Latest Trends in LS-DYNA User Community

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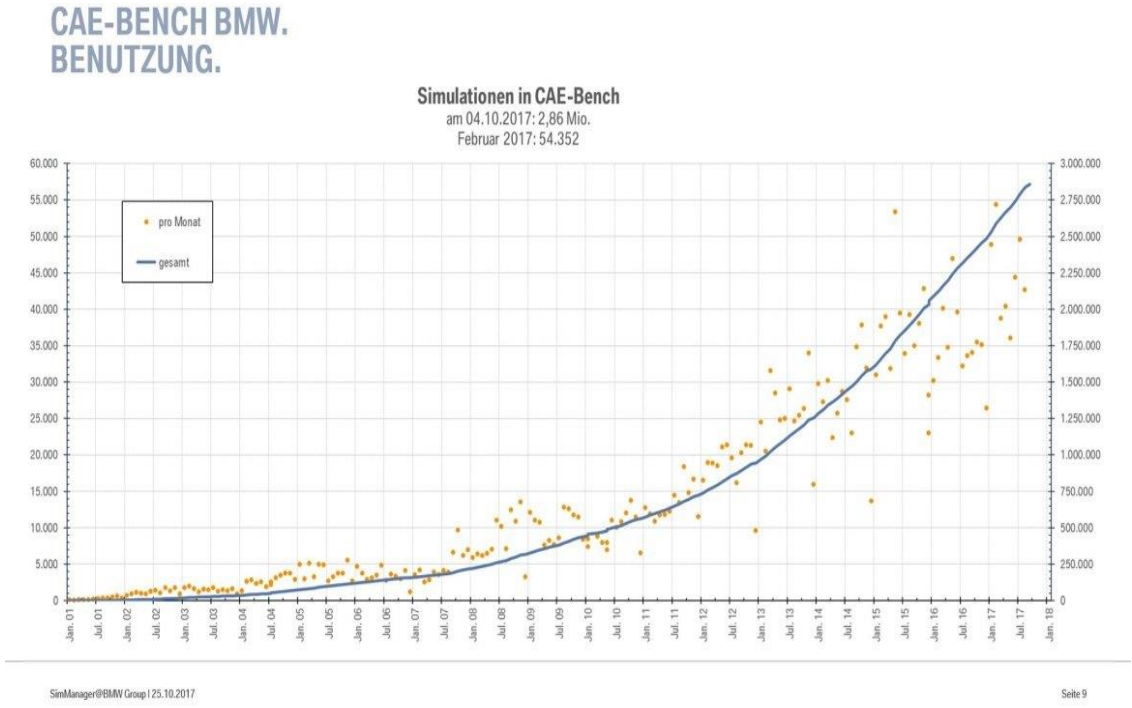
Oasys
LS-DYNA ENVIRONMENT

1. Crash simulation data compression

Challenge

- In order to improve engineering design …
  - more simulations are performed
  - larger, more detailied Models are used
- Large amounts of data are generated! (several PetaByte per year)
  - The data has to be …
    - analyzed
    - exchanged
    - archived
  - Network connections and storage space can become bottlenecks!



Data Compression

Compression approaches

- Two fundamentally different compression approaches:

- **Lossless Data Compression**

  The original data can be restored identically from the compressed data

- **Lossy Data Compression**

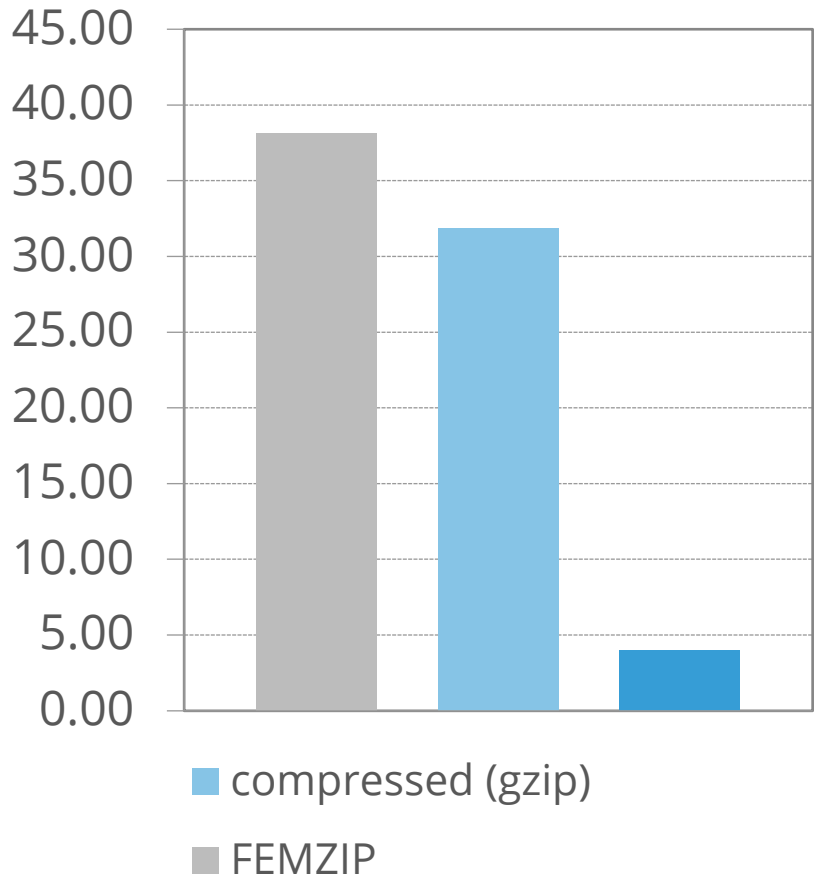
  The original data **cannot** be restored identically from the compressed data

- With lossy data compression schemes a much stronger reduction can be achieved!

Data Compression

Solution

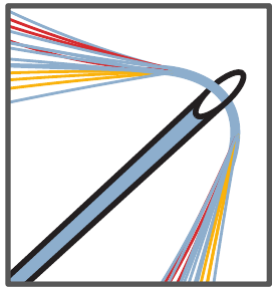
Floating-point data cannot be efficiently compressed losslessly:



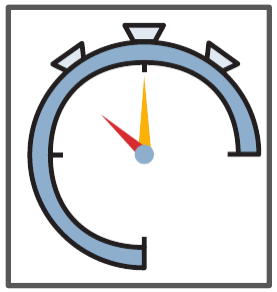
- A compression factor of only 1.2 is obtained
- The solution is **FEMZIP**

Advantages

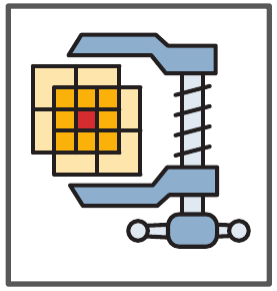
Compression tool-Femzip



Shorter Data Transfer Times
Simulation results can be transfered significantly faster



Quicker Data Loading
Compressed data can be loaded quicker into post processors. No more RAM issue. Multiple Jobs can be read together if needed.



Reduced Archive Size
Storage and backup capacities can hold more simulation results

Functionality

Parameter file

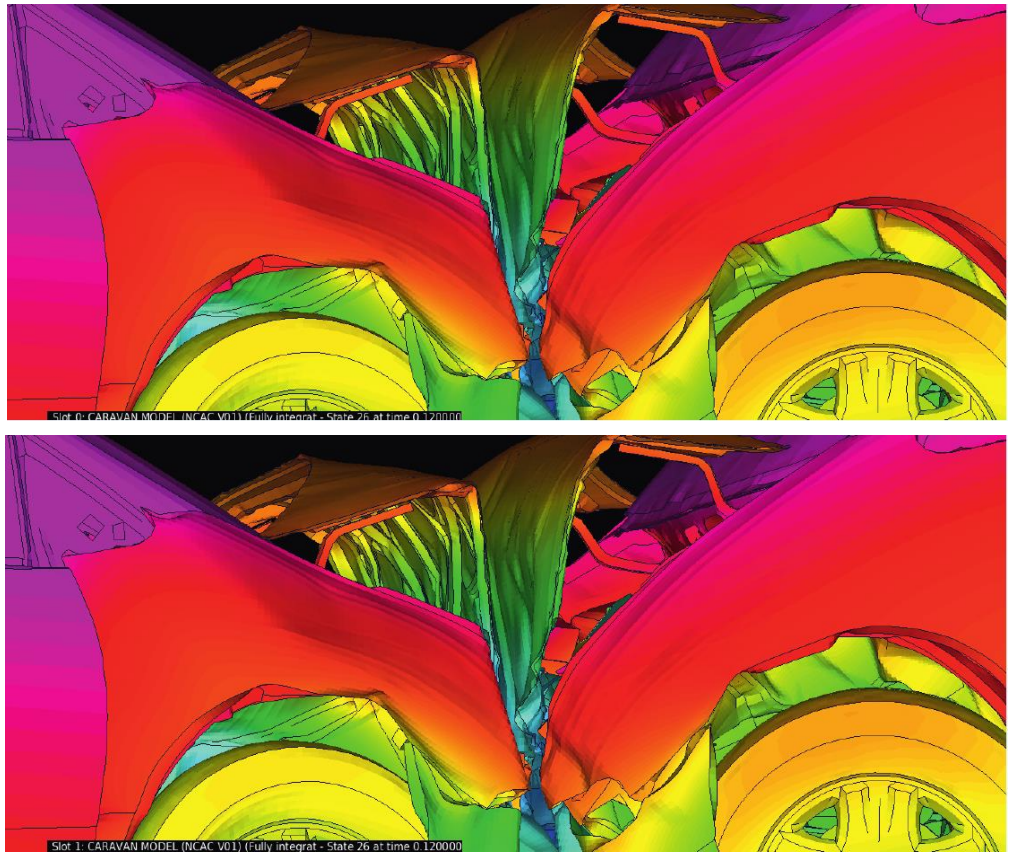
```
FEMZIP Standard Configuration File  (mm, s, Tons, N)

  Number of extra values per shell:             5
  Number of extra values per solid:             6
  Number of extra values per thick shell:       5

   Node values: precision
         coordinates                    :       0.10000000
         velocities                     :       10.0000000
         accelerations                  :       10000000.0
   Shell values: precision
         sigma                          :       1.00000000
         epsilon                        :       0.00100000
         bending_moment                 :       1000.00000
         shear_resultant                :       10.0000000
         normal_resultant               :       10.0000000
         thickness                      :       0.00100000
         internal_energy                :       1.00000000
   Thick shell values: precision
         sigma                          :       1.00000000
   Solid values: precision
         sigma                          :       1.00000000
   1D-element values: precision
          axial_force                   :       10.0000000
         s_shear_resultant              :       10.0000000
         t_shear_resultant              :       10.0000000
         s_bending_moment               :       1000.00000
         t_bending_moment               :       1000.00000
        torsional_resultant              :       1000.00000
```

Loss less compression

Result comparison

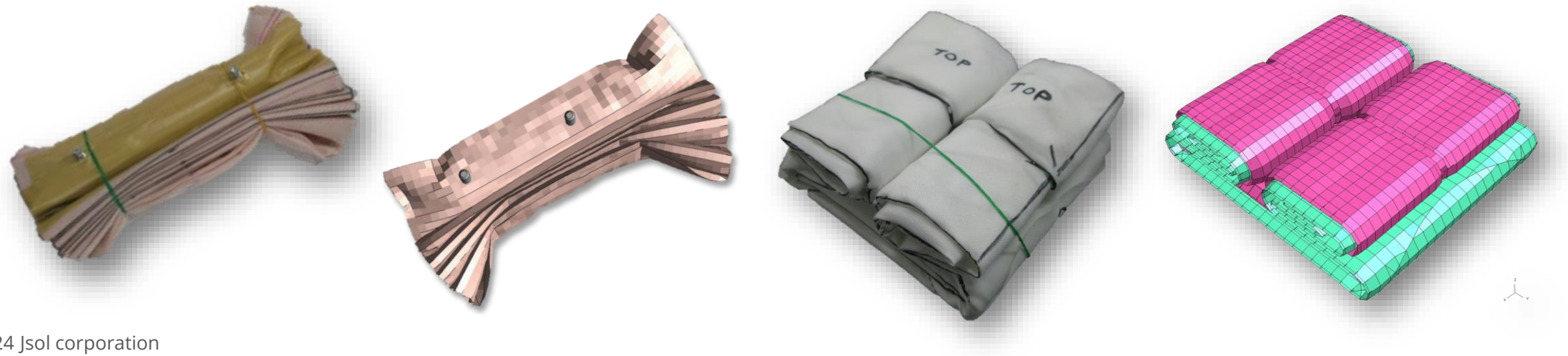


The visual appearance of the original and the compressed results is shown. While a compression of 88% was achieved but no difference is noticeable.

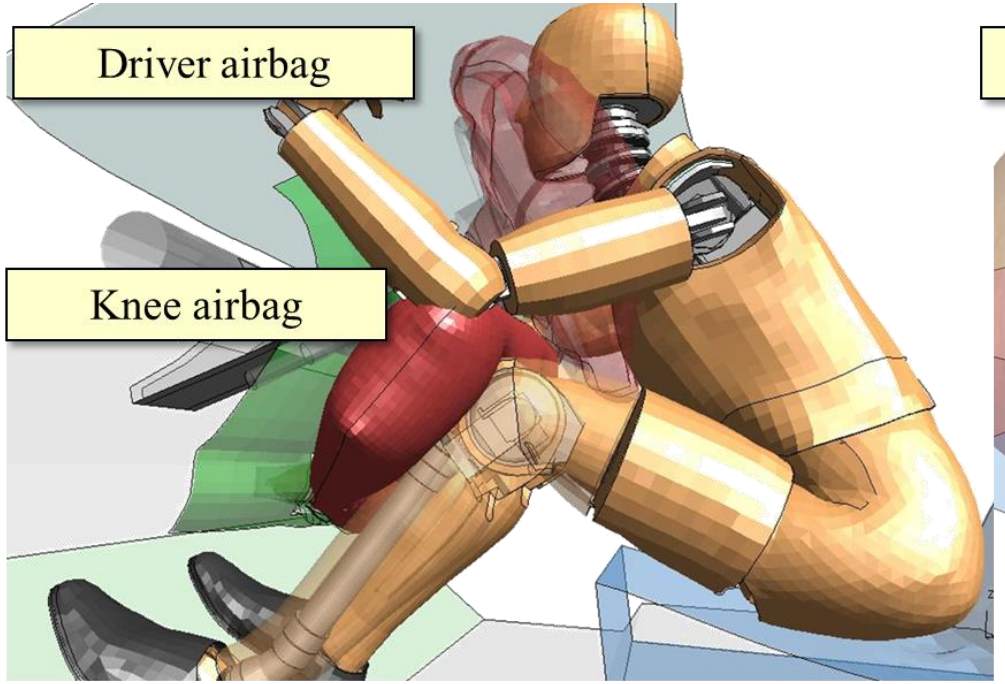
Source: topcrunch.org

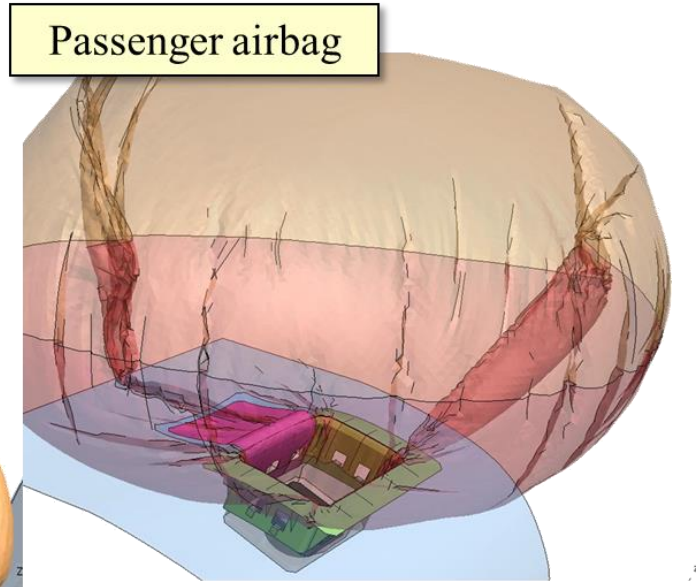
2. Simulation Based Airbag folding

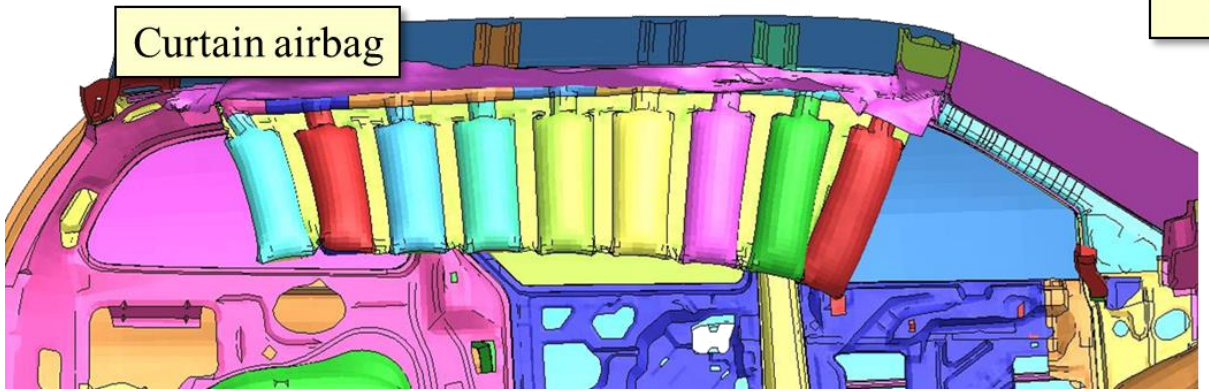
- Pre-processor method can fold simple patterns very quickly but can't create the complex folded shapes often used in modern airbag designs.
- Simulation-based approach requires preparation and calculation time but can be applied to almost any kind of folding pattern thanks to the physical, realistic nature of the folding process.



Airbag deployment simulations

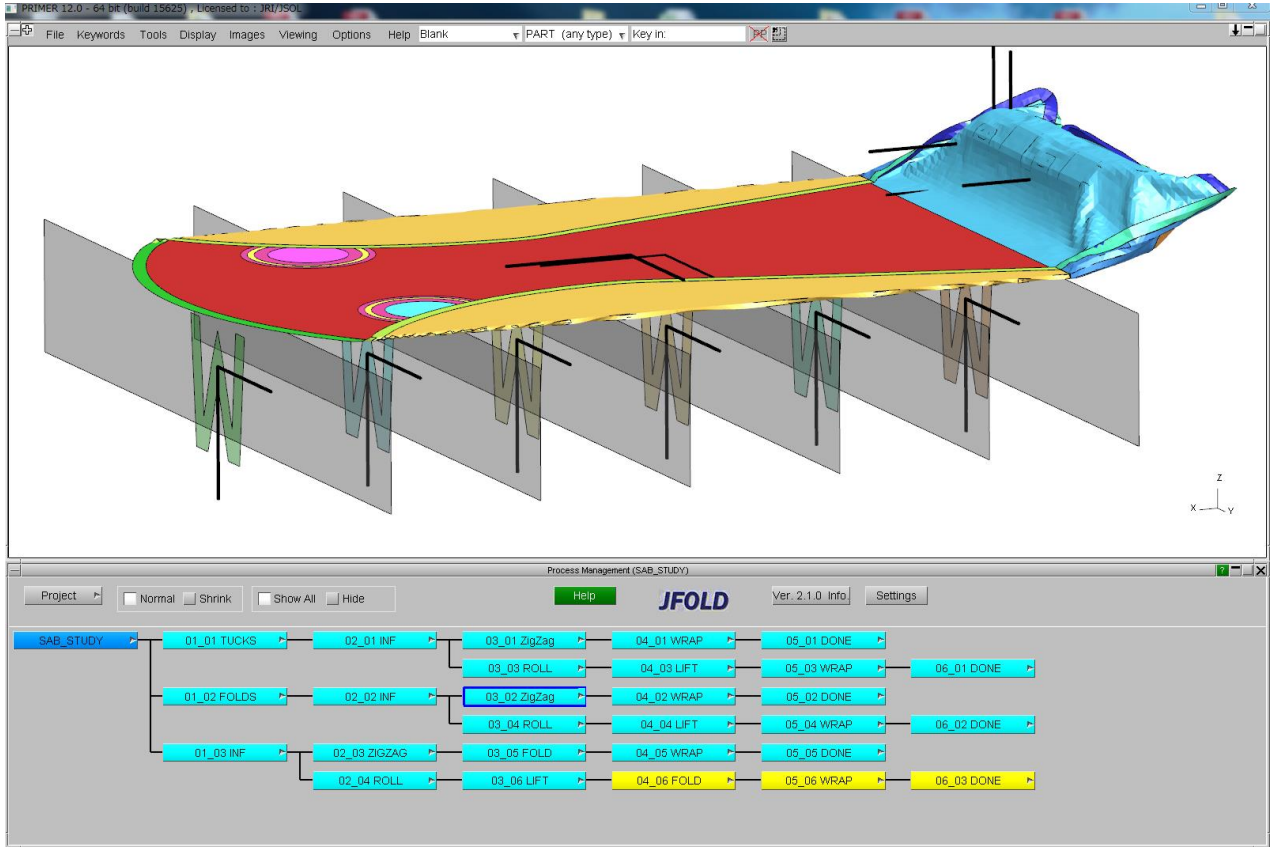






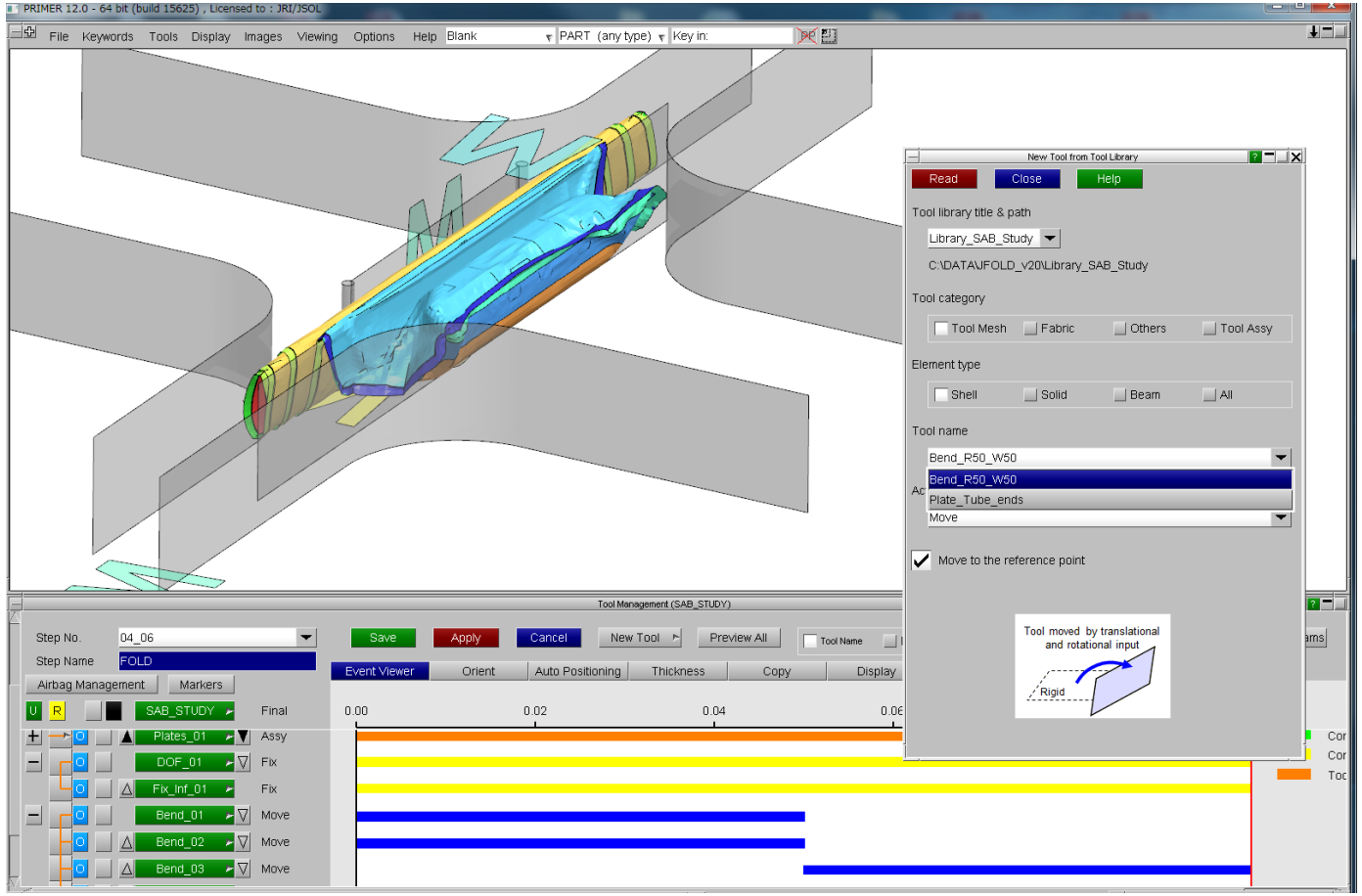
Introducing JFOLD

- JFOLD is a software tool developed by JSOL Corporation that helps the user perform simulation-based folding on an airbag model.



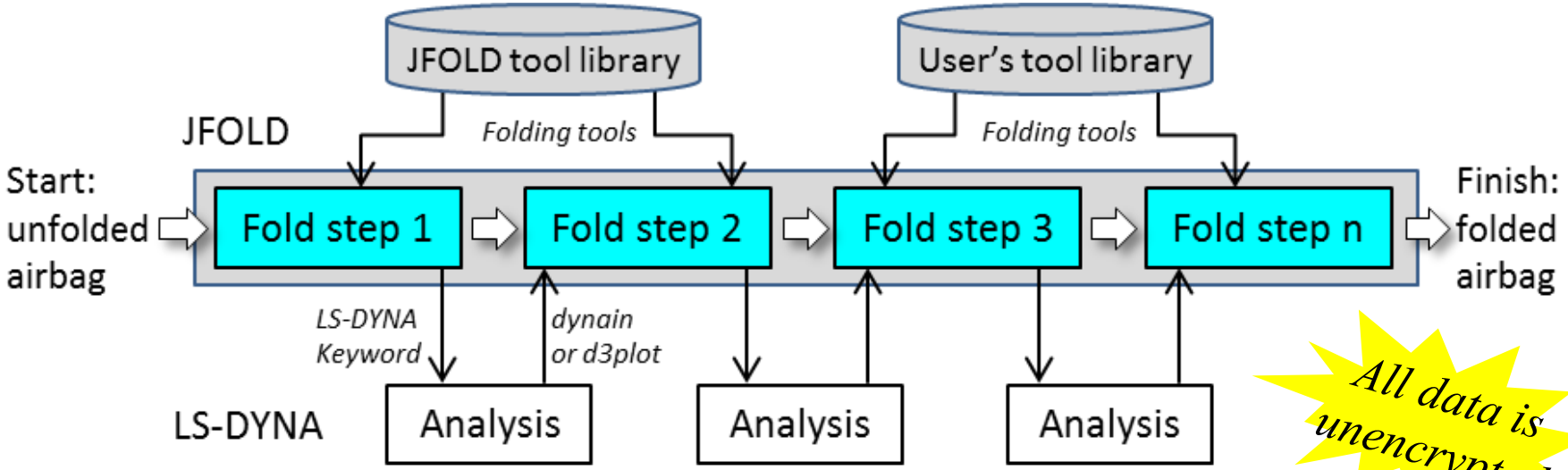
Introducing JFOLD

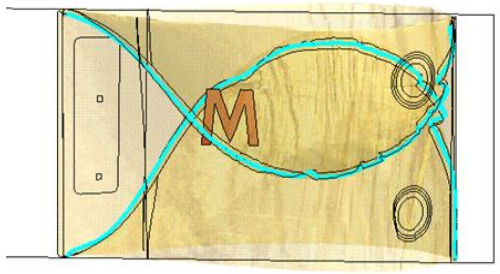
- JFOLD runs inside Oasys PRIMER as a JavaScript, and uses LS-DYNA to simulate each folding step.

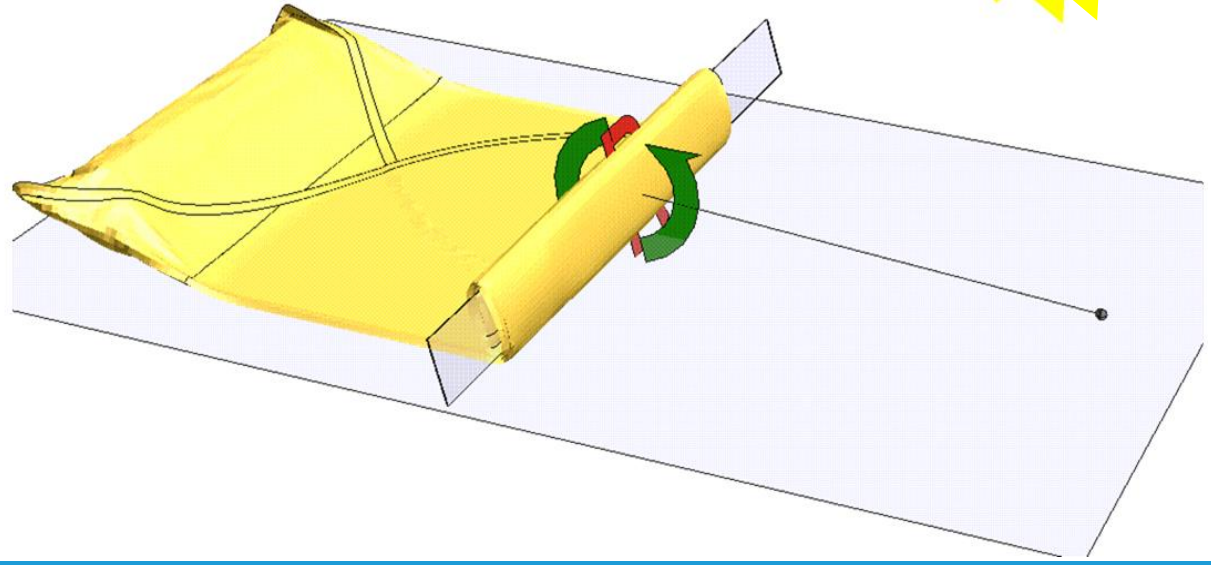


Oasys

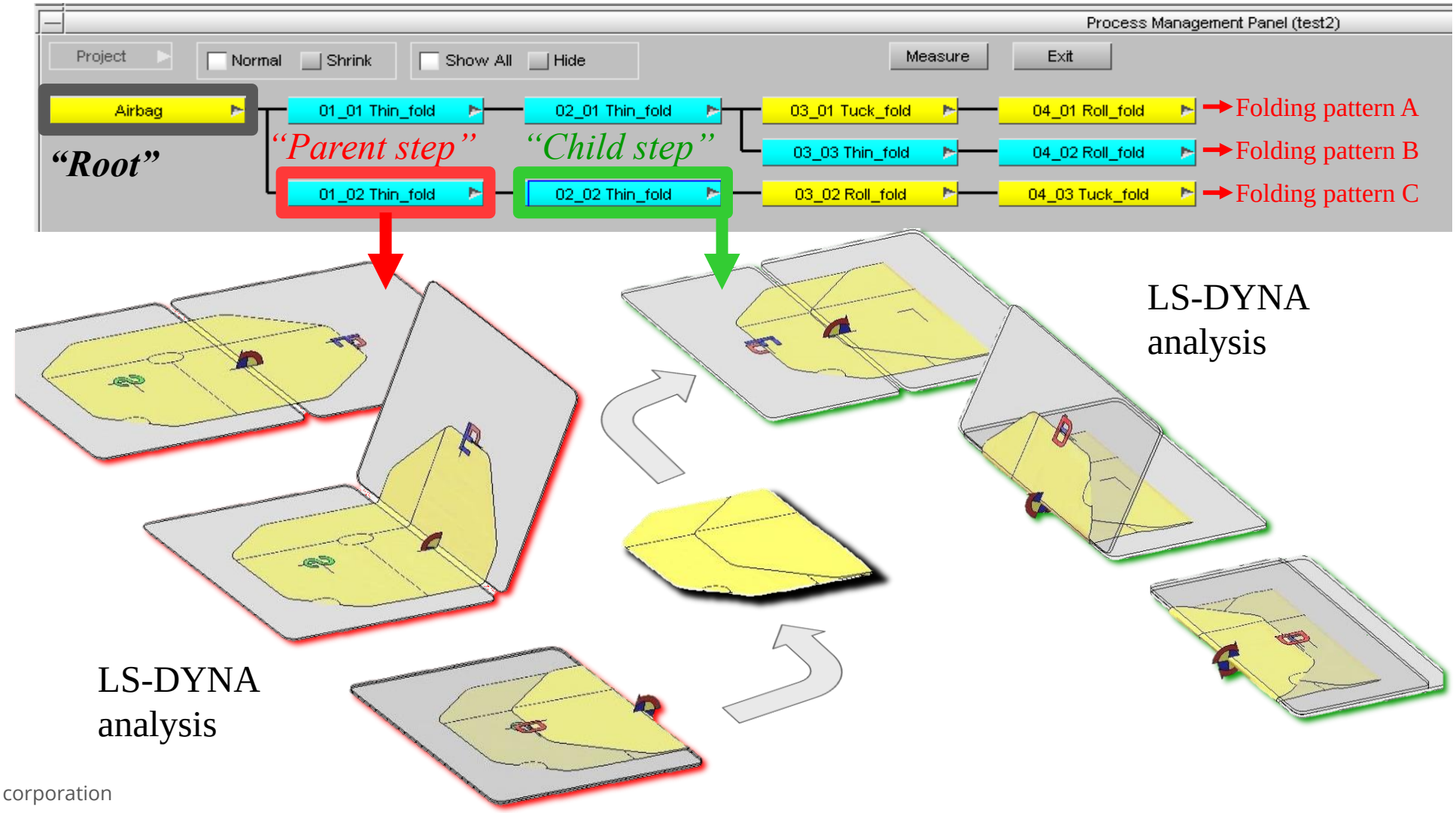
How JFOLD works



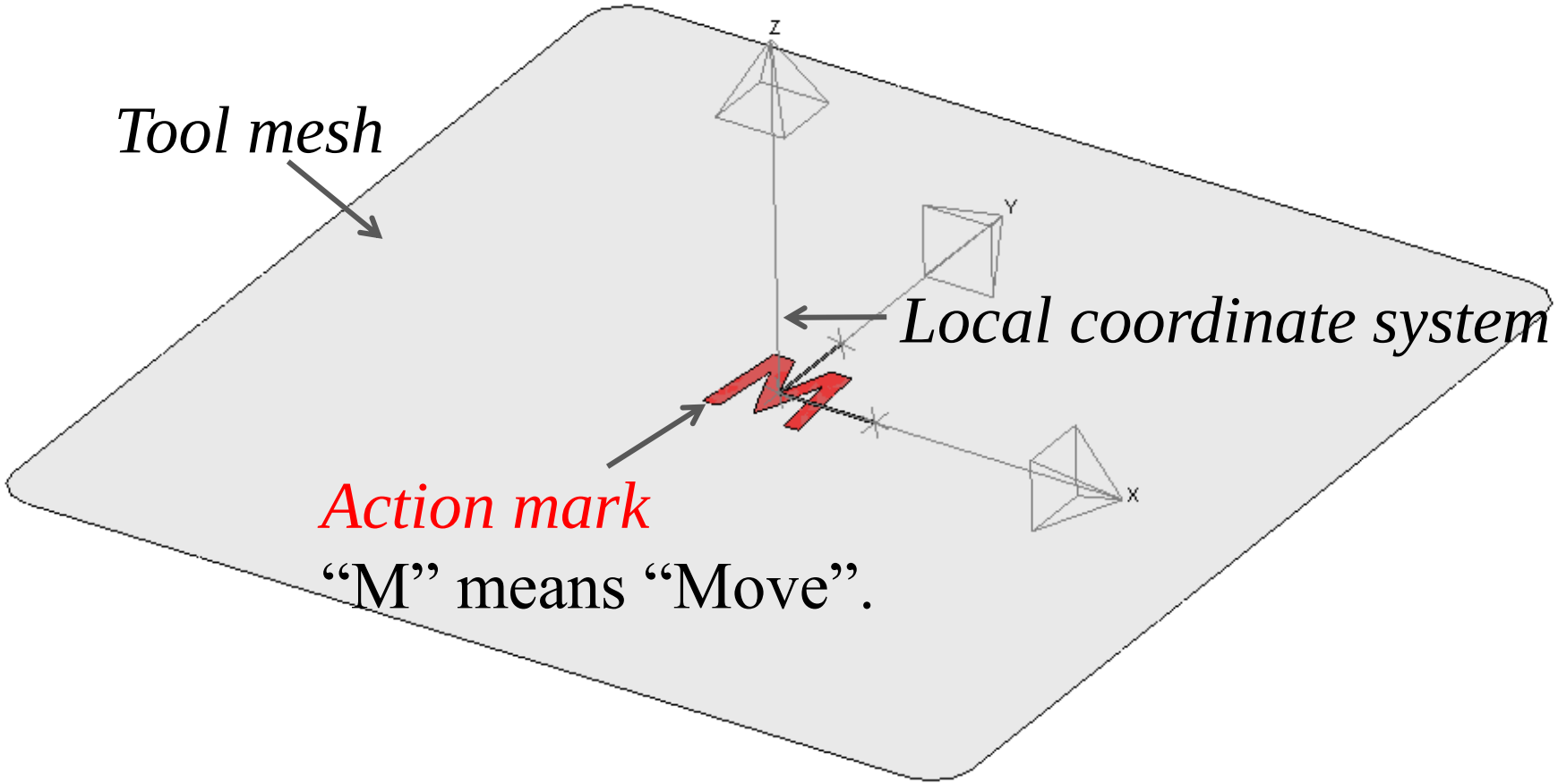




Process Management Panel



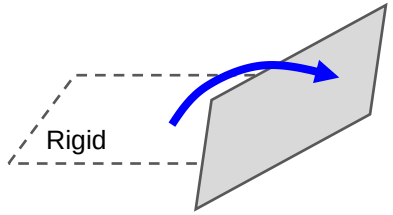
Tool mesh



Action types of tool mesh

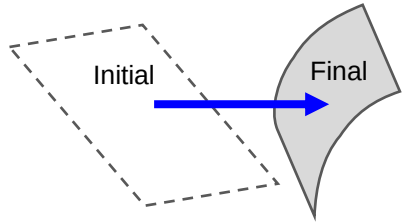
Stationary

Move



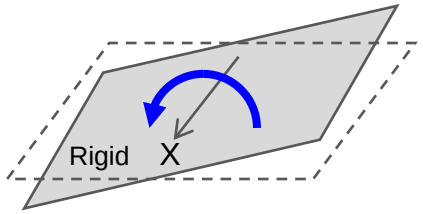
*BOUNDARY_PRESCRIBED_MOTION_RIGID

finalGeom



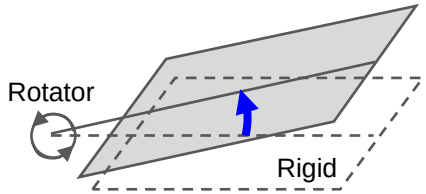
*BOUNDARY_PRESCRIBED_FINAL_GEOMETRY

Roll



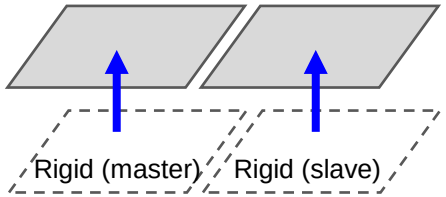
*BOUNDARY_PRESCRIBED_MOTION_RIGID

Fold



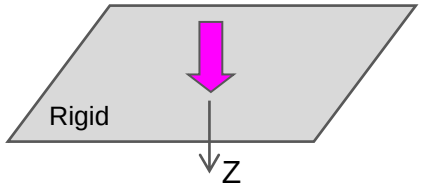
*BOUNDARY_PRESCRIBED_MOTION_RIGID

Dependent



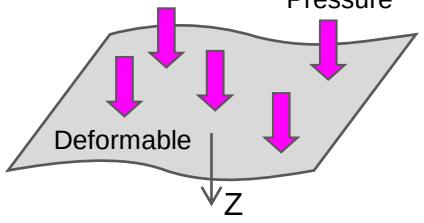
*CONSTRAINED_RIGID_BODIES

Load



*LOAD_RIGID_BODY

Press

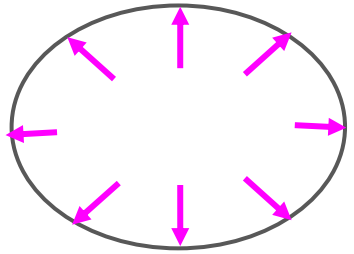


*LOAD_SHELL

Fabric tool and Components

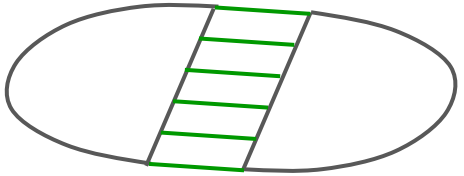
Fabric tool

Pressure



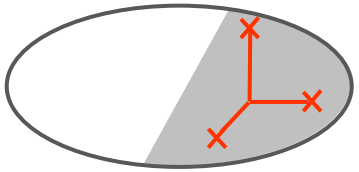
*AIRBAG_LOAD_CURVE

Stitching



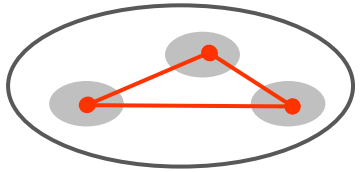
*MAT_CABLE_DISCRETE_BEAM

Fix



*BOUNDARY_SPC

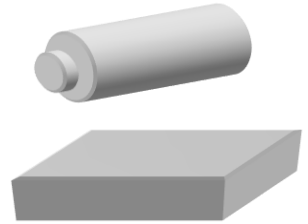
Rigidify



*CONSTRAINED_NODAL_RIGID_BODY

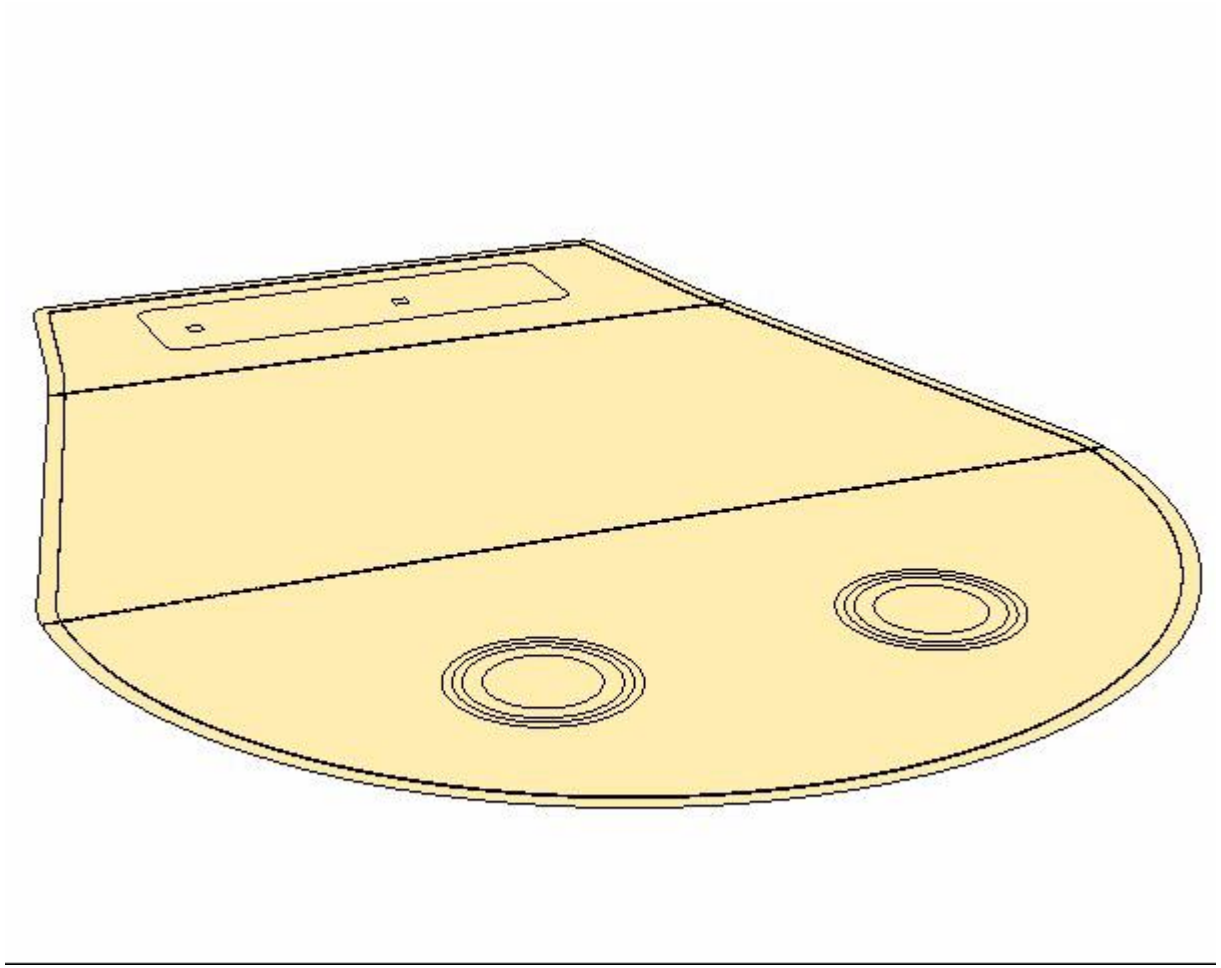
Components

Inflator, module case, etc

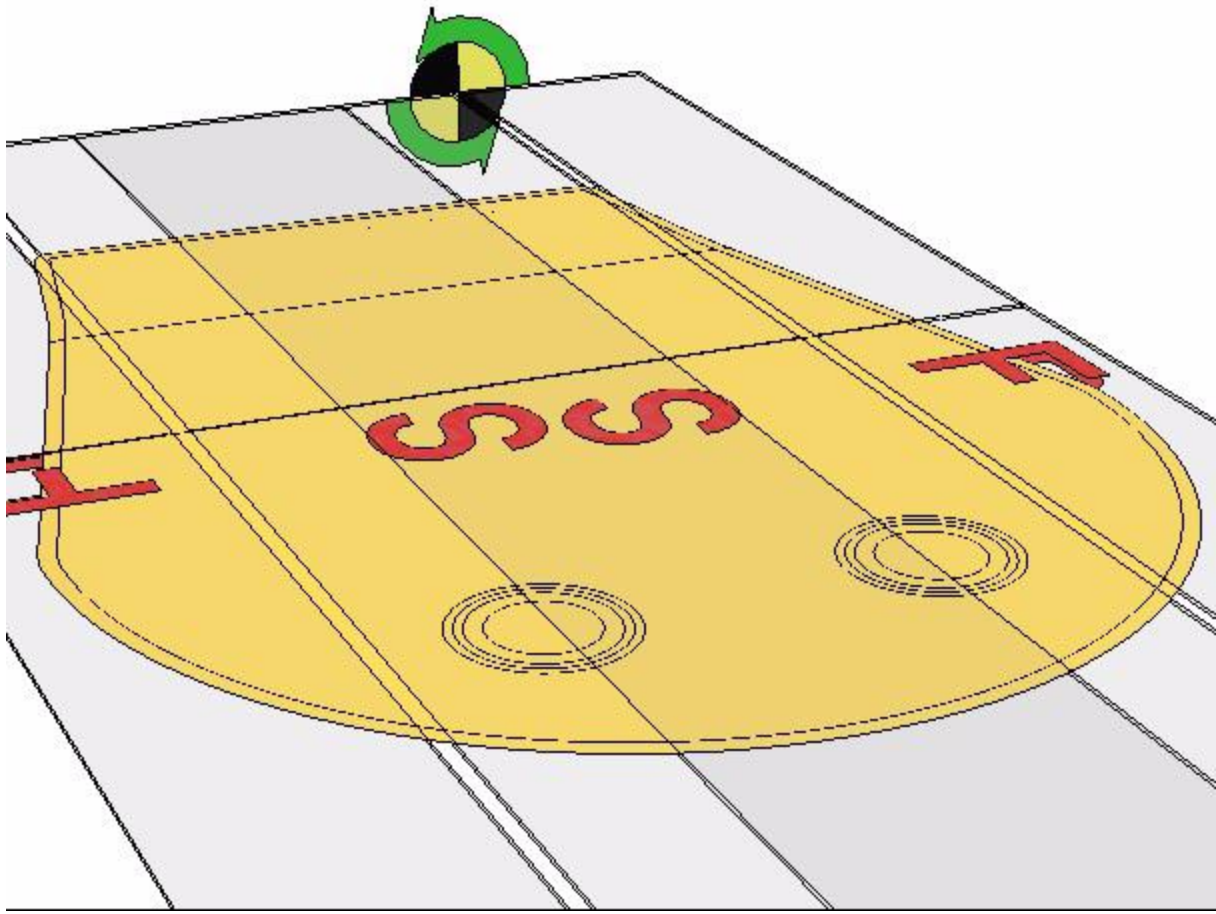


*BOUNDARY_PRESCRIBED_FINAL_GEOMETRY

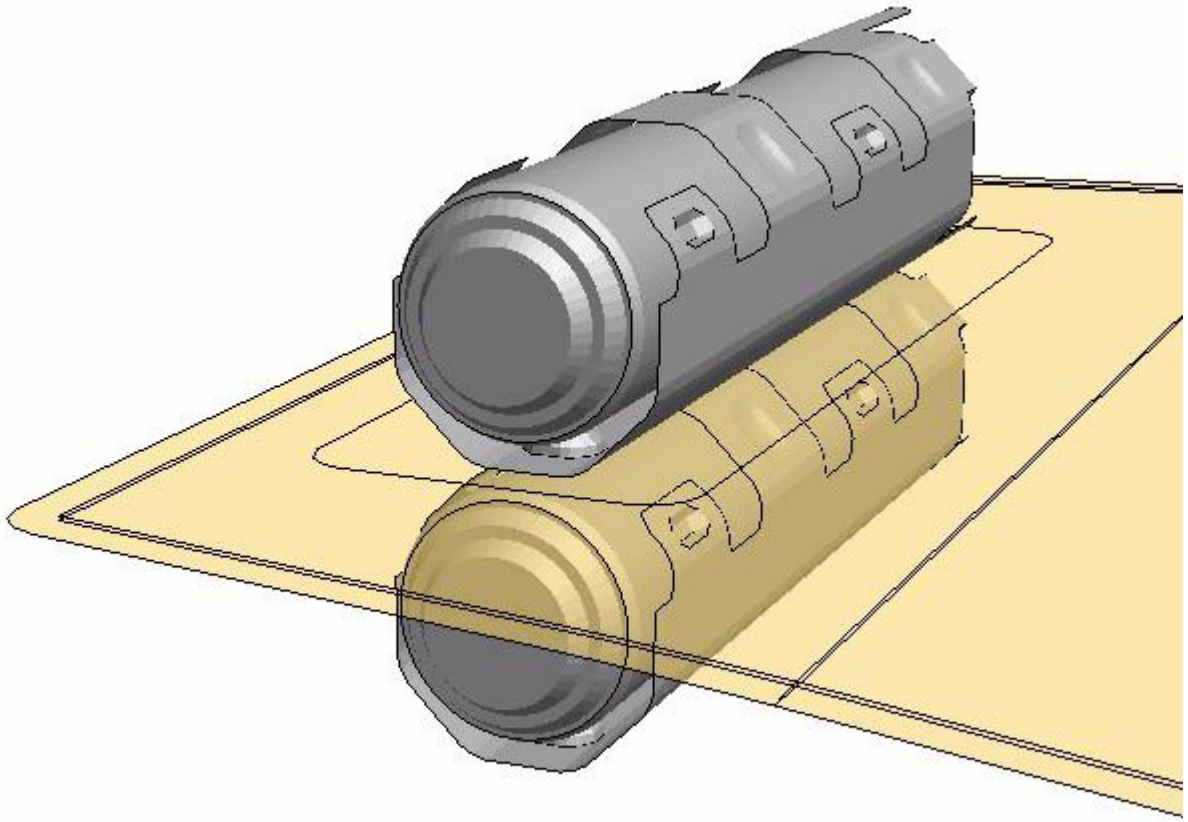
Tuck Folding



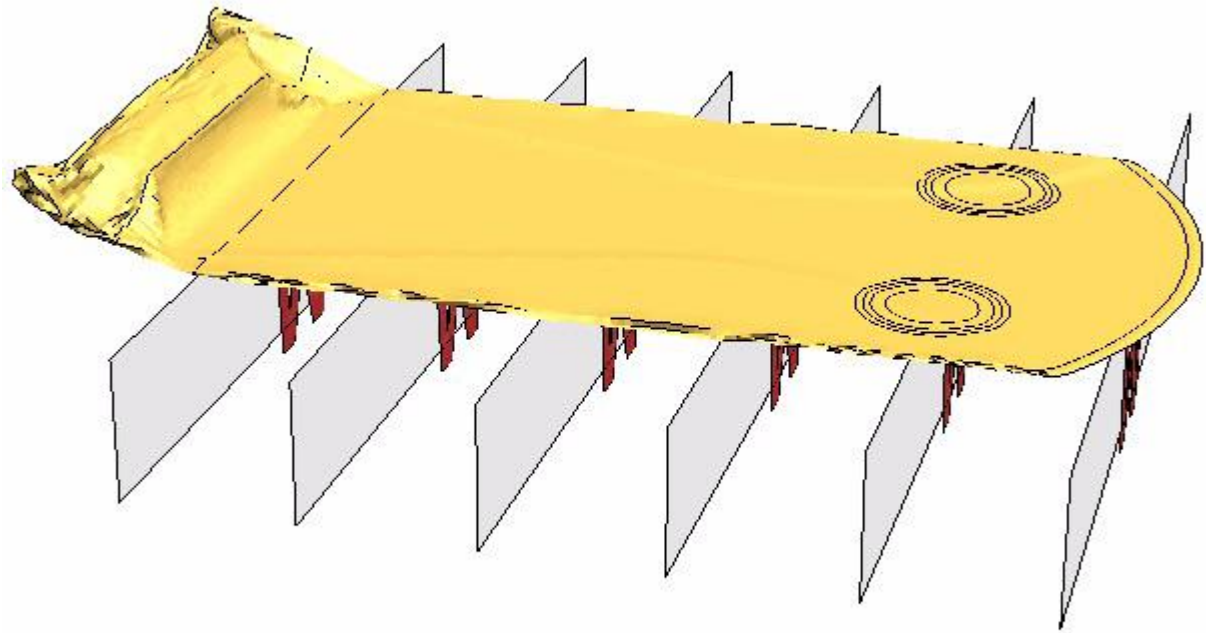
Thin Folding



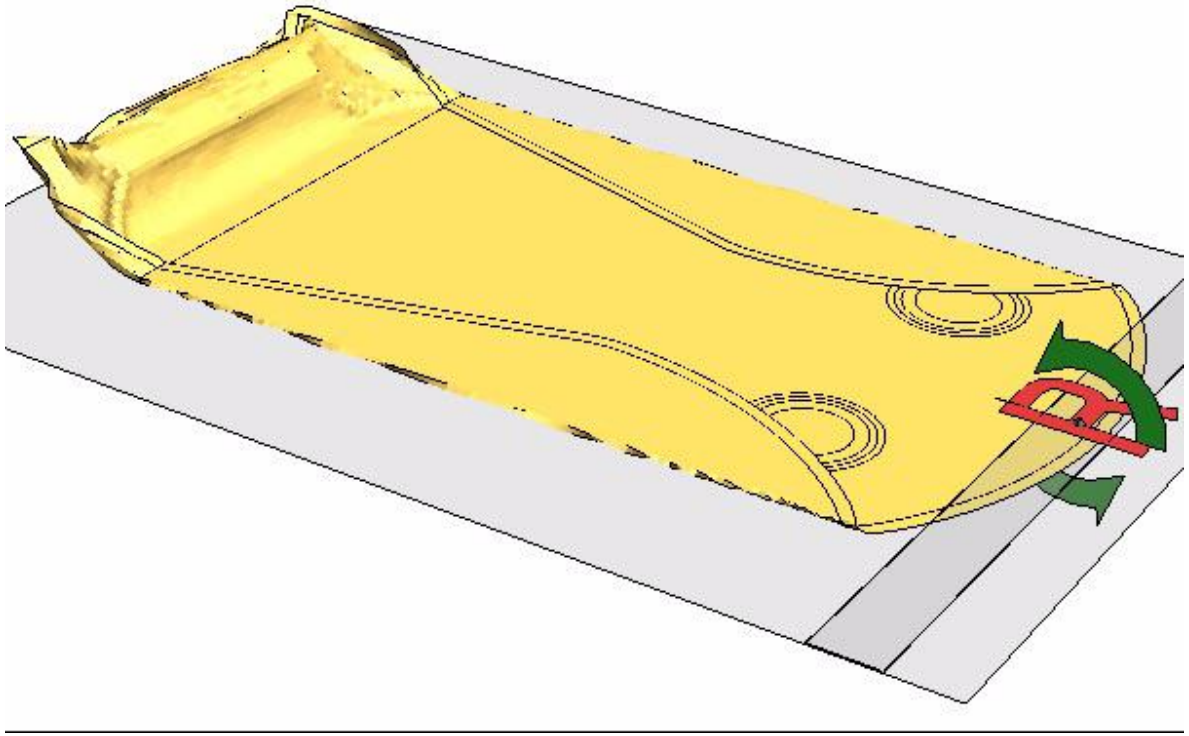
Inflator Fitting



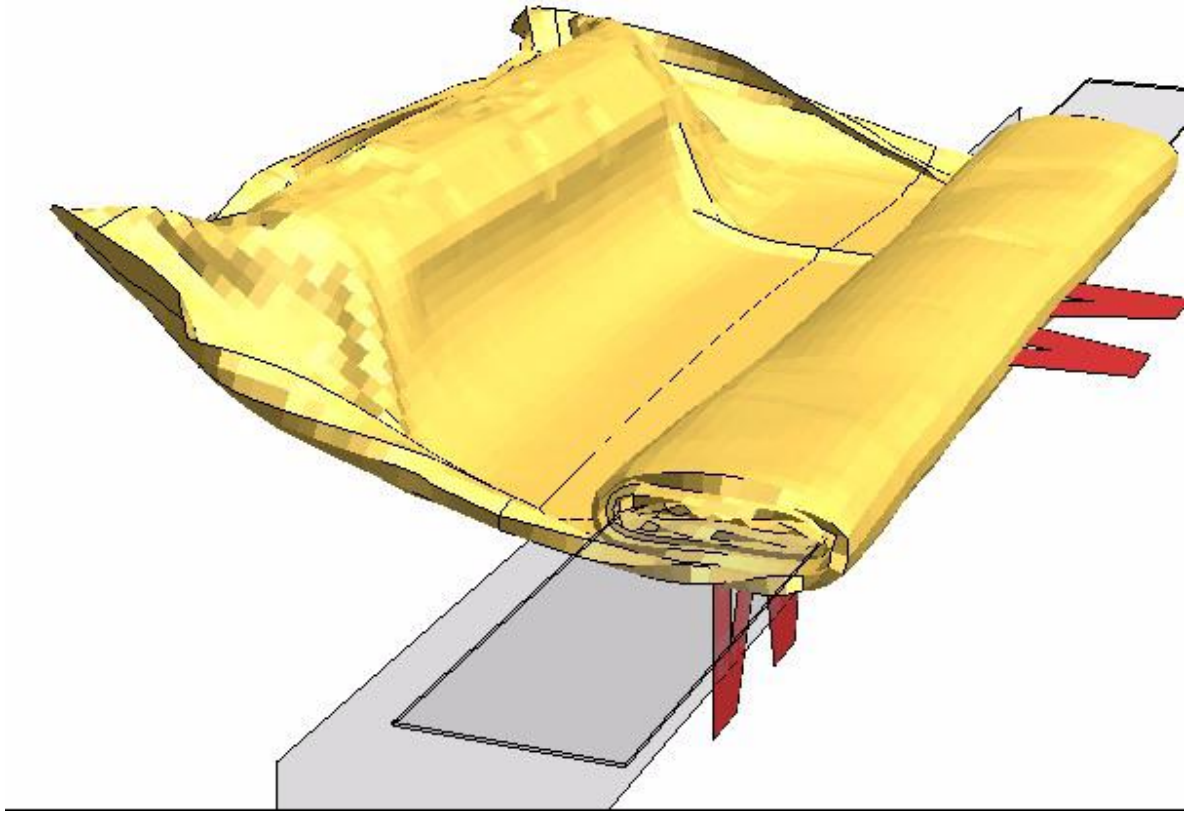
Zig-Zag Folding



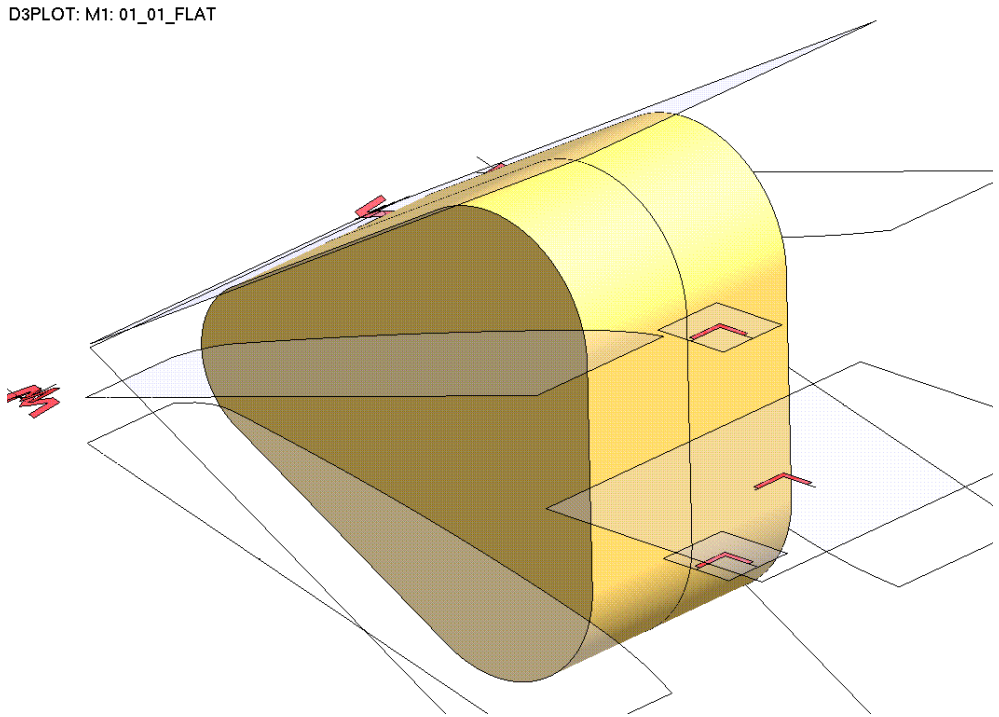
Roll Folding

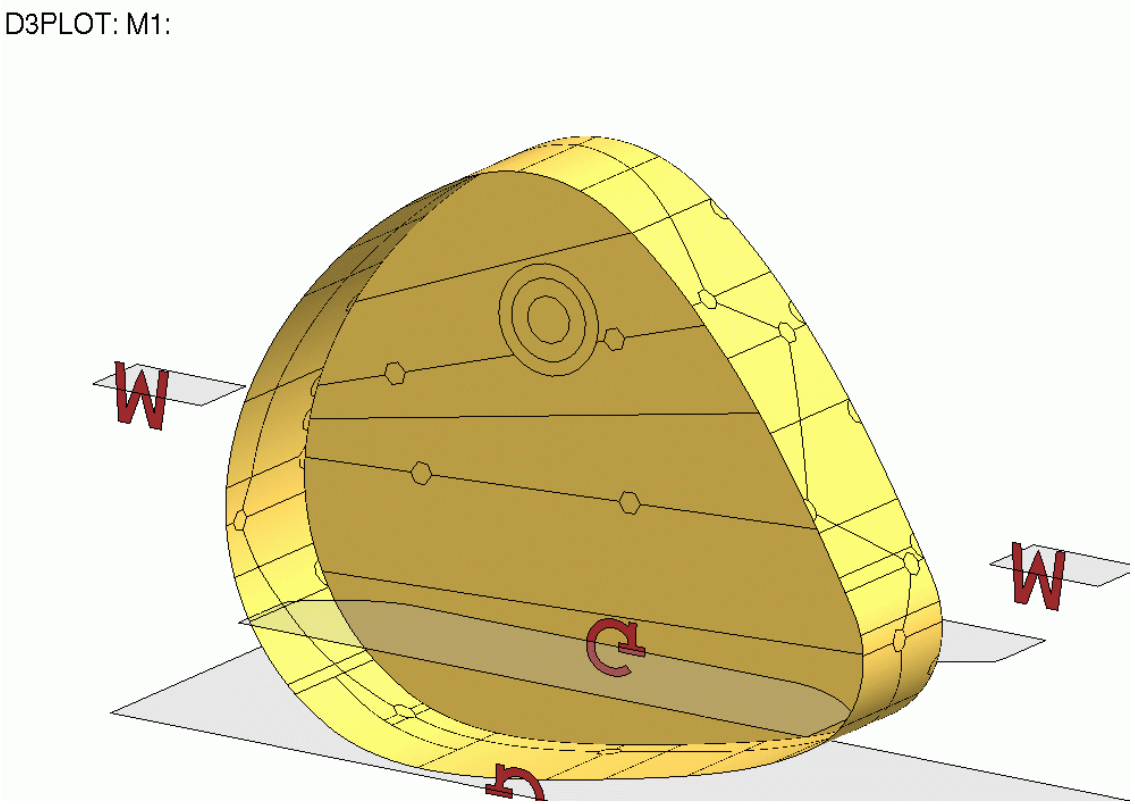


Lift Folding

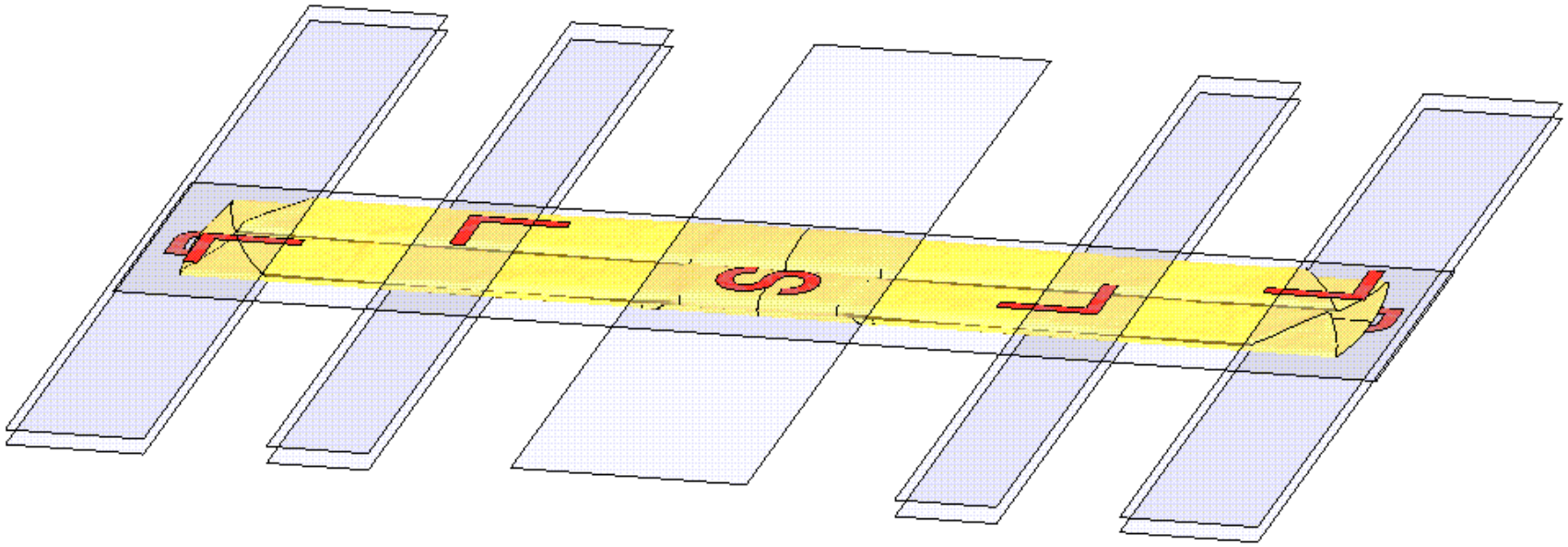


Passenger airbag folding





Z-folding performed by load type tools

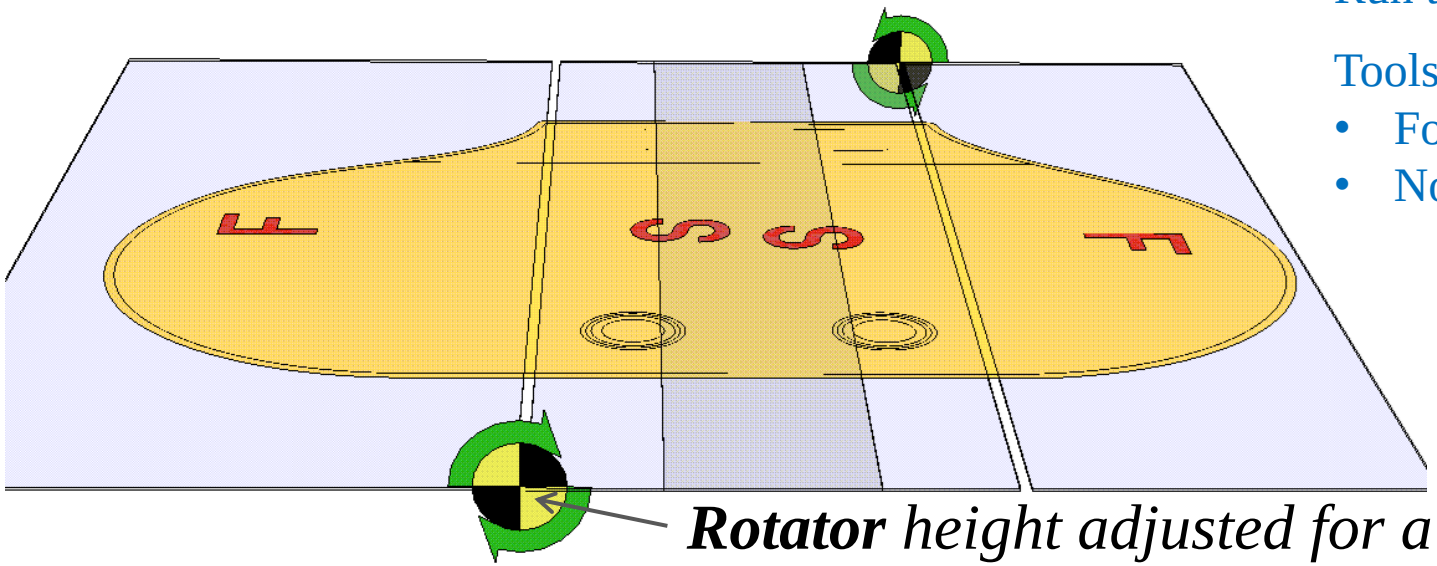


Example of Built-in Tool Assembly

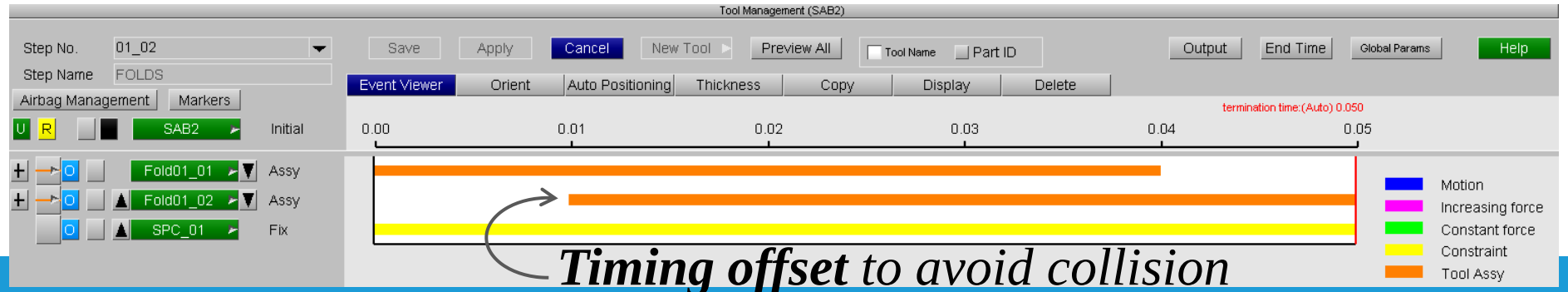
In this project, two **folding assemblies** were used: the left folds over the right.

Prep time: 5min
Run time: 15min (16cpu)

Tools required:
- Fold assembly x2
- Node fix (SPC) x1



***Rotator** height adjusted for a thicker fold*



***Timing offset** to avoid collision*

Oasys

Project Sharing Capability

Request new airbag development

OOP studies
Trim breakout studies
Full vehicle injury studies

Need to change folding pattern!

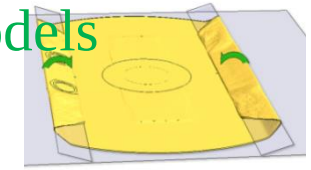
Car maker

Folded airbag model

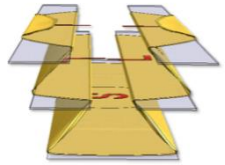
Request new folding pattern

Costs and delays!

Supplier Develop prototypes & folded CAE models



Refold airbag model

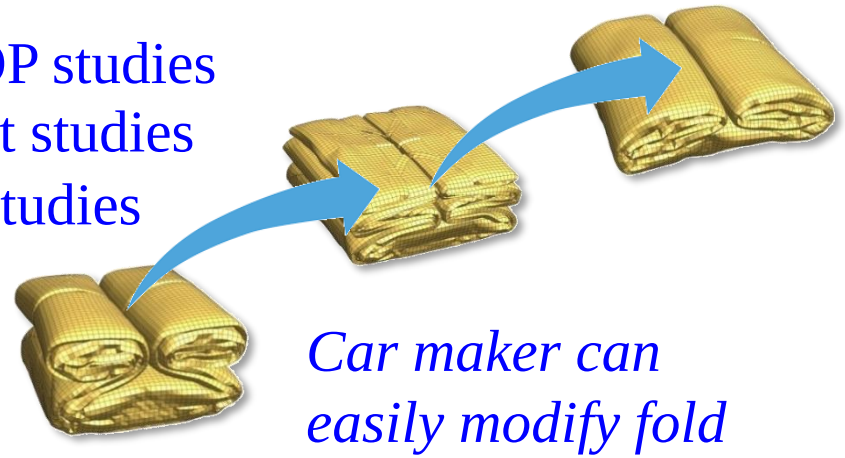


Refold airbag

Project Sharing Capability

Request new airbag development

OOP studies
Trim breakout studies
Full vehicle injury studies

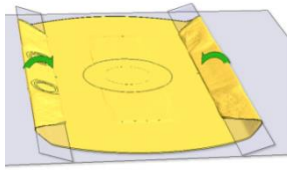


Car maker

Shared JFOLD project data

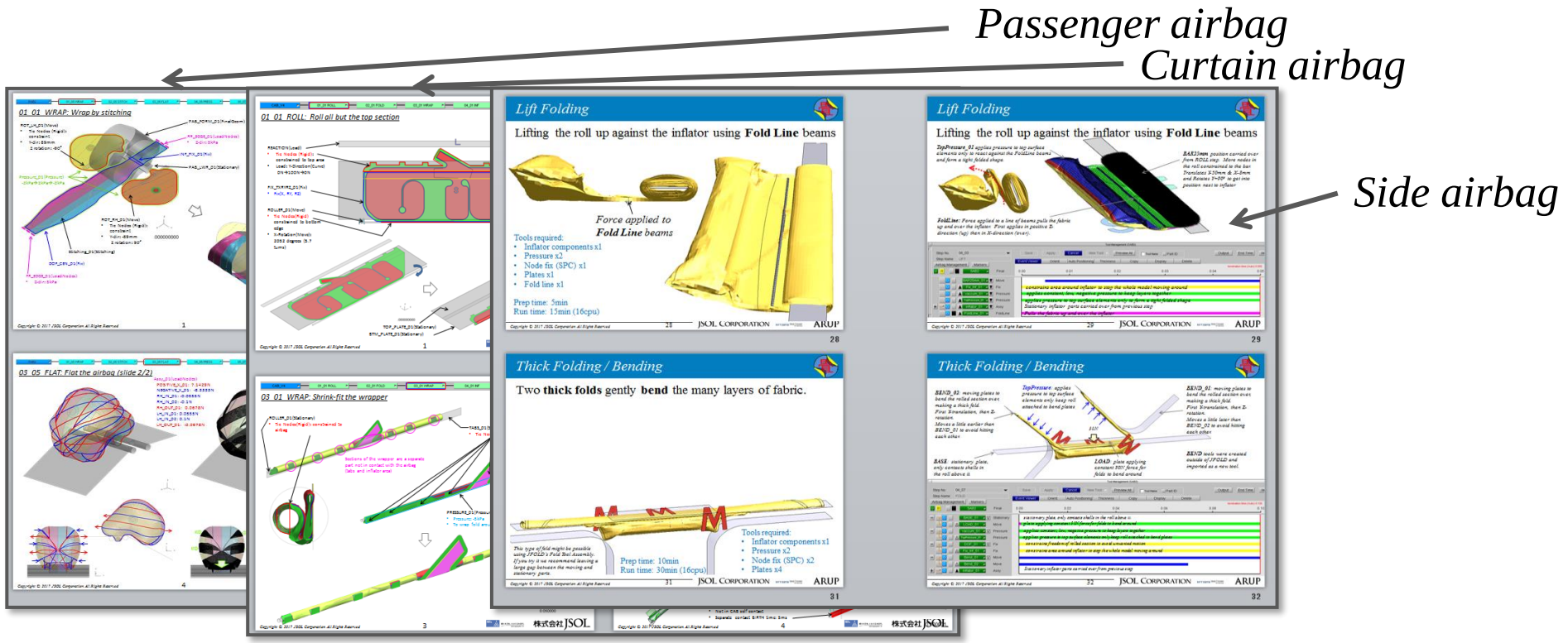
Car maker can easily modify fold pattern using JFOLD ✓

Supplier Develop prototypes
Fold using JFOLD



Final design updates using JFOLD

Eight Free Example Projects including Five Tutorials



JFOLD Users' Site https://support.jsol-cae.com/jfold_en/

Tutorial manuals (5)

Example Data (3)

Oasys

Summary

- In summary, an airbag folding JFOLD tool fulfils the following characteristics:
  - produces high quality folded models to predict accurate deployment behaviour
  - enables the folding of complex airbags that could not be attempted with pre-processors
  - easy to use, contains built-in tools and folding know-how
  - speeds up overall modelling time
  - allows the rapid investigation of various folding patterns
  - enables sharing of folding data between supplier and vehicle manufacturer
  - creates unencrypted input data allowing users full flexibility of access
  - uses existing site solver, LS-DYNA and pre-processor, Oasys Primer to minimise software costs

Thanks