Powering Innovation That Drives Human Advancement

Recent Developments in LS-DYNA
- Part I -

LS-DYNA: Tightly Coupled, Scalable Multi-Physics Solver

- Finite Elements
- Meshless
- IGA
- Multiscale
- DEM/SPH

One Code, One Model, Multiphysics

- Solid Mechanics
- Electro-Magnetism
- Fluids
- NVH/Acoustics
- Thermal
- Chemistry

Ansys LS - DYNA

HPC / Cloud

LS-PrePost | LS-OPT | LS-TaSC | Mechanical | Ansys Forming | Dummies, HBM & Barriers | pyDYNA

Industries

- Crash
- Aerospace
- Biomedical
- Electronics
- Defense
- …

Release Management

Every **alternative** year LS-DYNA release will get **Long-term support** e.g. R14, R16, R18…

Existing versions used in production will continue to get LTS support until discontinued. *

We continue to release new version with new features every year.

*Workbench Mechanical uses a pre-determined stable LTS version of LS-DYNA.

Upcoming Releases			
LS-DYNA R12.2.2	LTS release	Service Pack	**August 2024**
LS-DYNA R13.2	LTS release	Service Pack	**Q4 2024**
LS-DYNA R14.1	LTS release	Service Pack	**Q4 2024**
LS-DYNA R16.0	LTS release	New Release	**2025 R1**

New features and enhancements in LS-DYNA R16

PART I

- Airbag methods
- Contacts
- Material models
- Misc.
- SPG/ISPG
- LS-OPT/LS-TasC
- PyDYNA

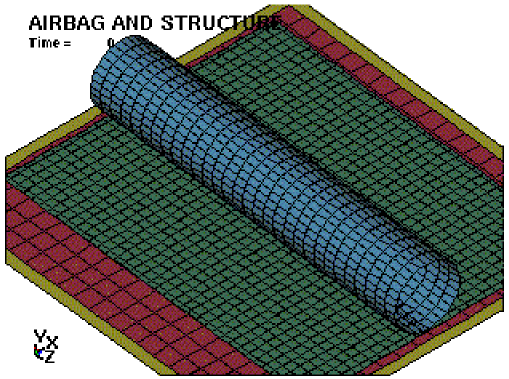
PART II

- EM
- Implicit
- ICFD + CESE
- NVH
- IGA
- Ansys Forming
- LS-Prepost

Airbag methods

CPG, CPM, S-ALE

History of airbag methods

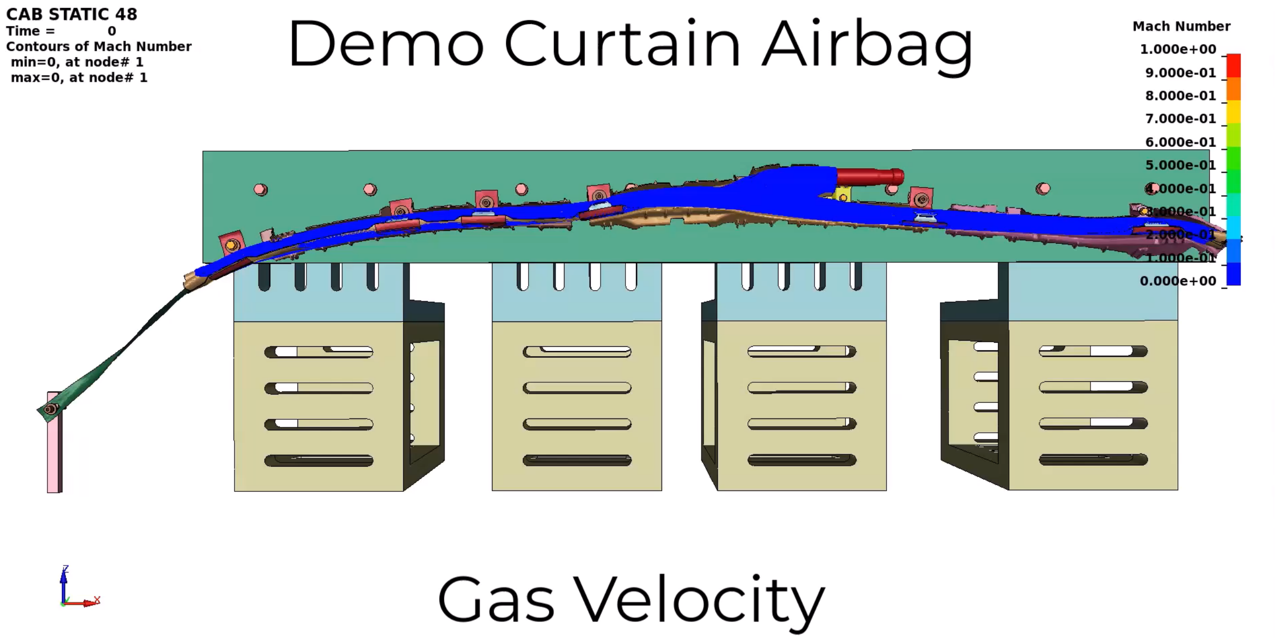


- CV (Control Volume)
  - Simple pressure, too simple for deployment phase
- ALE (Arbiratry Lagrangian Eulerian)
  - Higher accuracy, but CPU intense and difficult to handle
- CPM (Corpuscular Particle Method)
  - Considers the effect of transient gas dynamics and thermodynamics by using a particle to represent a set of finite air or gas molecules
  - Current state-of-the-art: fast and robust
  - Hits accuracy limits for complex gas flows as observed in curtain airbags, for instance

→ **Need for a more sophisticated approach**

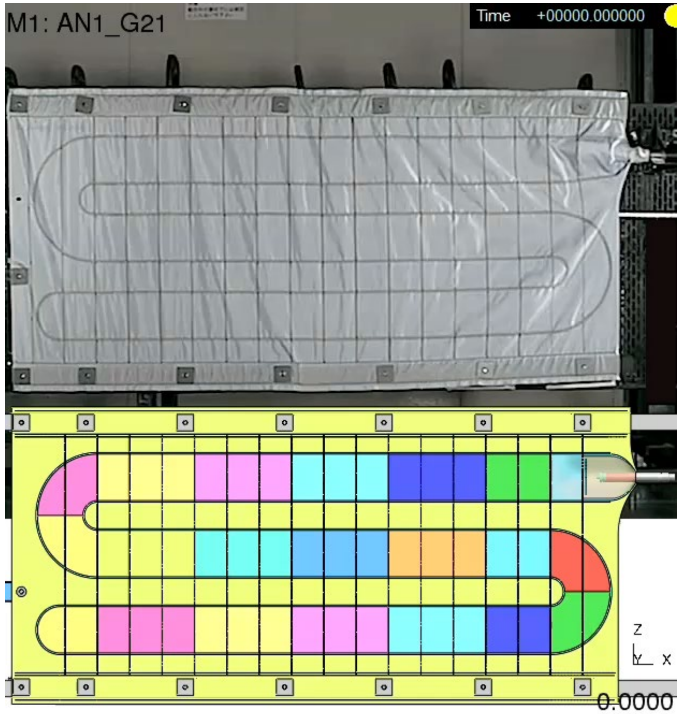
Introducing CPG: A New CFD Approach to Airbag Deployment

- **Continuum-based Particle Gas (CPG)**: Particle method solving Navier-Stokes equations
- Innovative CFD method particularly well-suited for airbag deployment simulations
- Superior accuracy for complex gas flows, as seen in curtain airbags
- Validation studies with multiple partners
- Brand new solver - First release R16
- New keyword *AIRBAG_CPG



Introducing CPG: A New CFD Approach to Airbag Deployment

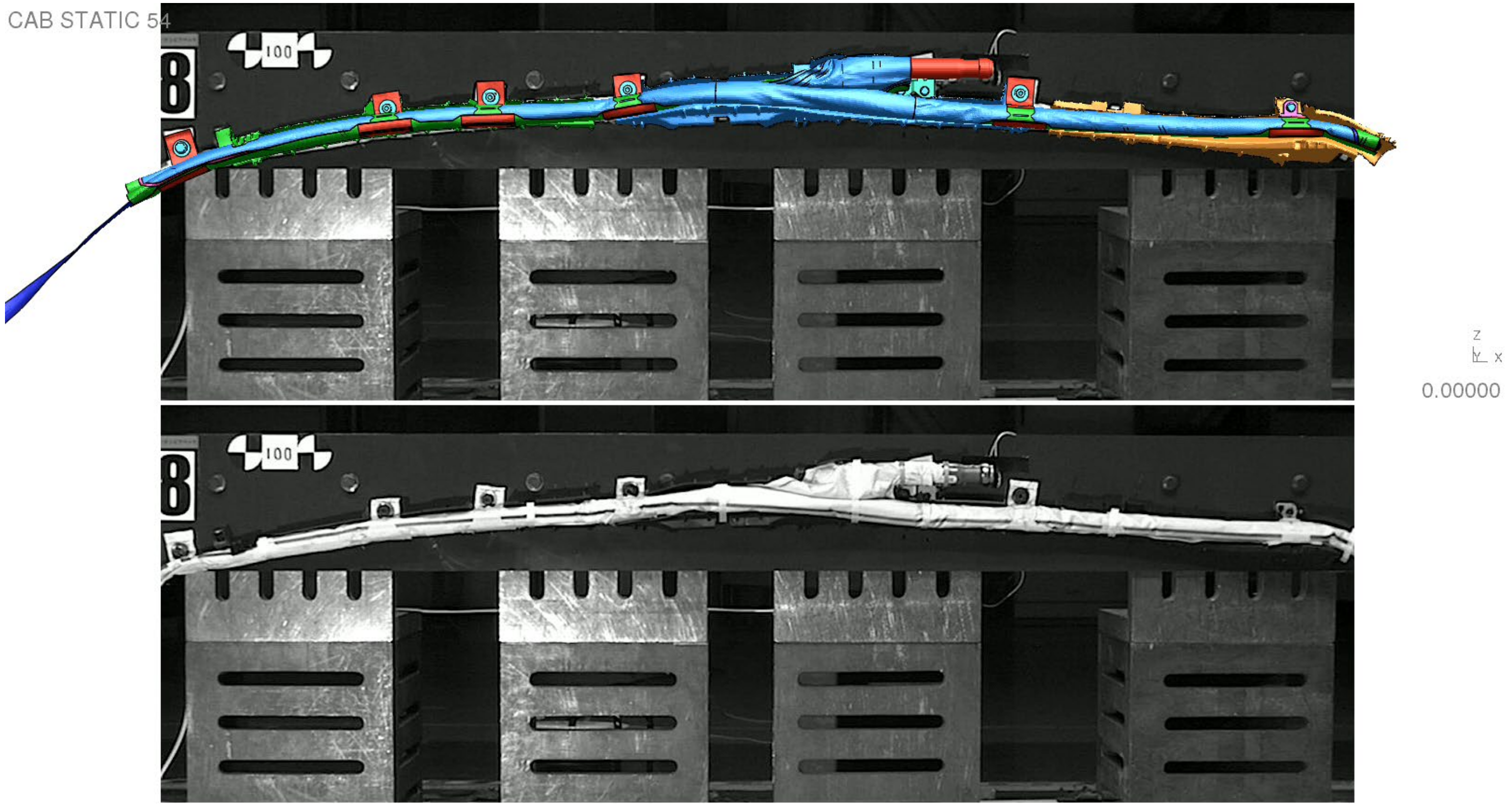
- Ongoing collaboration with Toyoda Gosei Co., Ltd to validate method and implementation
- Custom-made experimental setup to accelerate development
- The goal is to **reduce the need for numerical tuning**; this requires:
  - Good fabric material characterization
  - Excellent measurement of the inflator characteristics
  - …



Experimental data courtesy of Toyoda Gosei Co., Ltd.
Numerical model courtesy of JSOL Corporation.

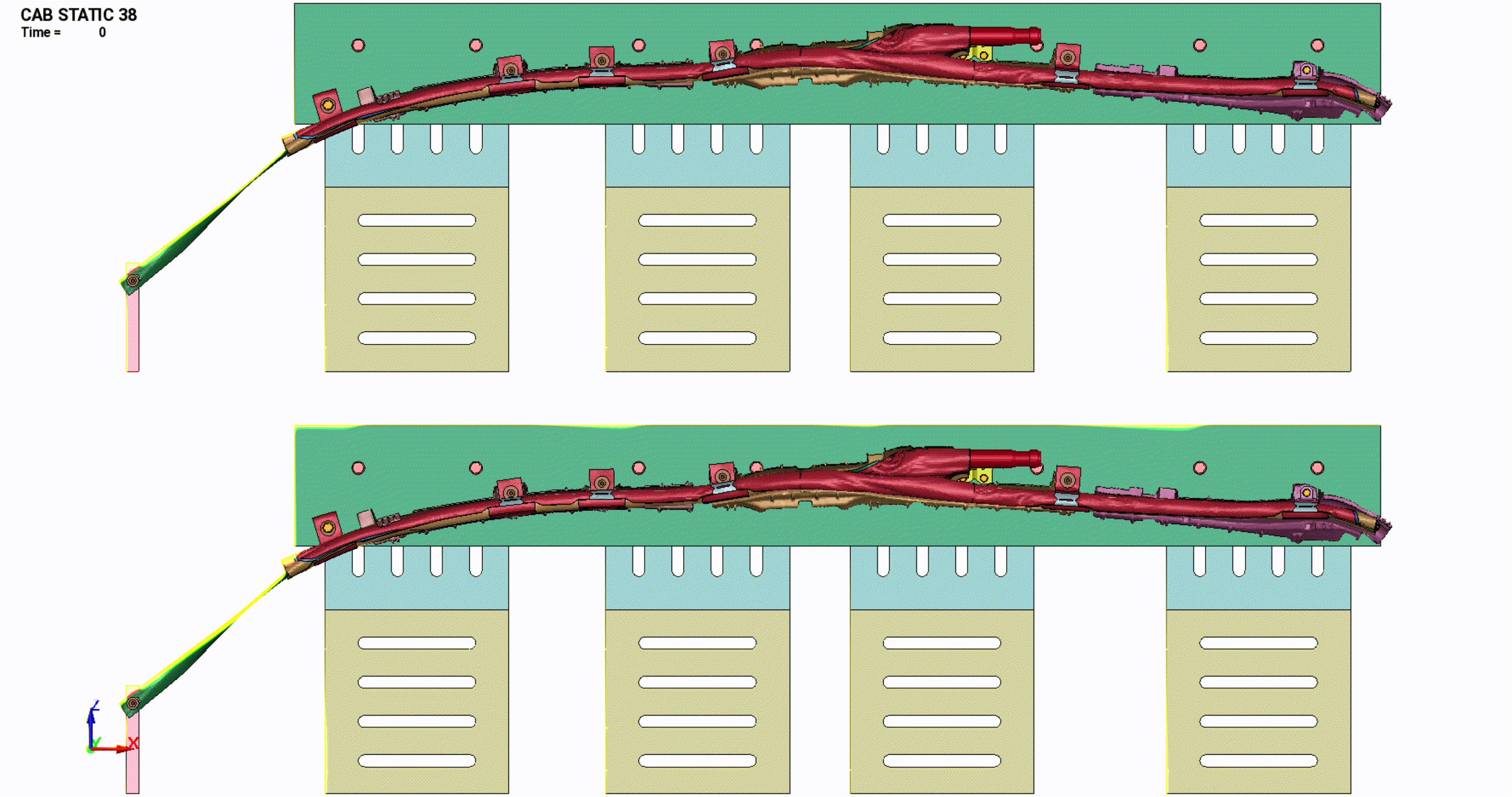
Introducing CPG: A New CFD Approach to Airbag Deployment

Bringing airbag deployment simulations to new levels of predictive accuracy.



Model and experimental testing courtesy of JSOL Corporation.

CPG  CPM, Virtual airbag



1. IAIR=4, front deployed faster than the rear

2. Use CPG (less tuning) to create the base run

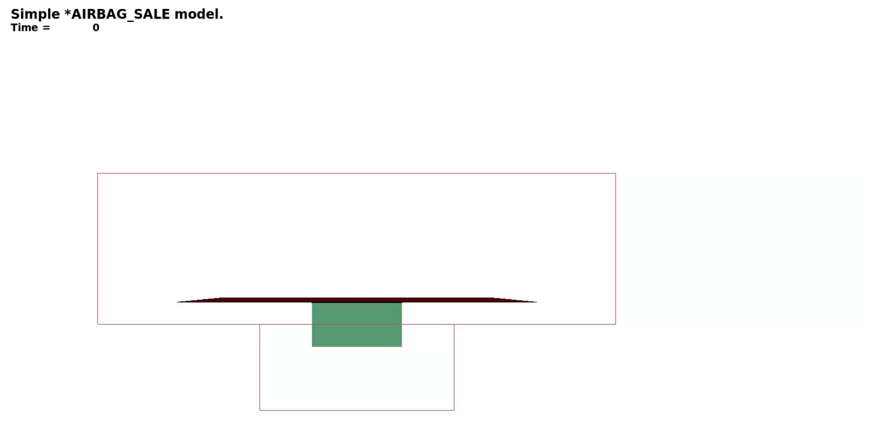
3. Based on the CPG results, new CPM (more tuning) feature (**IAIR=6**) is implemented for better kinematics

*AIRBAG_SALE: Reviving ALE Airbag Deployment

- Three obstacles ALE airbags had
  - Contact locking: Bag segments from different chambers stuck and locked
  - Narrow bag gap: Gas flow constrained; bag opening slowed
  - Speed: ALE formulation high cost. More than several days.

- *AIRBAG_SALE: airbag capability reimplemented in S-ALE
  - Anti Contact Locking: ILOCK option prevents chambers getting close.
  - Gas Front Segment Pre-opening: ILVL/DECAY option to pre-open segments ahead of gas front.
  - Faster: MPP efficiency and scalability. ~ a day.
  - User-friendly: A single wrapper keyword generating many S-ALE keywords.

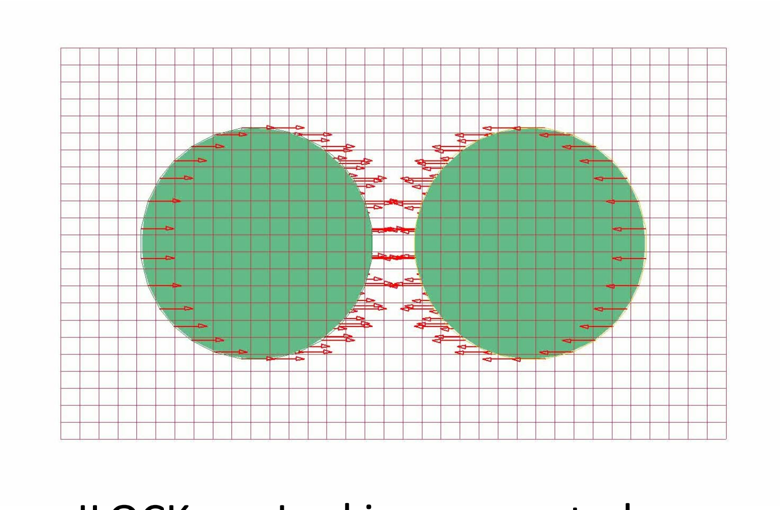
*AIRBAG_SALE: Reviving ALE Airbag Deployment



A simple moving airbag

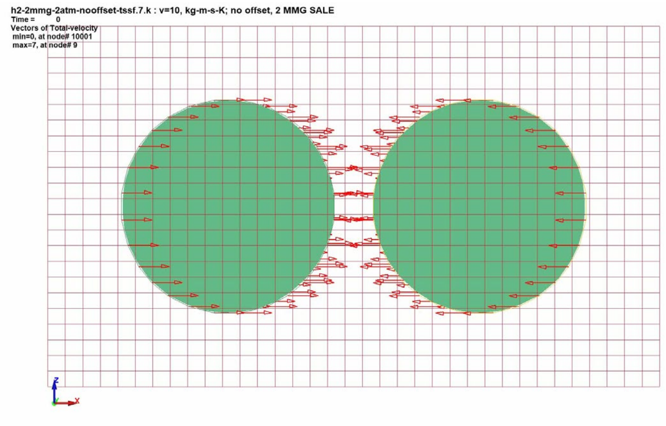
*AIRBAG_SALE, a centralized wrapper, holds all information to automatically generate general S-ALE keywords.

*ALE_STRUCTURED_MESH with _MOTION, ALE mesh to follow and expand to cover the moving airbag.



ILOCK on: Locking prevented

Two bags Colliding
Contact Locking



ILOCK off: Bags locked, FSI failed

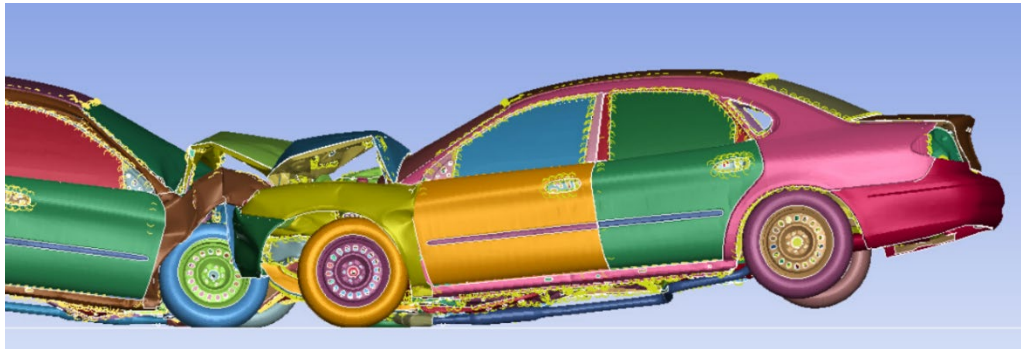
Contacts

Modular Contact

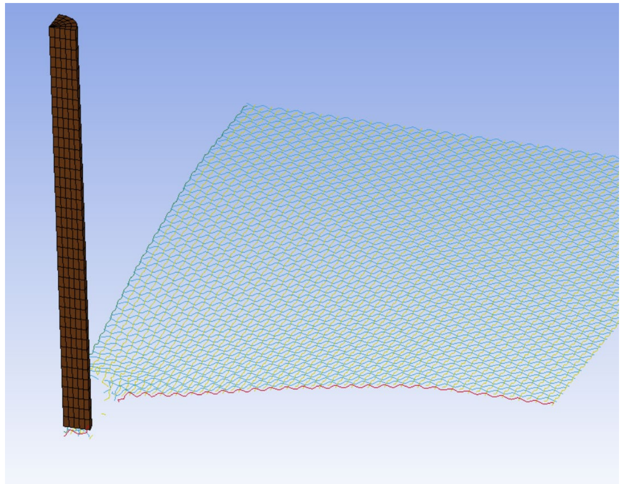
- Goal
  - Better performance and scalability harnessing modern CPU & GPU architectures
  - Simpler keyword input for different contact definition
  - Friction, failure, and other options will be available across all contact types

- Current status
  - New implementation of existing SOFT=0/1 contact (SOFT=2 in progress)
  - Same keyword-input. Only difference: enabled by setting SOFT=10/11
  - Currently supported CONTACT keywords:
    - AUTOMATIC_SINGLE_SURFACE, AUTOMATIC_GENERAL[_INTERIOR][_EDGE_ONLY], SINGLE_EDGE
    - AUTOMATIC_SURFACE_TO_SURFACE
    - AUTOMATIC_ONE_WAY_SURFACE_TO_SURFACE, AUTOMATIC_NODES_TO_SURFACE

Preliminary Performance Results



- Car-2-car crash:
  - ~10M elements per car
  - Two single-surface contacts with MC; surface-to-surface still "groupable"
  - Execution on 6 compute nodes, 44 cores each (264 cores overall)
  - => Contact time reduced from 1h38m27s to 1h01m03s (reduction by **~38%**)

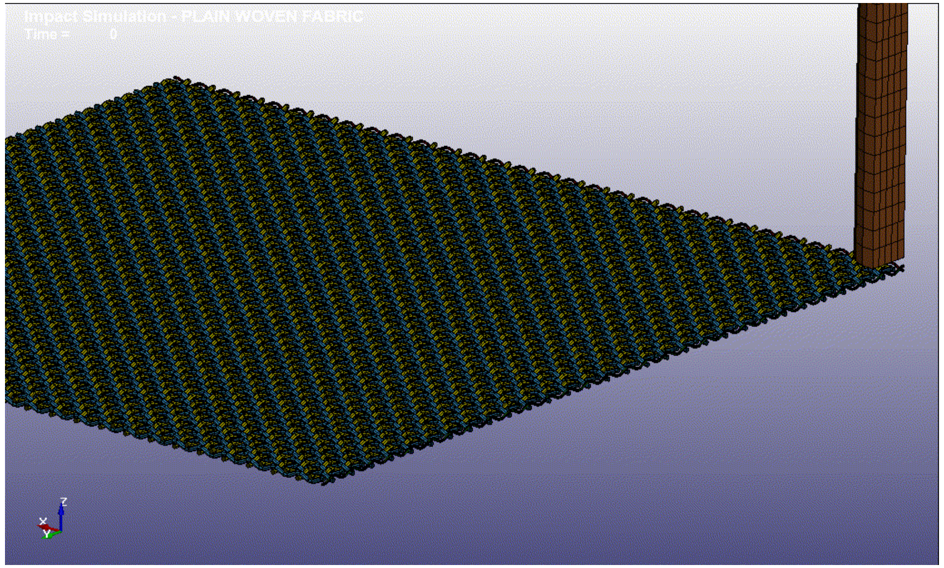


- Impact on woven textile fabric:
  - Small test example (~14k beams)
  - Mainly beam-to-beam contact
  - Execution on single node, single core
  - => Contact time reduced from 67s to 27s (reduction by **~60%**)

Beam elements in segment-to-segment contacts

- SOFT=2
  - has checked contact between shell elements, solid elements and thick shell elements for the past 23 years
- New in R16 is the addition of beam elements and discrete beam elements
  - Checks beam-to-beam, beam-to-shell, beam-to-solid, and beam-to-thick shell
  - Works with all keyword options that segment-to-segment contact supports
  - The interface must include edge-edge checking: DEPTH=5, DEPTH=15, DEPTH=35, DEPTH=55
  - Beams are assumed to have rectangular cross sections

Solid impactor penetrates woven fabric modeled by beam elements

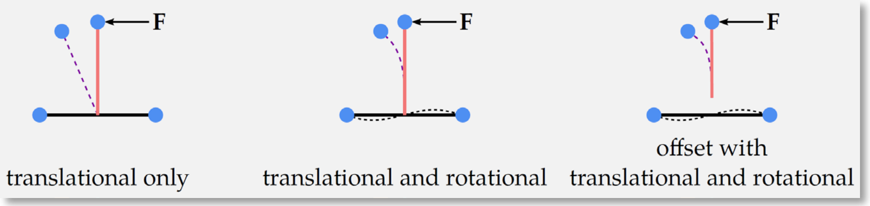


Constrained Tied Contacts and Selective Mass Scaling

- Up to now only partially supported with SMS
  - Offset treatments requires the correct kinematic assumptions to be incorporated into the momentum equations, this used to be treated in an ad-hoc manner
- Complexity in models often require that the segment side of different tied contact interfaces share nodes
  - This requires a "groupable" treatment of tied contacts, meaning that all are processed at once, but SMS is using the "non-groupable" branch
- New option **TIEOPT** on *CONTROL_CONTACT to address both shortcomings
  - For SMS, this option is mandatory,
    implying that all combinations of tied contacts are properly supported

Constrained Tied Contacts and Selective Mass Scaling

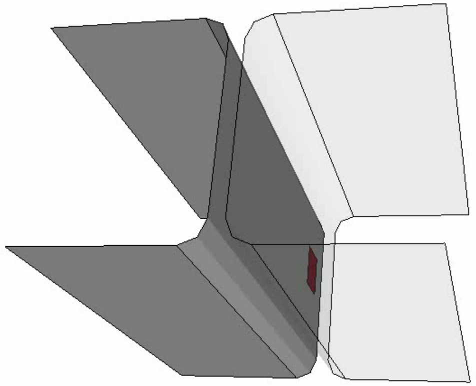
- Setting TIEOPT=1 (or using SMS) will result in
  - SMP and MPP tied contacts are the same, and will find the same node/segment pairs
  - The segment sides of different contact interfaces are allowed to share nodes
  - The SHELL_EDGE_TO_SOLID_CONSTRAINED_OFFSET option becomes available
  - The kinematic properties (translations and/or rotations) of the nodes involved are accounted for, automatically "degrading" a tied contact when there is no sense in processing rotational DOF, or change the way rotational DOF are constrained



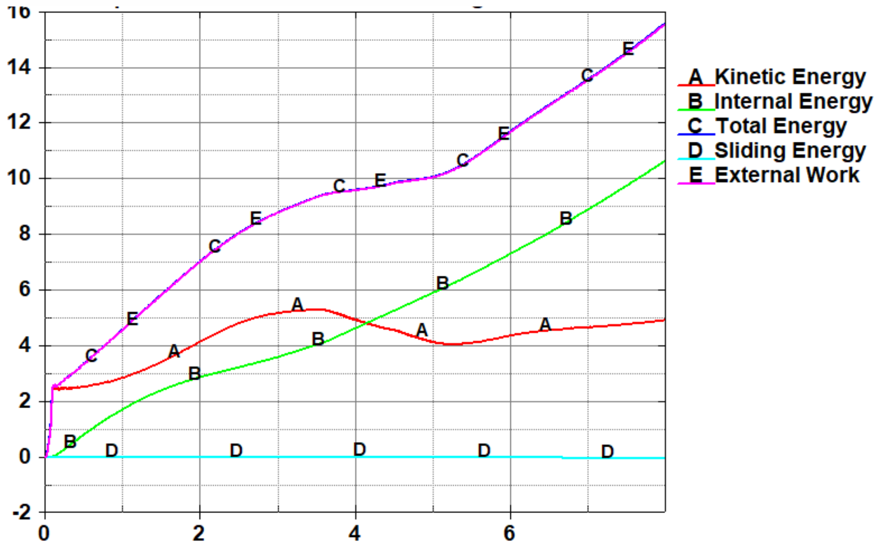
- Setting TIEOPT=2 will result in
  - Everything above, but the SHELL_EDGE_TO_SURFACE will internally be converted to a SHELL_EDGE_TO_SOLID option, justified by the hypothesis that avoiding rotational DOF on the segment side will increase robustness

Constrained Tied Contacts and Selective Mass Scaling

- Two simple models for verification
  - Solid cohesive spotweld tied to shell panels
  - Shell panels tied to shell spotweld

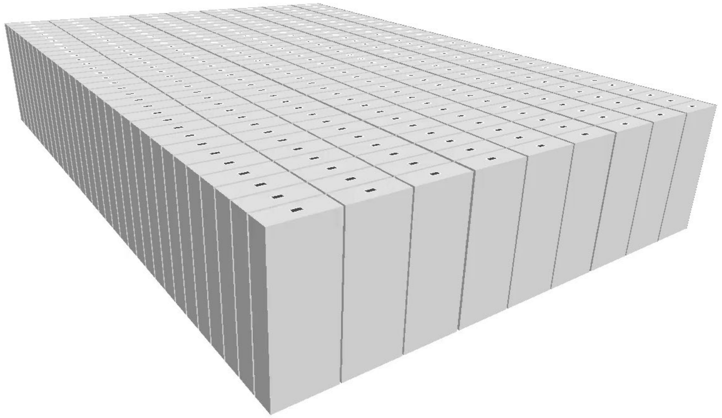


- Six runs for each model
  - Constrained offset tied contacts combining
    - NODES_TO_SURFACE, SHELL_EDGE_TO_SURFACE, and SHELL_EDGE_TO_SOLID
    - Using one and two interfaces for the tie
- Monitoring energy balance and kinematic behavior

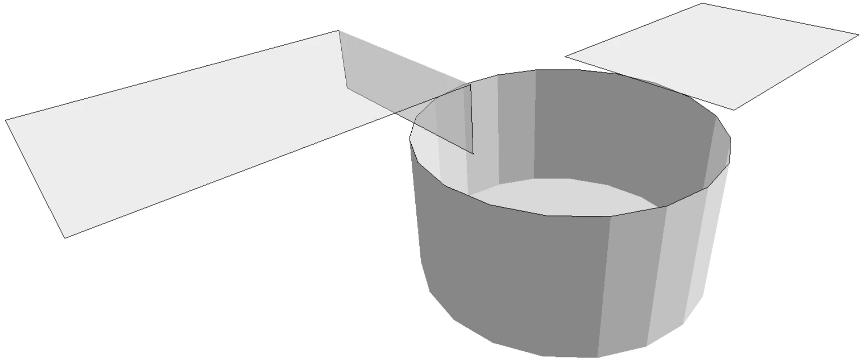


Thermal Contact Enhancements

- Single surface contact definition made available for simplified preprocessing
  - Using the example of thermal runaway in battery packs
  - Instead of ~100 surface to surface contacts, 1 single surface contact will suffice



- Thermal edge contact available
  - Works for single surface as well as single surface contact
  - Also developed in the context of battery packs
  - Only if the underlying contact is mortar

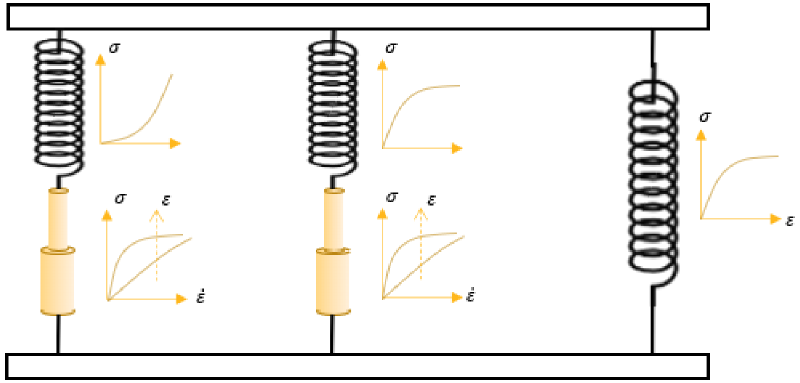


Ansys

Material models

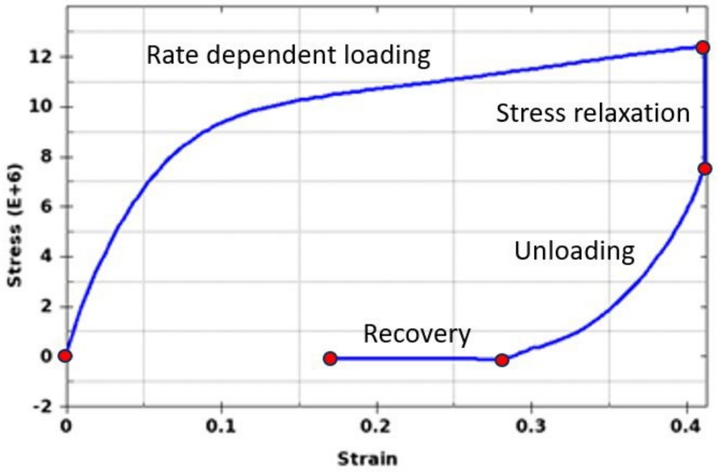
*MAT_RRR_POLYMER/*MAT_317

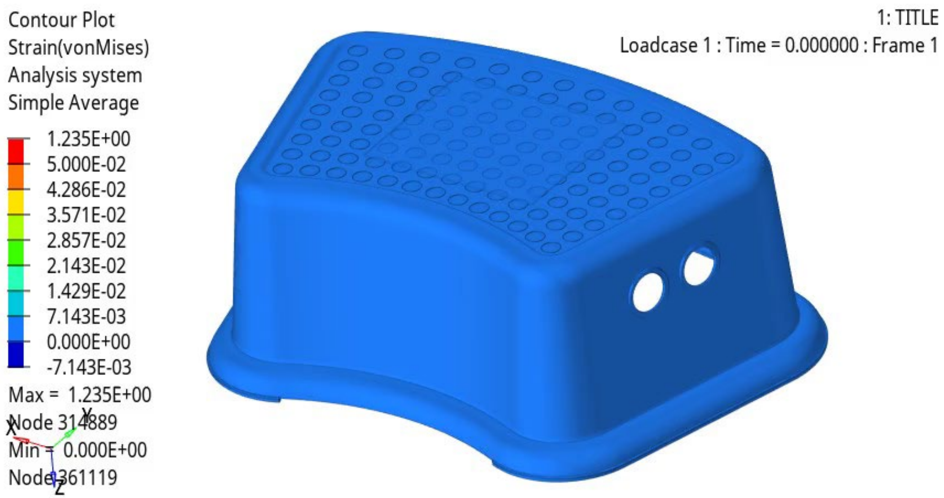
- New material model for thermoplastics
  - Developed in collaboration with IKEA
  - Handles impact, stress relaxation, and material recovery
  - Builds on the rheologic network framework, containing three links with springs and dampers



Both springs and dampers are functions of strain; allows improvements without adding more links

  - Requires 24 material parameters, and a sophisticated parameter fit





Kinderhocker FÖRSIKTIG

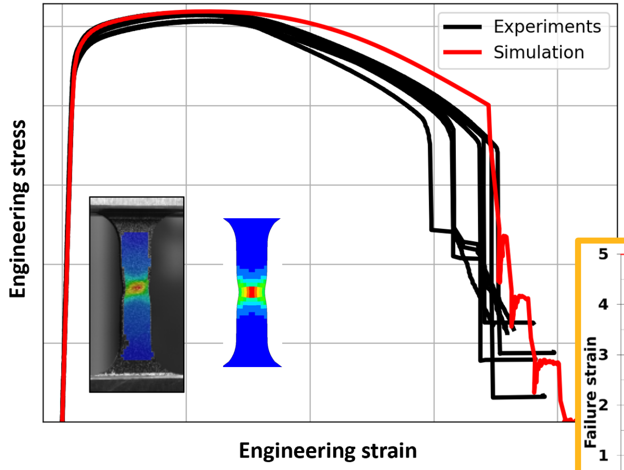
Basic incremental failure (BIF)

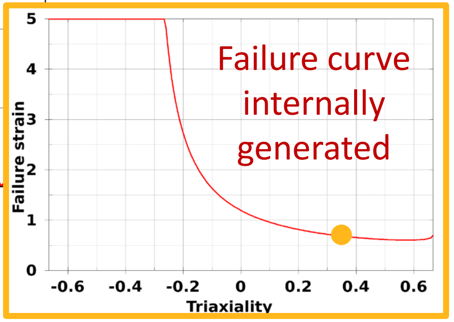
Details: F. Andrade@14:45 (KLEINER SAAL)

- Easy-to-use incremental failure model
  - Requiring only tensile test for calibration
  - Ideal to get good failure modeling when material data is scarce
  - It works for shell and solid elements (triaxiality and Lode parameter dependence)

True plastic strain at failure for triaxiality = 1/3, Lode parameter = 1

```
*MAT_ADD_BASIC_INCREMENTAL_FAILURE
$        MID                NUMFIP   VOLFRAC     NEROD
           1                   -80
$       EPSF       LCSS     LCREGD     LCSRS    DMGEXP
         0.3                                          2
```





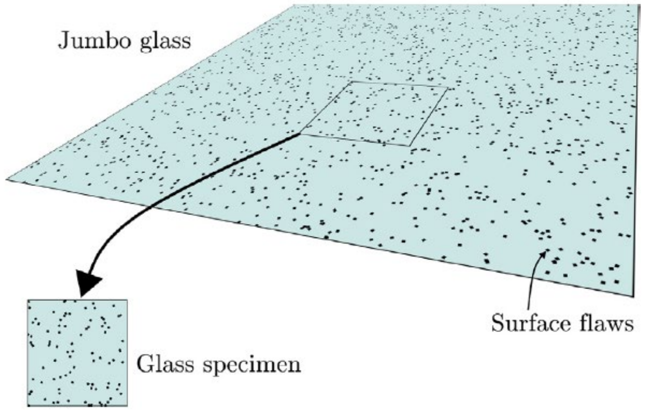
Example: Complex phase steel

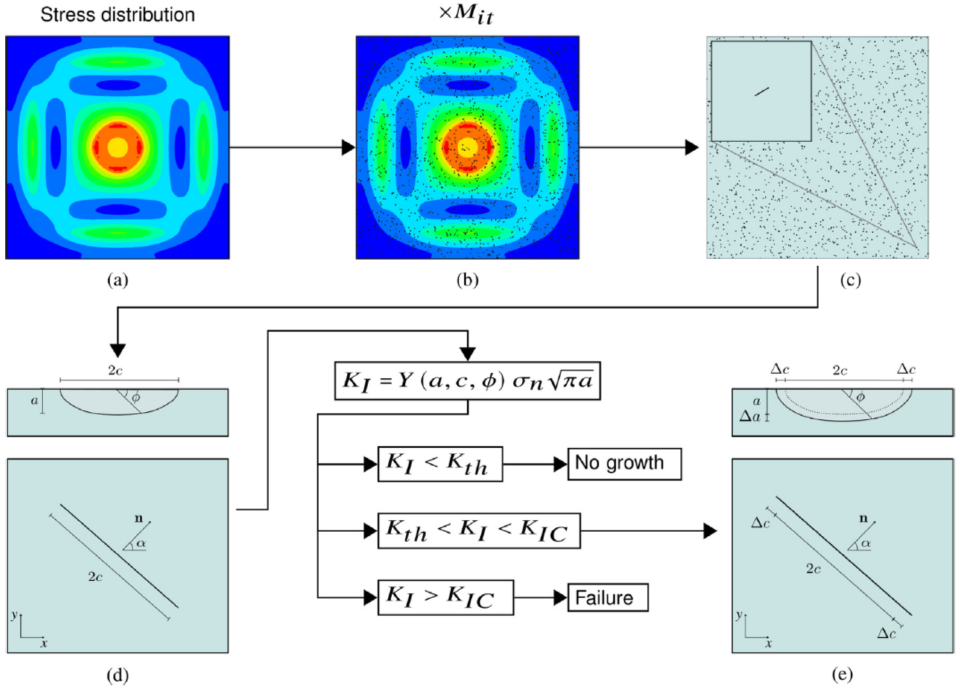
Experiment FAIL (MAT24) BIF

Glass strength prediction model

- Available as *MAT_GLASS_SPM
  - Monte-Carlo based fracture initiation predictor
  - combines the theories of linear elastic fracture mechanics (LEFM) and sub-critical crack growth (SCG)
  - generates a representative sample of virtual glass plates which are monitored during the simulation
  - GSPM predicts tensile strength, initiation location, and initiation time for the 1st crack, then *MAT_280 takes over for crack propagation

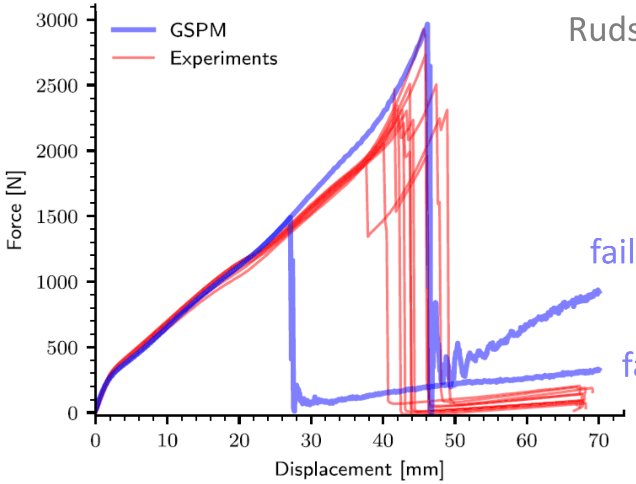
  - Model details and calibration procedure for new parameters described in Rudshaug et al. (2023)





Glass strength prediction model

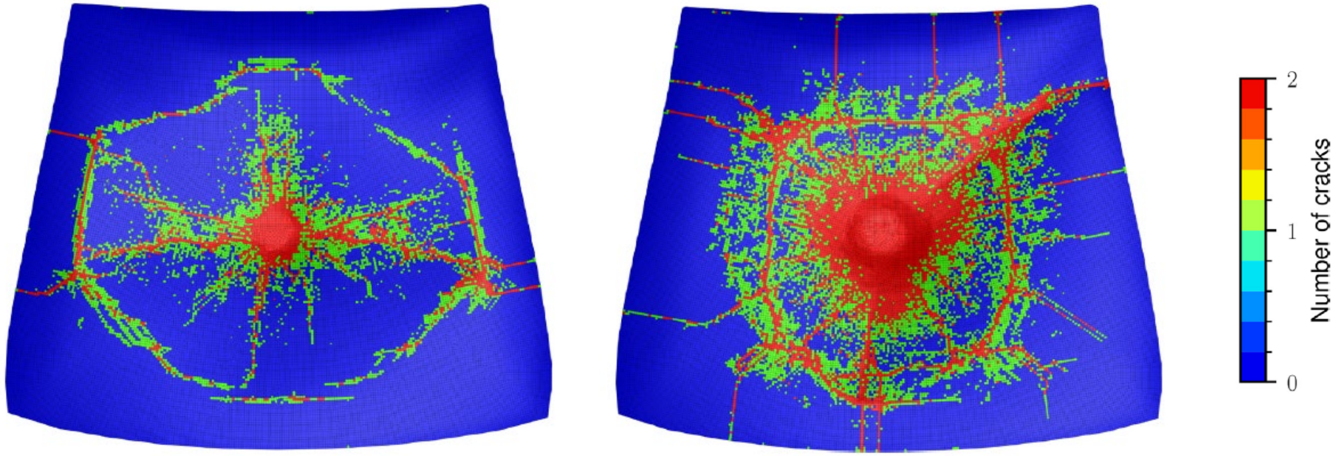
- Capabilities of the new method
  - Can describe the probabilistic fracture behavior of glass and SCG
  - Predicts the strength of glass plates of various geometries exposed to many different load cases
  - User can select a representative case of a glass plate fracture strength simply by altering the failure percentile parameter
  - Example: windshield impact



Rudshaug et al. (2023)

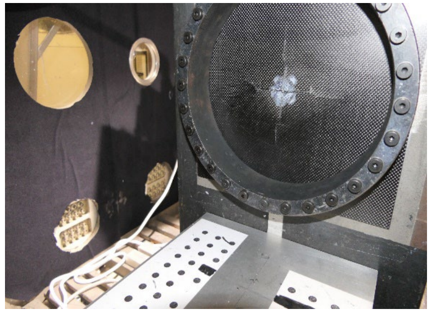
failure percentile 0.05 (weak windshield)

failure percentile 0.95 (strong windshield)

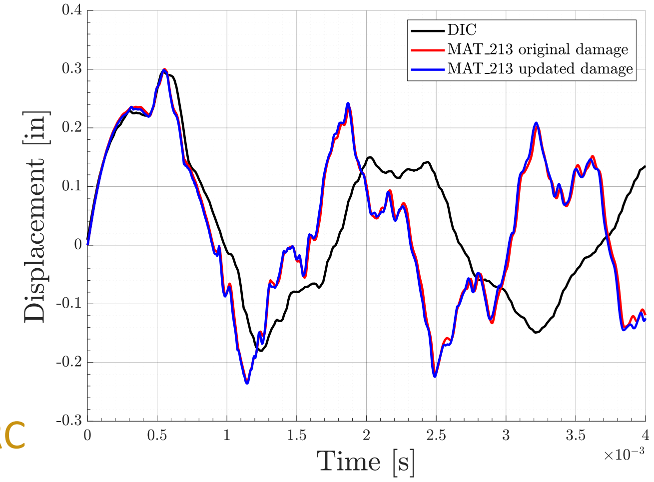


*MAT_COMPOSITE_TABULATED_PLASTICITY_DAMAGE V1.3.7

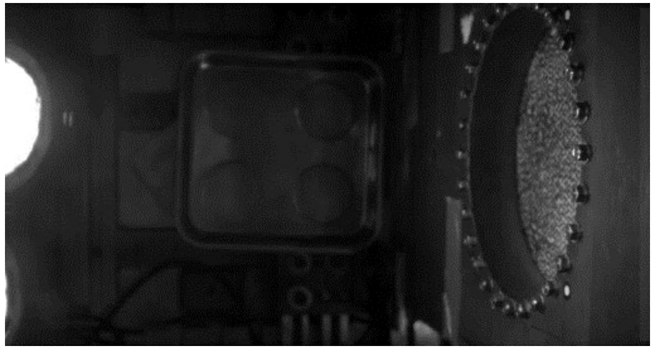
- *MAT_213 features
  - orthotropic, visco-elastic-plastic material with temperature and rate dependencies, damage, failure, and probabilistic analysis
- New in R16
  - Thick shells, Tsai-Wu Failure Criterion tied to post-peak damage curve, enhanced input check, improved error messages, and updated User Guide

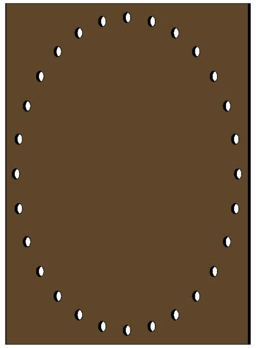


Bird Strike on Rotorcraft Fuselage Structure at NASA-GRC



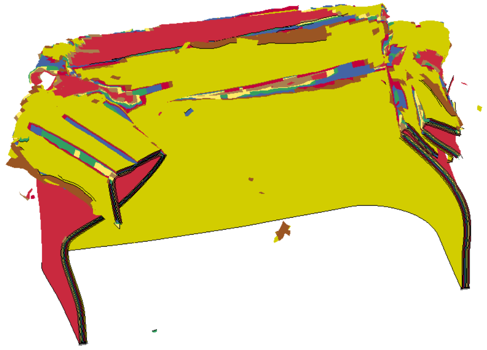
Simulations at NASA-GRC





Simulations of NASA-GRC High Velocity Impact Tests at ASU

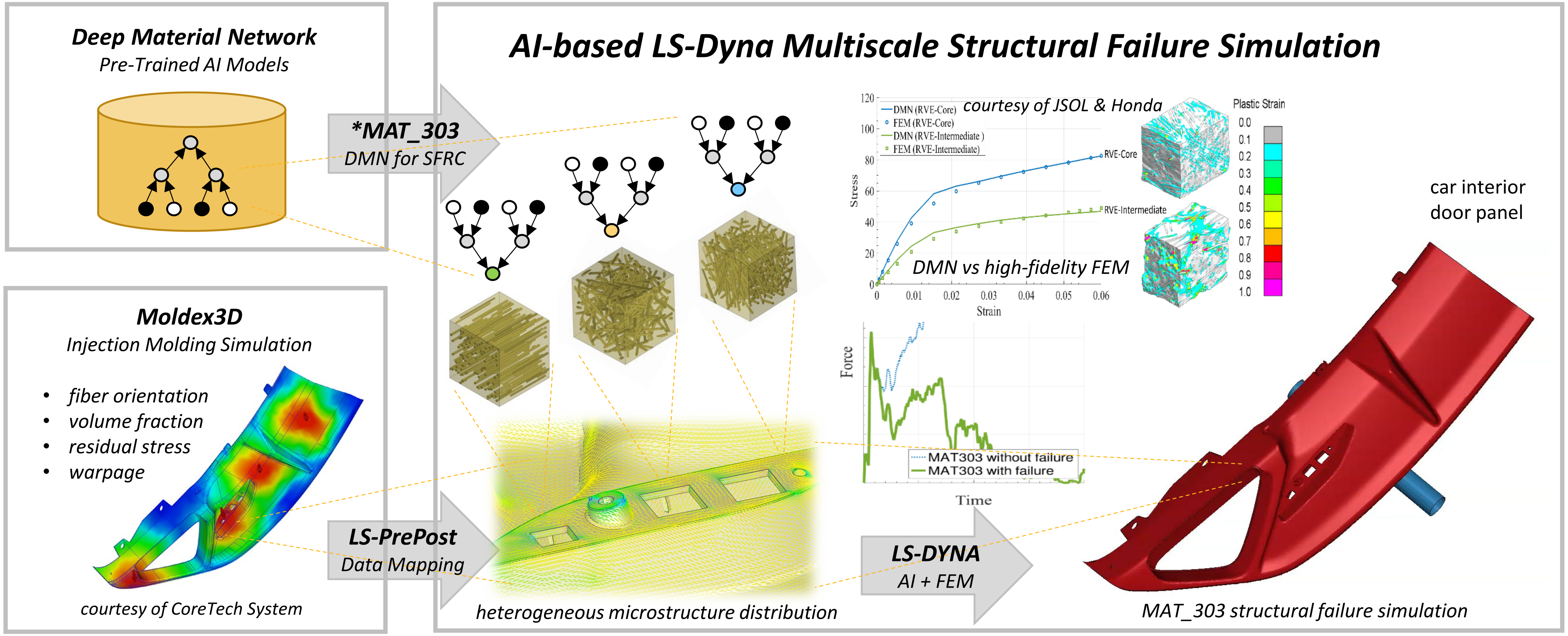
MAT_213 Project: ASU, OSU, GMU, FAA, NASA, Honda, Ansys



Simulations of low velocity crush testing at Honda NA

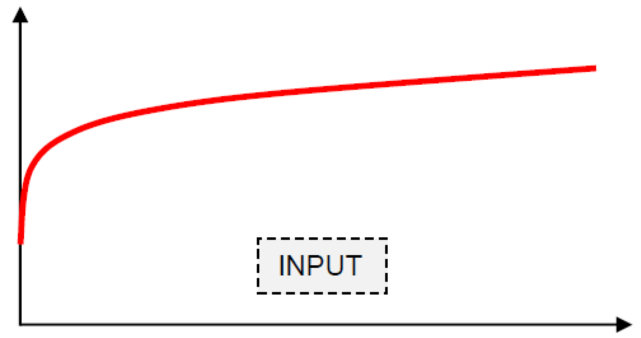
Deep Material Network (DMN)

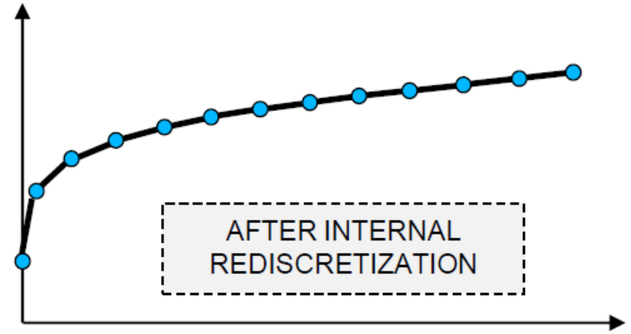
- DMN: AI method for multiscale analysis of fiber-reinforced composites
- New in R16: Moldex3D ~ LS-Dyna simulation workflow enhanced for multi-component injection molded products
- New in R16: *MAT_303 is extended to offer multiscale anisotropic failure prediction for short-fiber composites



Enhancements for curves

- *DEFINE_CURVE uses internal rediscretization (equally spaced points) since many years
  - Until 2007: 100 points per curve
  - 2007-2015: global LCINT on *CONTROL_SOLUTION
  - Since 2015: curve specific LCINT possible (but memory still set by max. LCINT)





- Now from 2025 (R16): new storage scheme
  - Significant memory reduction, particularly when different curves have different values of LCINT
  - Evaluating these curves is also more efficient
  - Changes necessary for user materials

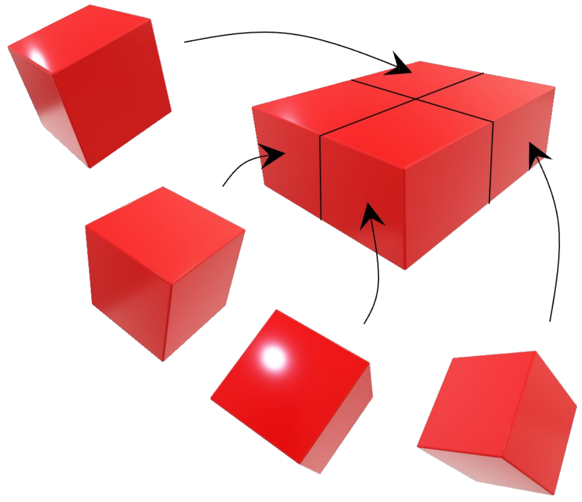
e.g. 10,000 curves with mostly LCINT=1000
+ a few with LCINT=5000

OLD ≈ 200 megawords (800 MB in single prec.)
NEW ≈ 10 megawords (40 MB in single prec.)

Reference configuration treatment

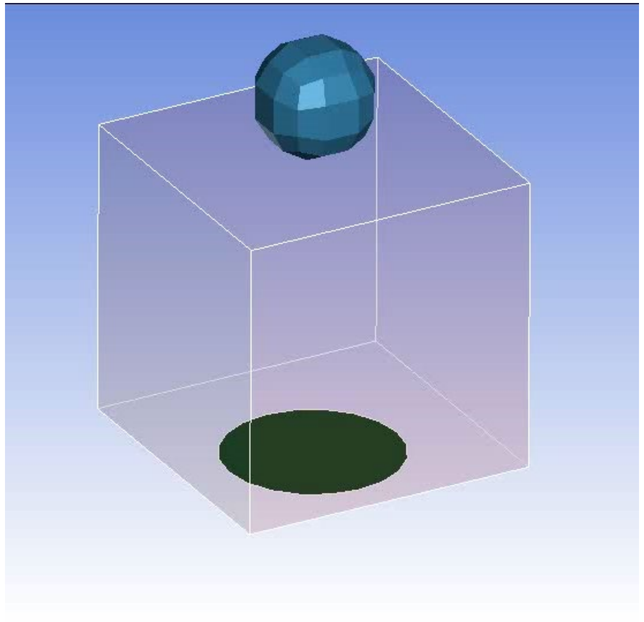
- *NODE_REFERENCE
  - Nodal coordinates in a reference configuration
- *ELEMENT_SOLID/SHELL_REFERENCE
  - Connectivities of elements “of interest”
    - The EID corresponds to the same EID in the *ELEMENT_... list of elements
    - The N1,… references nodes in the *NODE_REFERENCE list and *not* the ones in *NODE

Generalization of
*INTIAL_FOAM_REFERENCE_GEOMETRY
*INITIAL_STRESS_SOLID/SHELL

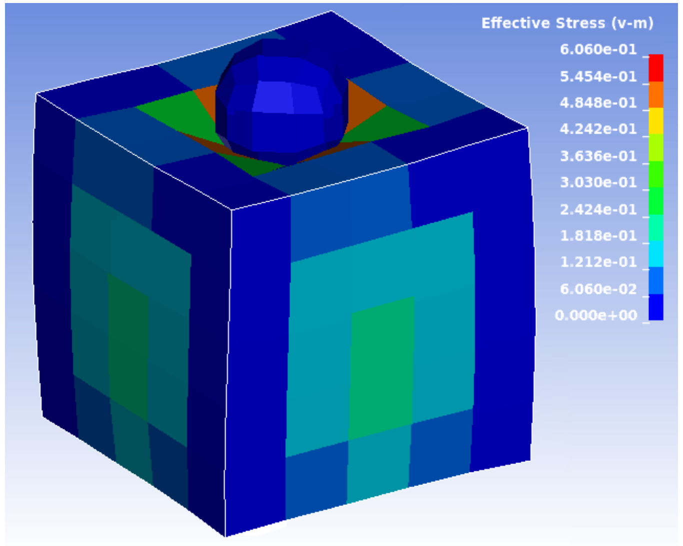


- Whenever an *ELEMENT_SOLID/SHELL_REFERENCE is present in an input deck, this will be taken as the reference configuration of this element, overriding any other option
- Provides a seamless approach to dealing with hyperelasticity in a dynain context

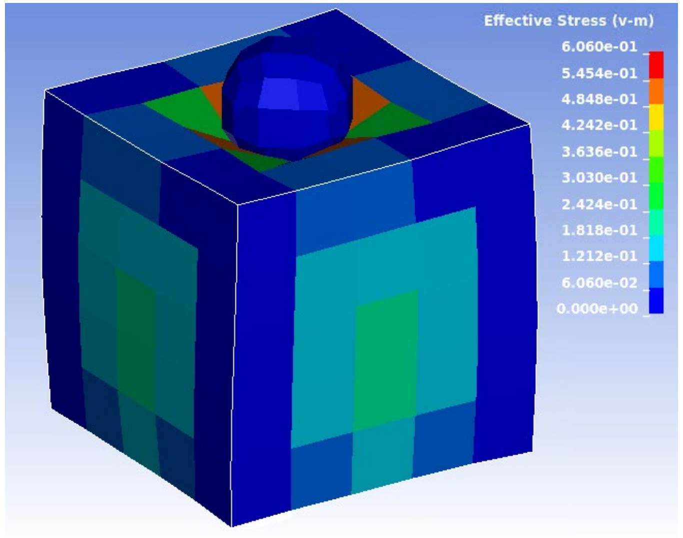
Rubber test



End of first simulation



Beginning of second simulation



- A rubber cube with *MAT_BLATZ-KO is deformed according to above, after which a dynain file is written
- A second simulation just holds it in place

- “All” combinations of FMATRX, FTYPE, including second simulation running both explicit and implicit
  - A total of 32 cases
- All cases provide the correct stress state at the beginning of the second simulation

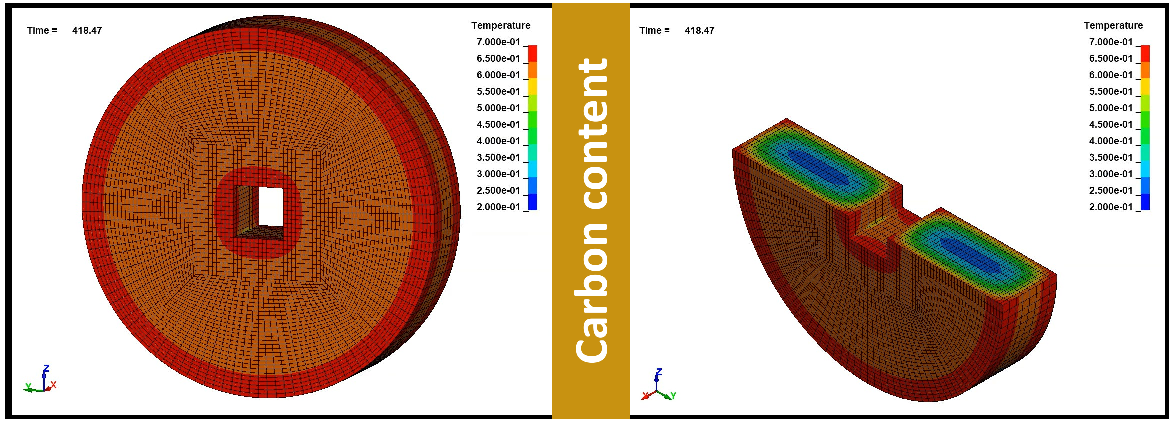
New concept of external variables - Introduction

- New keyword *LOAD_EXTERNAL_VARIABLE defines temporally varying spatial distribution of an external variable field
  - e.g., moisture, state-of-charge, carbon content, absorbed hydrogen, …
  - Direct, tabular input per node or node set (curve)
  - Result data from a previous run interpreted as external variable (LSDA file)

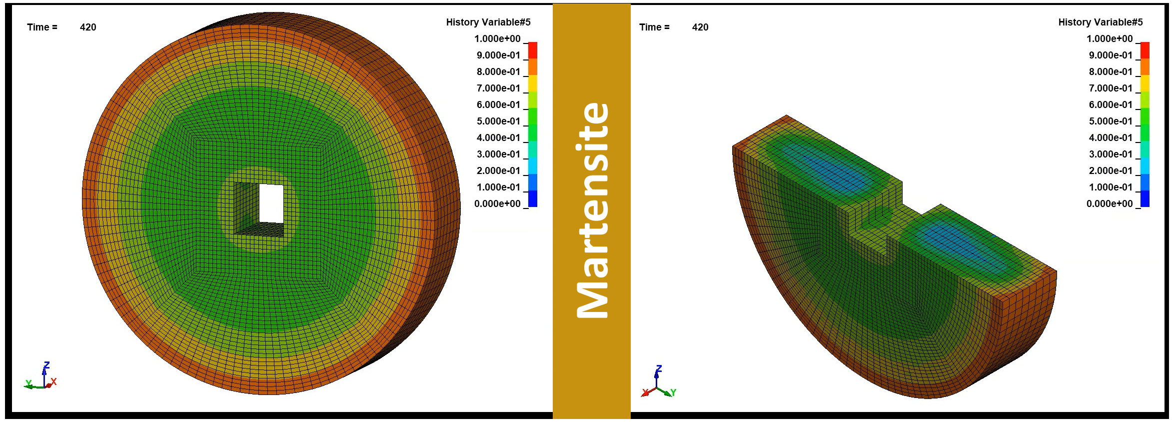
- External variable distribution used to modify
  - Thermal material properties in *MAT_T08 and *MAT_T10
  - Structural material properties in *MAT_106 and *MAT_251
  - Phase change parameters in *MAT_254
  - Volume of a part with *MAT_ADD_EXTVAR_EXPANSION

New concept of external variables – Case hardening example

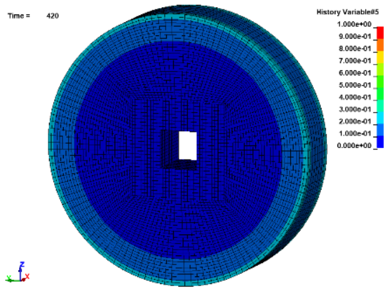
- Heating of a steel specimen in an oven with a carbonaceous environment
  - Austenitization in the material (due to heating)
  - Diffusion of carbon into the material (using temperature as external variable)



- Quenching of the specimen
  - Carbon concentration locally improves martensite formation



Result w/o carburization



Details: T. Klöppel@14:25 (KLEINER SAAL)

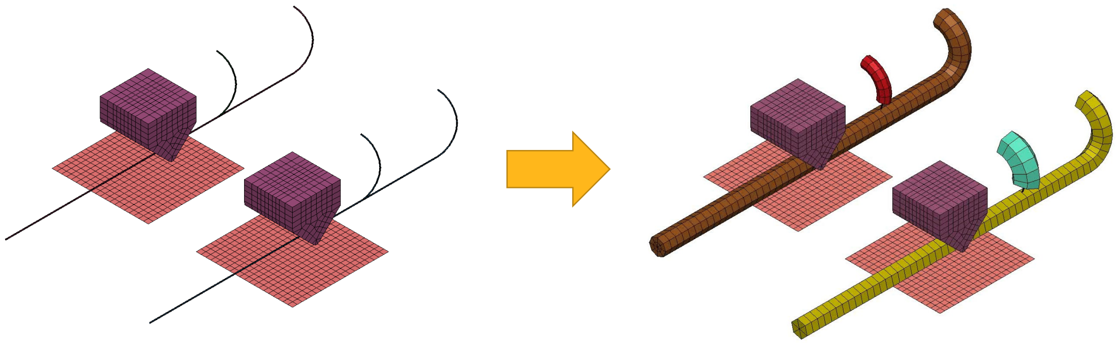
Miscellaneous

Cables, Connections, Rigid bodies, Autodyn

Simplified electric cable modeling with *DEFINE_CABLE

- Simple creation and analysis of electric cables for modeling wire failure in vehicle crash
  - Automatic creation of cables from beam elements
  - Final cables can be a mix of solids/shells/beams
  - Links cross-section data to each original beam element
- Data available in binout (*DATABASE_CABLE)
  - Compression (contact) force
  - Cross-section area
- Data summary available in ASCII-file
  - Time and location for maximum compression force and minimum cross-section area for each cable and for whole model

Cable generation from beam elements



Data summary

```
PART-WISE DATA:

 Beam part=  83990001, sampling frequency=         1 cycles
 maxstress=    0.4953E-01, time=    0.5000E+01, element=            46
 minarea  =    0.5891E+02, time=    0.5000E+01, element=            48
 maxforce =    0.5590E+01, time=    0.4998E+01, element=            46

 Beam part=  83990002, sampling frequency=        10 cycles
 maxstress=    0.7170E-01, time=    0.4991E+01, element=       6020579
 minarea  =    0.8419E+02, time=    0.4997E+01, element=       6020579
 maxforce =    0.9542E+01, time=    0.4997E+01, element=       6020579

 Beam part=  83990005, sampling frequency=         1 cycles
 maxstress=    0.3333E-03, time=    0.4854E+01, element=       6020613
 minarea  =    0.3247E+03, time=    0.2972E+01, element=       6020613
 maxforce =    0.0000E+00, time=    0.0000E+00, element=             0

 Beam part=  83990006, sampling frequency=         1 cycles
 maxstress=    0.5296E-03, time=    0.2155E+01, element=       6020623
 minarea  =    0.8662E+02, time=    0.2664E+01, element=       6020623
 maxforce =    0.0000E+00, time=    0.0000E+00, element=             0

DATA FOR ALL PARTS:

 maxstress=    0.7170E-01, time=    0.4991E+01, element=       6020579, part=      83990002
 minarea  =    0.5891E+02, time=    0.5000E+01, element=            48, part=      83990001
 maxforce =    0.9542E+01, time=    0.4997E+01, element=       6020579, part=      83990002
```

Enhancements for SPR2/SPR3 connectors

Details: M.Hübner@14:45

*MAT_100

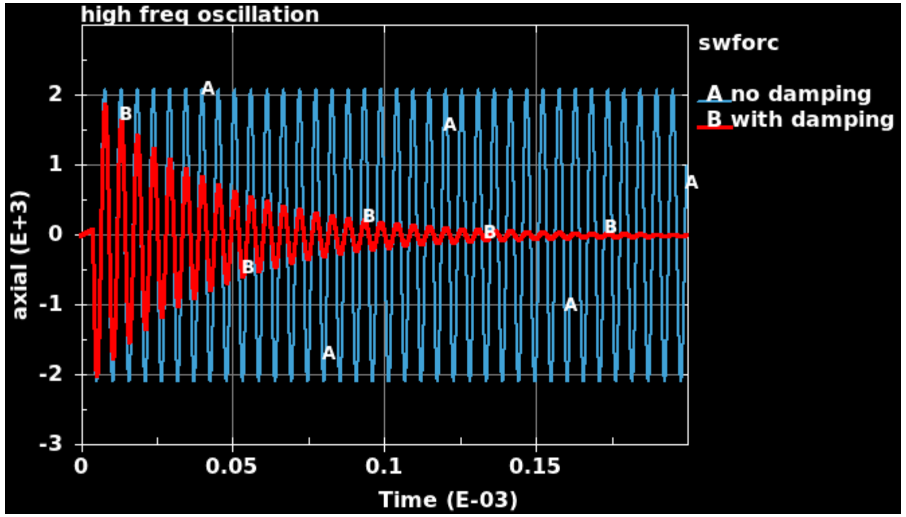
$$f = \left(\frac{\sigma_n}{\sigma_n^F}\right)^{m_n} + \left(\frac{\sigma_b}{\sigma_b^F}\right)^{m_b} + \left(\frac{\tau}{\tau^F}\right)^{m_\tau} - 1$$

- Optional failure criterion (SPR3)
  - Force-based criterion developed to simplify transition from *MAT_SPOTWELD

$$f_c = \left(\frac{\langle f_n \rangle}{\mathrm{FFN}}\right)^{\mathrm{EXFC}} + \left(\frac{m_b}{\mathrm{FFB}}\right)^{\mathrm{EXFC}} + \left(\frac{f_t + \mathrm{MFSFC} \bullet m_t}{\mathrm{FFS}}\right)^{\mathrm{EXFC}} - 1$$

SPR3

- New search method (SPR2 & SPR3)
  - Sometimes better in difficult mesh conditions
- Added viscous damping (SPR3)
  - Reduces high-frequency noise

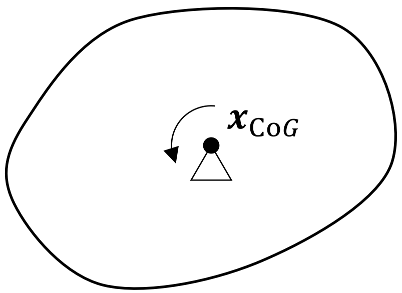


- New option STIFF2<0 (SPR3)
  - Load curve input for shear stiffness vs load angle: allows better fit of elastic mixed mode response
- Add TITLE option (SPR2 & SPR3)
  - This is used as the part title/name of the visualization beams

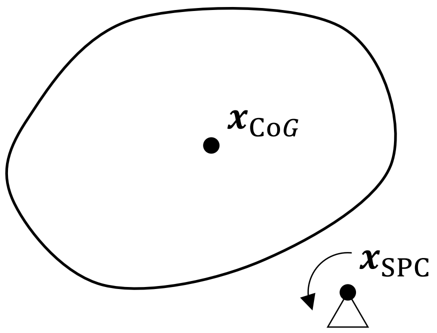
Rigid Body Constraint in Arbitrary Point

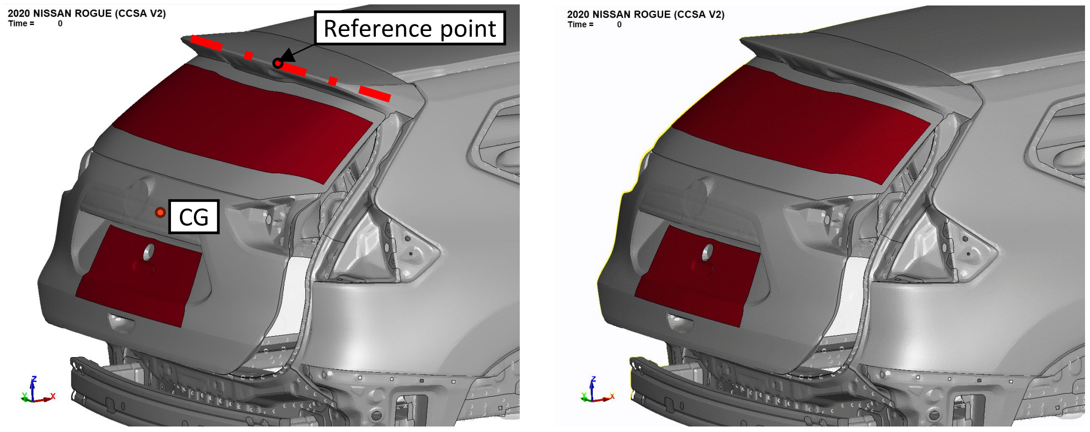
- Until now, constraints (applied through $|\text{CMO}| = 1$) and prescribed motion have always been translated to act in the center of gravity of a rigid body.
- By setting $|\text{CMO}| = 2$, the constraints or prescribed motion of the rigid body can be applied in a user specified coordinate.
- This enhancement is available also for nodal rigid bodies.

$|\text{CMO}| = 1$



$|\text{CMO}| = 2$

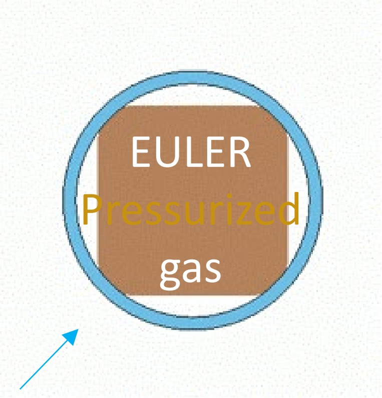




- Simulating the closing of body closures is done with rigid bodies, rotating at the hinges.
- Before update, the only way to achieve this was using _INERTIA to set the center of gravity at the hinges. However, this changes the physical properties and will not lead to accurate results.

Ansys Autodyn®: Enablement within LS-DYNA Solver

- Explicit analysis software with particular strength in simulating explosives
- Selected Autodyn solver technology available inside LS-DYNA solver as *EFV_...
  - EFV = Euler Finite Volume
  - 2 solvers: Multi-Material-Euler (2D,3D) and Euler-FCT (2D,3D)
- Allows coupling with LS-DYNA structures
- LS-DYNA ALE results can be used in subsequent EFV simulations
- Accessible via Ansys LS-DYNA or LSTC LS-DYNA
  -> no separate license needed
- Exposure inside LS-PrePost and Keyword Manual



LS-DYNA Structure

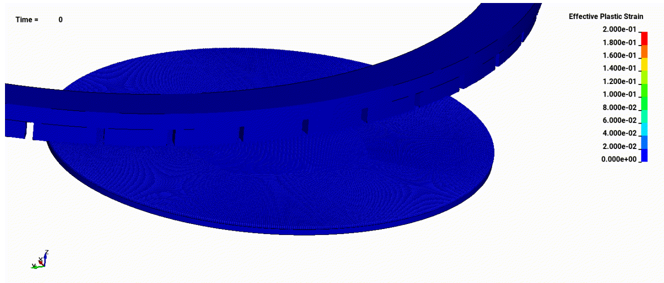
SPG/ISPG

(Incompressible) Smooth Particle Galerkin

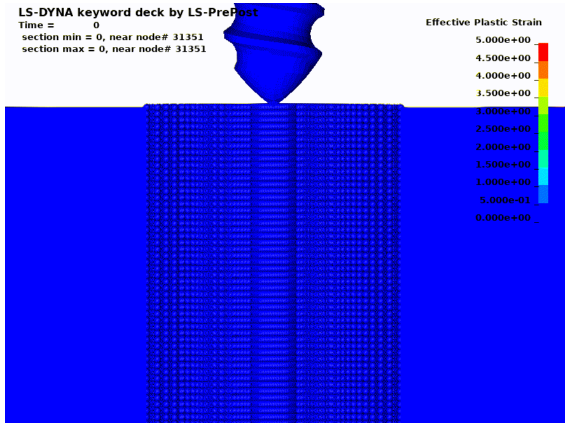
MPP SPG Particle-to-Surface Contact Algorithm

- R16 introduces MPP version for SPG particle-to-surface contact algorithm developed in R15 SMP
  - Unique contact algorithm for the stability and accuracy in SPG simulation.
  - Improved efficiency in large-scale problems.

Removal of silicon in semiconductor wafer by back-grinding



Orthopedic fixation strength analysis of cancellous screw in biomimetic bones



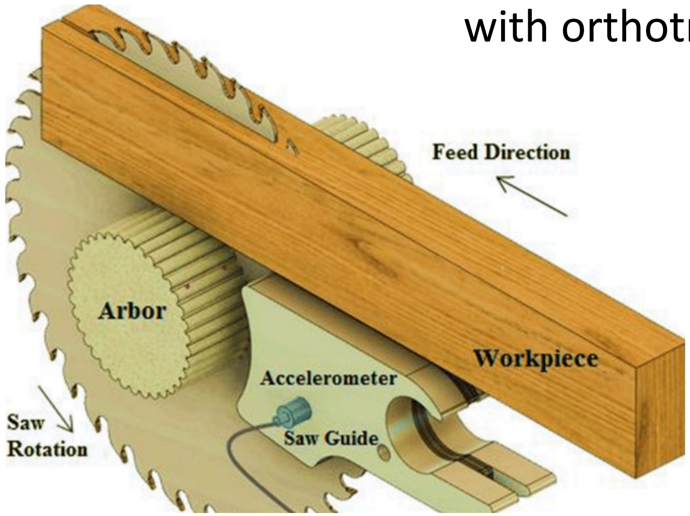
- Screw insertion following by screw pullout simulation.
- Study the effects of pilot hole size and screw cutting flute.

Collaboration with Ansys ACE (Ram Gopisetti, Amit Nair, Alex Rycman)

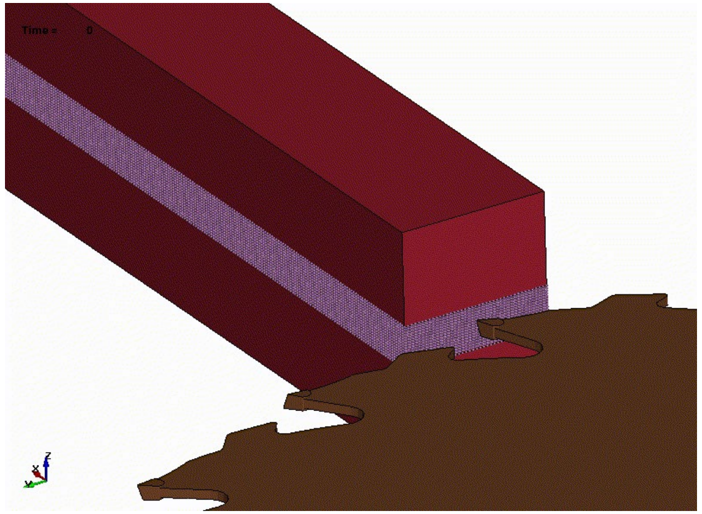
SPG Failure Simulation in Orthotropic Wood Materials

- R16 SPG can model orthotropic wood material (*MAT_WOOD_PINE)
  - Wood material properties vary with orientation.
  - SPG bond failure does not rely on continuum damage mechanics (CDM) and element erosion, thus the conservation of system mass and momentum.

SPG wood machining simulations
with orthotropic material



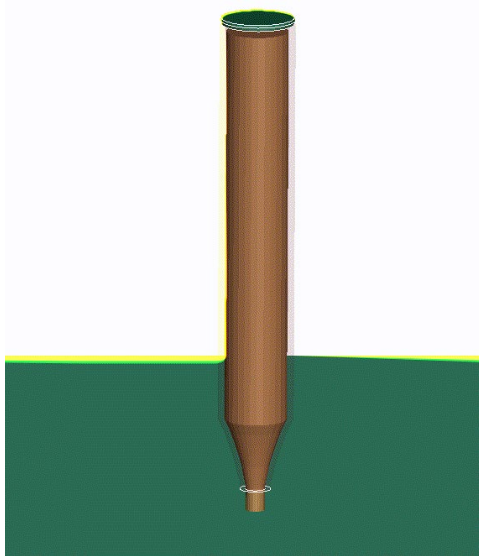
Int. J. Adv. Manu. Tech. V108, pp.1-15 (2020)



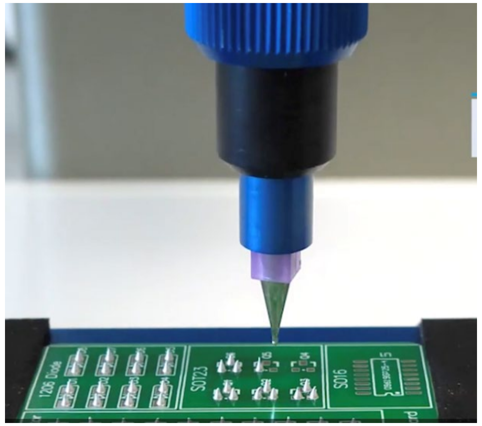
ISPG for Adhesive Fluid Dispensing and Dispersing

- Adhesive dispensing technique: auto, electronics, high-tech, biomedical and pharmaceutical industries
- Full-implicit **high-viscous non-Newtonian ISPG fluid** can be used to model this process
  - New adaptive refinement scheme to handle the fluid thinning effect
  - Including chemical reagents, biological fluids, and industrial adhesive fluids (epoxy, silicone, solder paste, …)

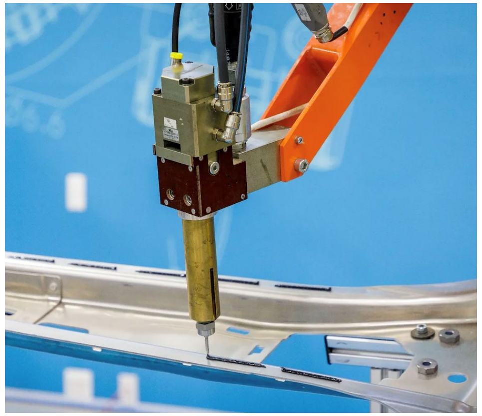
Dispensing for droplet deposition



Adhesive dispensing examples



Thermal conductive adhesive in electronics
preeflow.com

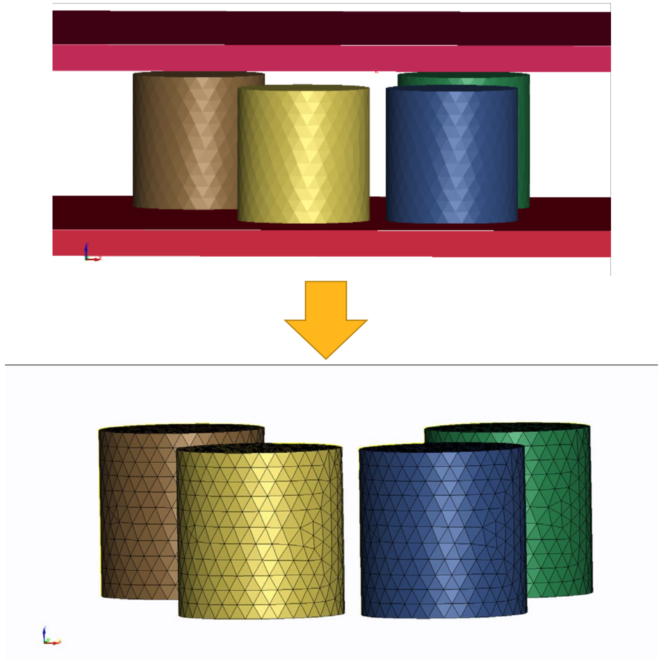


Structural adhesive on car body
henkel.com

MPP ISPG for Solder Bridging Defect Prediction

- Solder bridging defect is one of main soldering issues in Ball Grid Array (BGA) chip packaging
- R16 implicit ISPG introduces the MPP version for large-scale solder bridging defect prediction

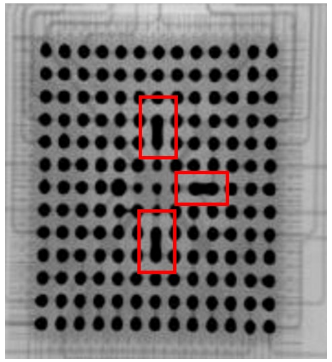
ISPG solder bridging simulation



Fluid surface merging considers contact and surface tension

Electronics applications

Bridging of two solder balls
Surfacemountprocess.com



BGA X-ray image
with 3 bridging defects

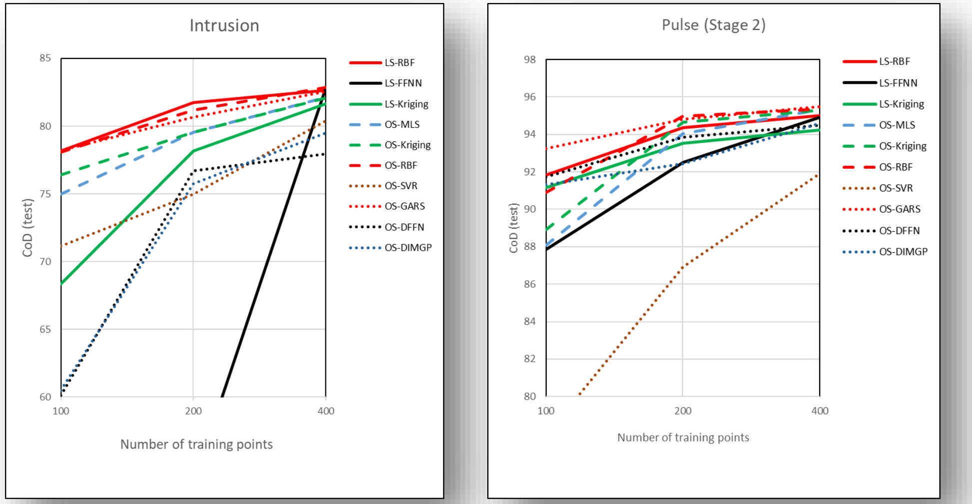
2001 IEEE Conference
H.K. Kim et al.
DOI: 10.1109/NSSMIC.2001.1008651

LS-OPT and LS-TaSC

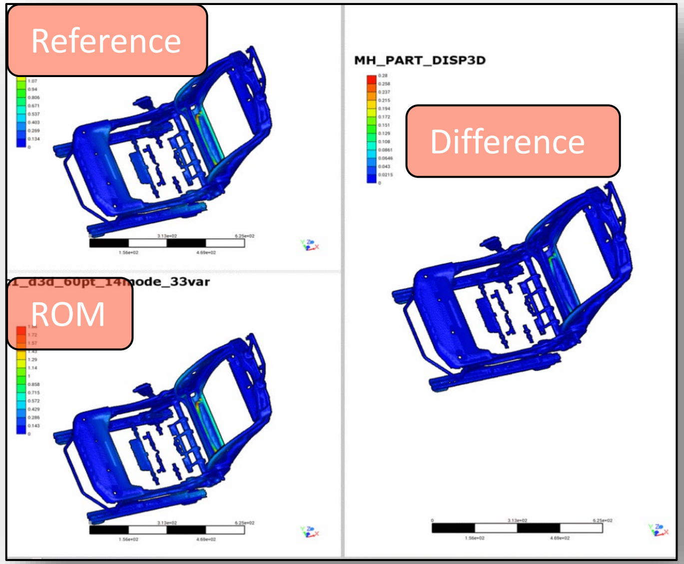
Recent Developments in LS-OPT

- Metamodels: Method of Optimal Prognosis (MOP)
  - Integrated from optiSLang
    → automatically selects the best metamodel
- Twin Builder interface
  - LS-DYNA ROM coupling:
    preparation of LS-DYNA output to generate ROM with Twin Builder
  - Twin Builder as low fidelity solver for LS-OPT tasks

12:15, STUDIO VI
LS-OPT Pro: Status and Outlook



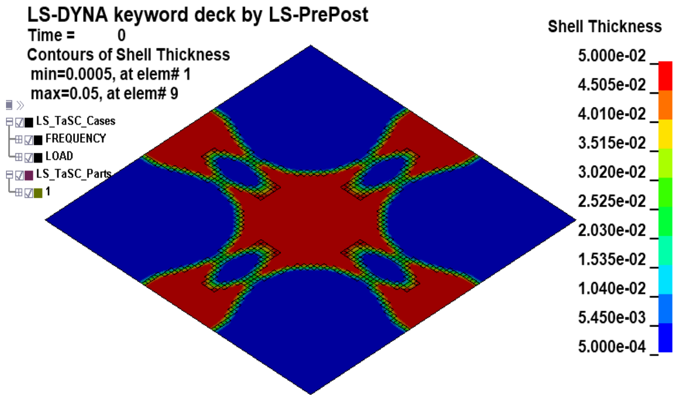
Metamodel performance comparison: Frontal crash



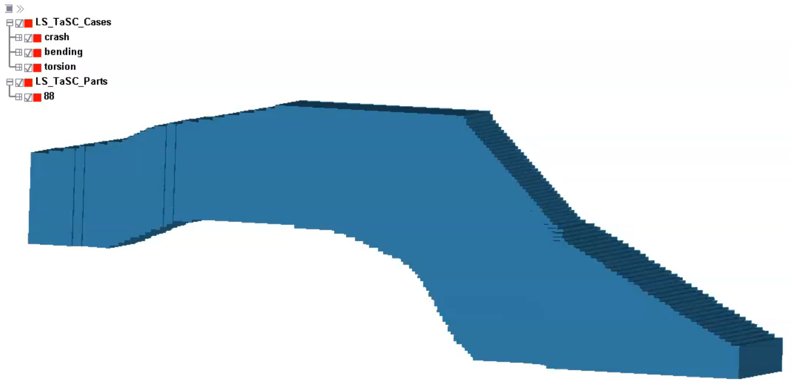
New Features in LS-TaSC

- Multidisciplinary design optimization for shell thickness
  - for combination of impact, static, and NVH load cases
- User customization
  - responses / FE model editing / design procedures
- User-defined load cases
  - import results from other analysis software (i.e., Ansys Mechanical, MSC Nastran, …)
- Minimum/maximum feature size controlling
  - mega-castings to integrate with energy absorption

14:45, STUDIO II
Overview of LS-TaSC and New Feature Highlights



Shell thickness design of a clamped plate for static (stiffest structure) and NVH (max. fundamental frequency) load cases.



Design evolution of a rear torque box for energy absorption casting together with the minimum & maximum feature size controlling, which prevents the holes from casting.

PyDYNA

PyDYNA V0.5.0 Released

- Pythonic package for providing a convenient and complete way to
  - build input deck, submit it to the LS-DYNA solver, and finally postprocess the results
- PyDYNA contains two submodules

ansys.dyna.core.pre

Highly abstracted APIs for creating and setting up DYNA input decks. Supports many classes: DynaMech, DynaIGA, DynaICFD, DynaSALE, DynaEM, DynaNVH, DynaMaterial, ...
→ used to generate LS-DYNA keywords.

ansys.dyna.core.solver

API to interact directly with the LS-DYNA solver.
Service provides a way to push input files to the solver, monitor the state of the running job, change the value of a load curve, and finally retrieve result files back from the server.

- Documentation and Examples: https://dyna.docs.pyansys.com/version/stable/

New features and enhancements in LS-DYNA R16

PART I

- Airbag methods
- Contacts
- Material models
- Misc.
- SPG/ISPG
- LS-OPT/LS-TasC
- PyDYNA

PART II

16:15
Stefan Hartmann

- EM
- Implicit
- ICFD + CESE
- NVH
- IGA
- Ansys Forming
- LS-Prepost

Ansys