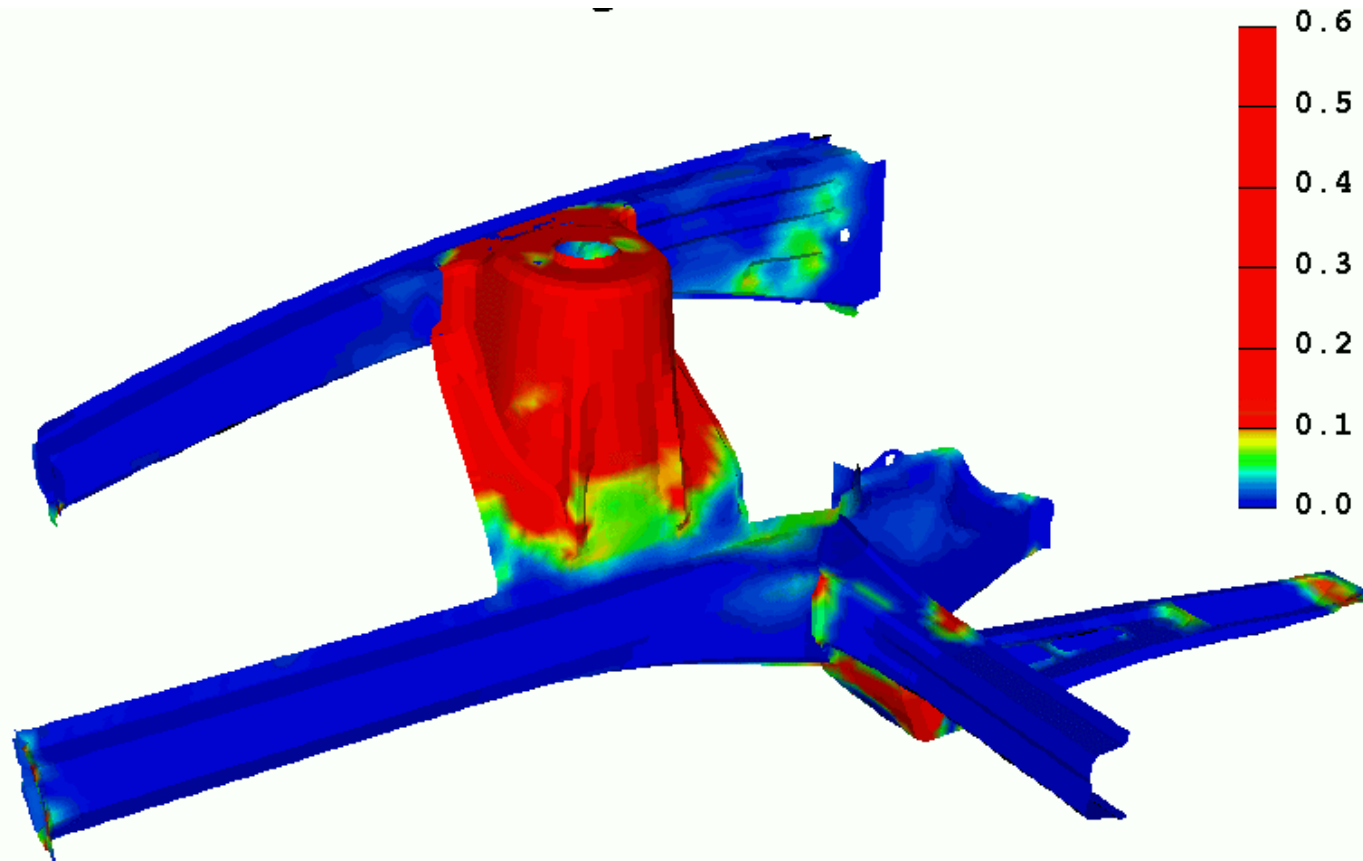
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Regions with Plastic Strain $< 3\%$



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One More

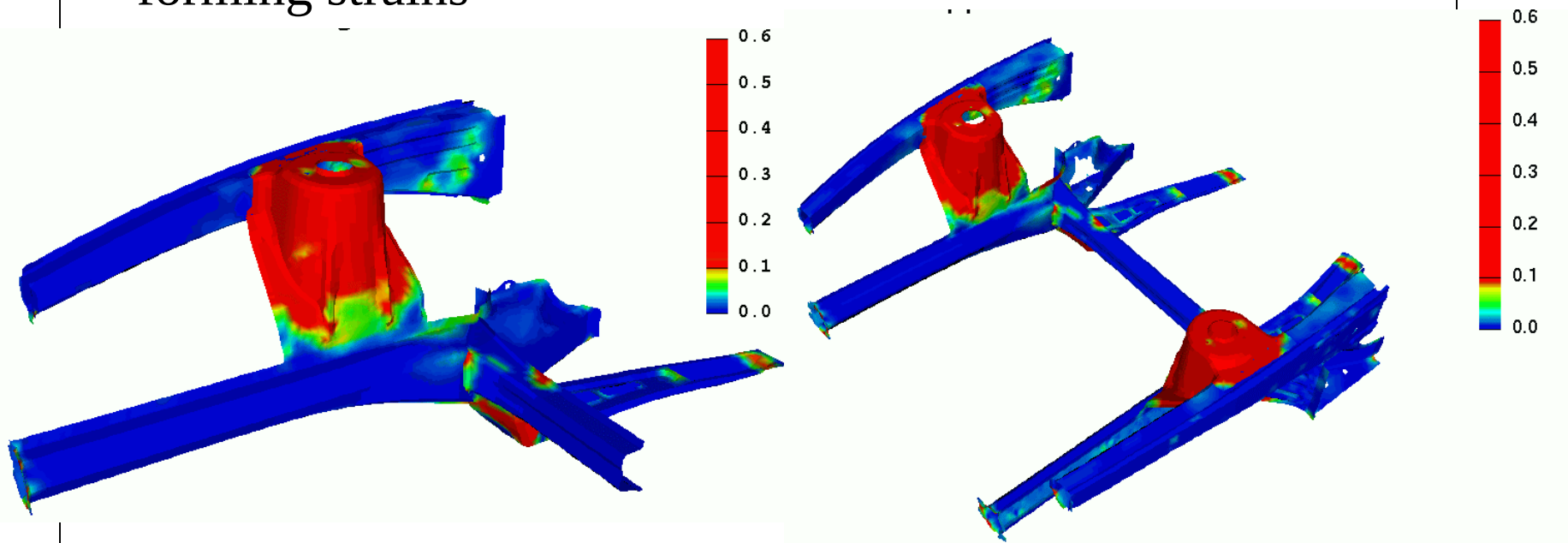


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Mapping of Strains into Crash Model

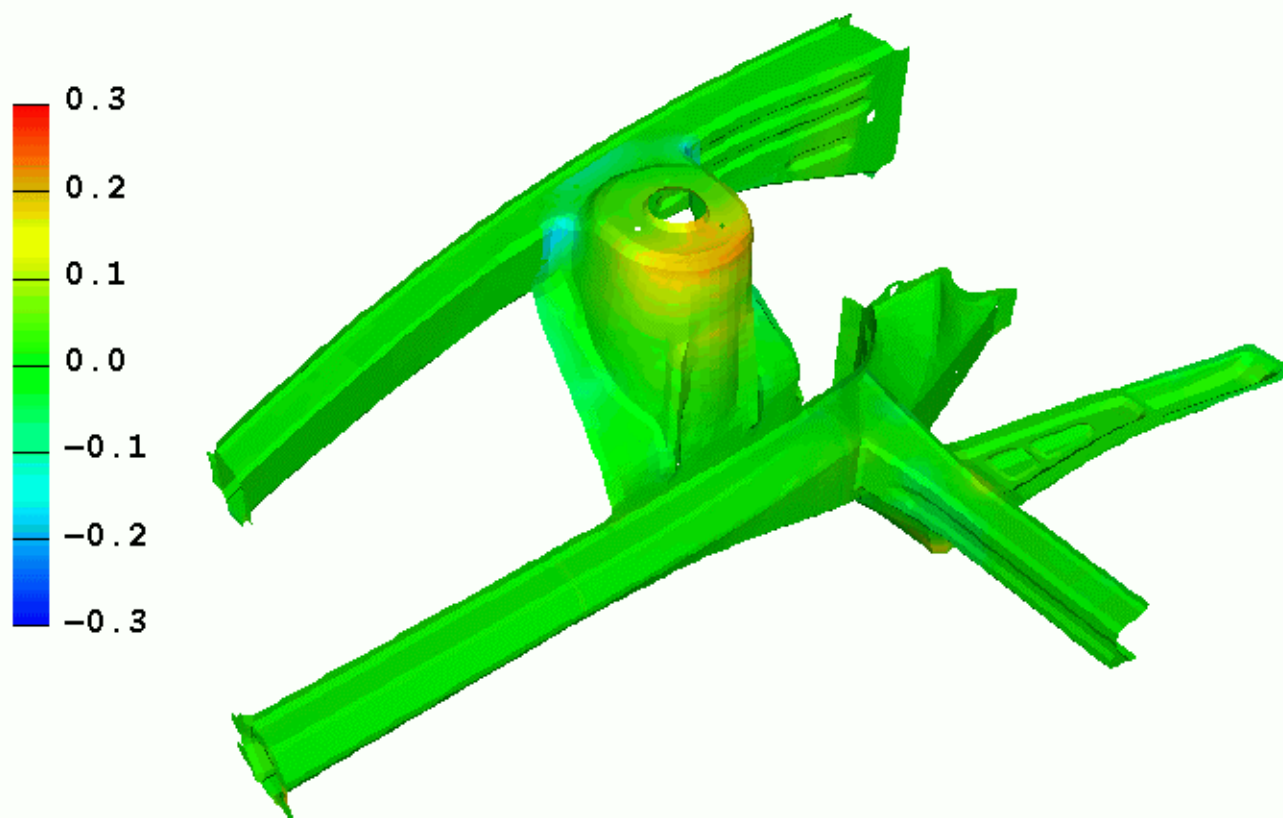
NASTRAN model-based
forming strains

Crash Model (DYNA3D)



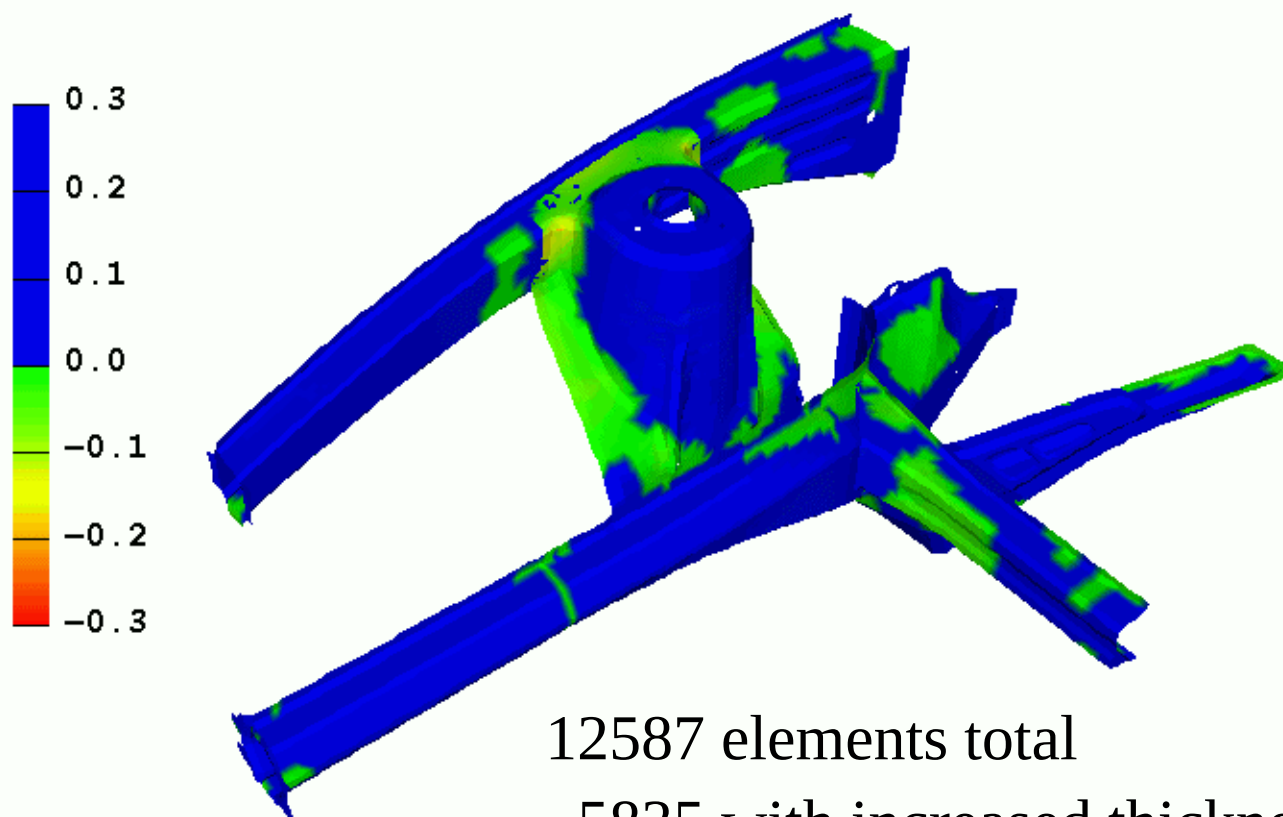
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Thickness Change after Forming [*100%]



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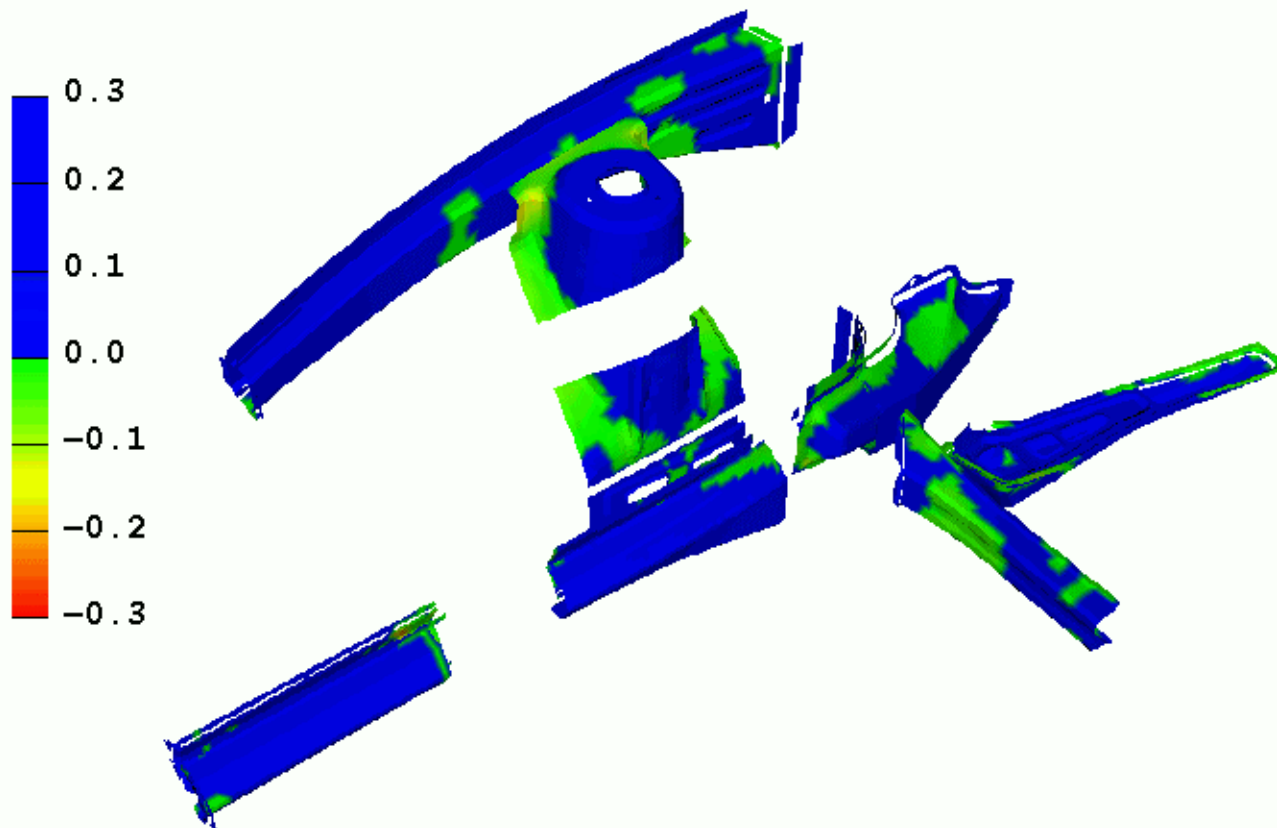
Areas with Thickness Increase



12587 elements total
5835 with increased thickness

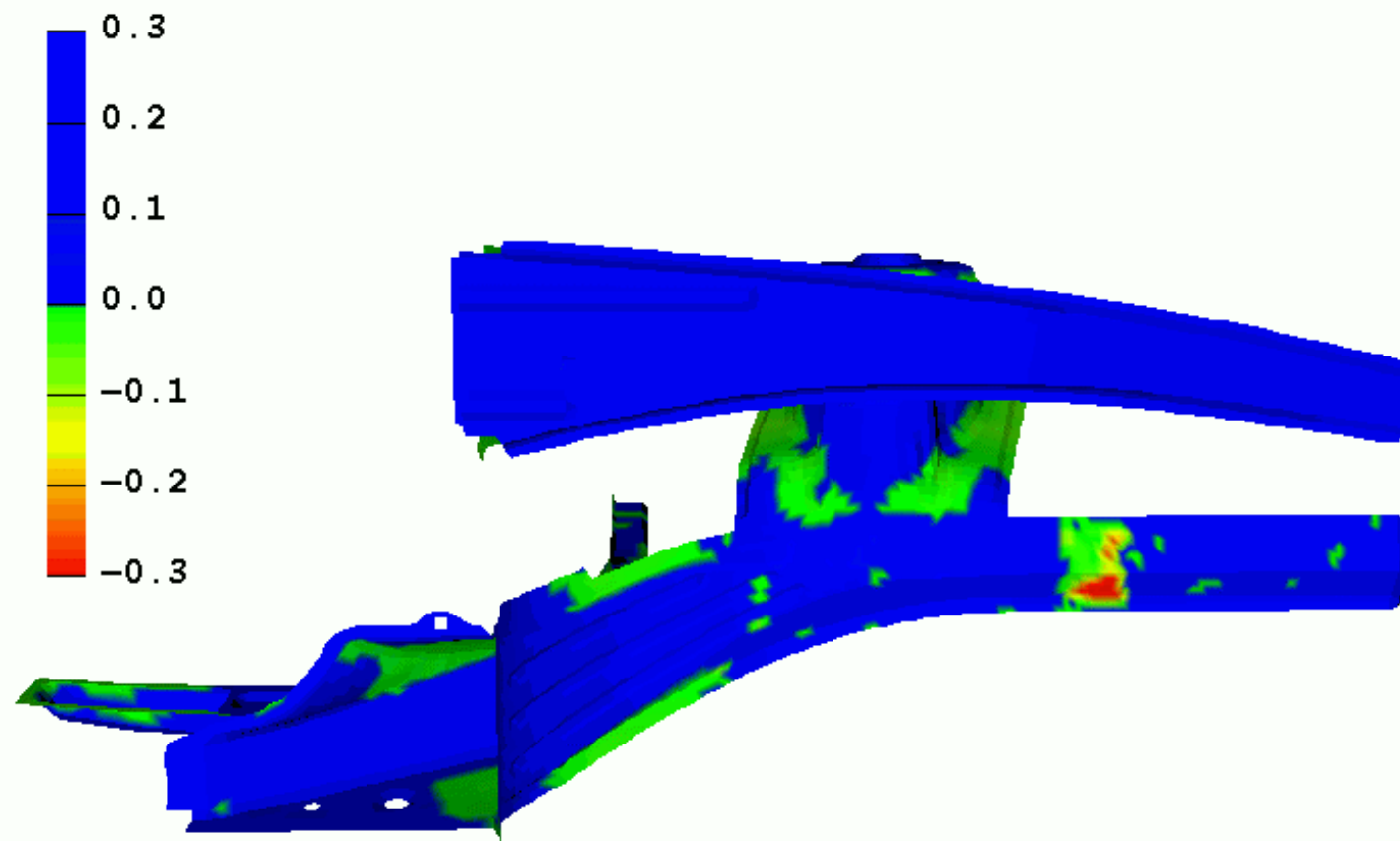
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Thickness Forming Data - Exploded View



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Thickness Data – Outer Side



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