Ansys LS-DYNA User Group Meeting

Nov 8, 2022

Objectives

- Communicate current LS-DYNA development trajectory.
- Collaborate with customers to get direct input.
- Adjust the development roadmap to accommodate customer needs.
- Formal platform for customers to network with the development team.

LS-DYNA – Crash and Beyond Roadmap

Presented by

Madhu Keshavamurthy

Ansys

Keeping Our Commitment Made in 2019

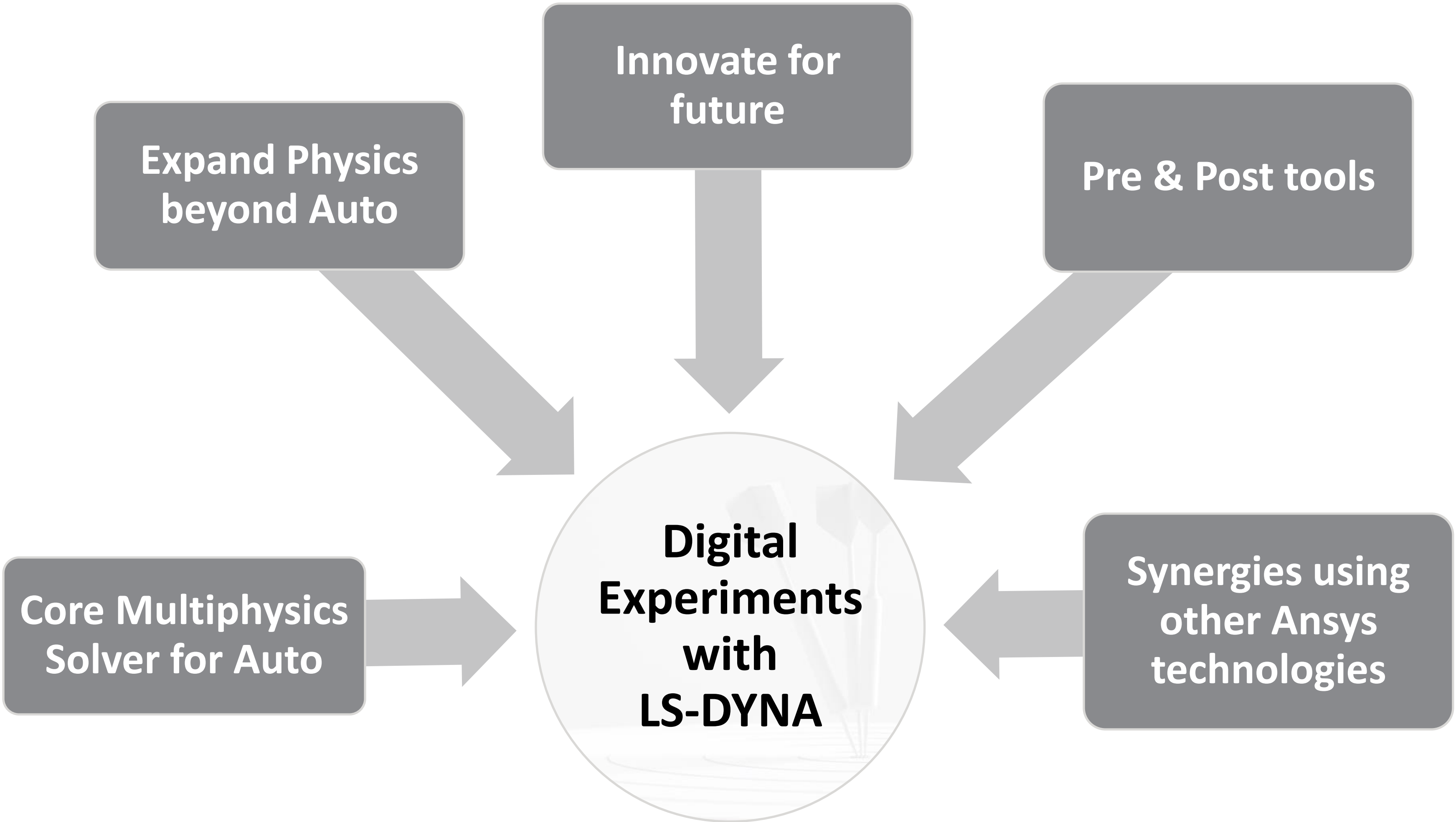
CONTINUE LEGACY OF TWO LEGENDS IN CAE

ALLOW INNOVATION TO THRIVE

CONTINUE TO KEEP CUSTOMER CENTRIC FOCUS

- Continue Current Development Trajectory
- Integrate and Work with LSTC partners Continue Direct Customer Engagements
- Continue Partnership with 3^{rd} Party Pre-Processors
- **No Forced Migration,** Use tools the way you see fit
- Expose LS-DYNA into ANSYS Mechanical
- Joint Projects with Flagship Solver technologies

LS-DYNA Development Strategy



One Code, One Model, Multiphysics

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

Thermal

MultiScale

Structures

EM

LS-DYNA®

One Code, One Model, Multiphysics

ICFD/CESE

NVH/Acoustics

ALE/SPH/CESE

IGA

DEM/MeshFree

Mechanical

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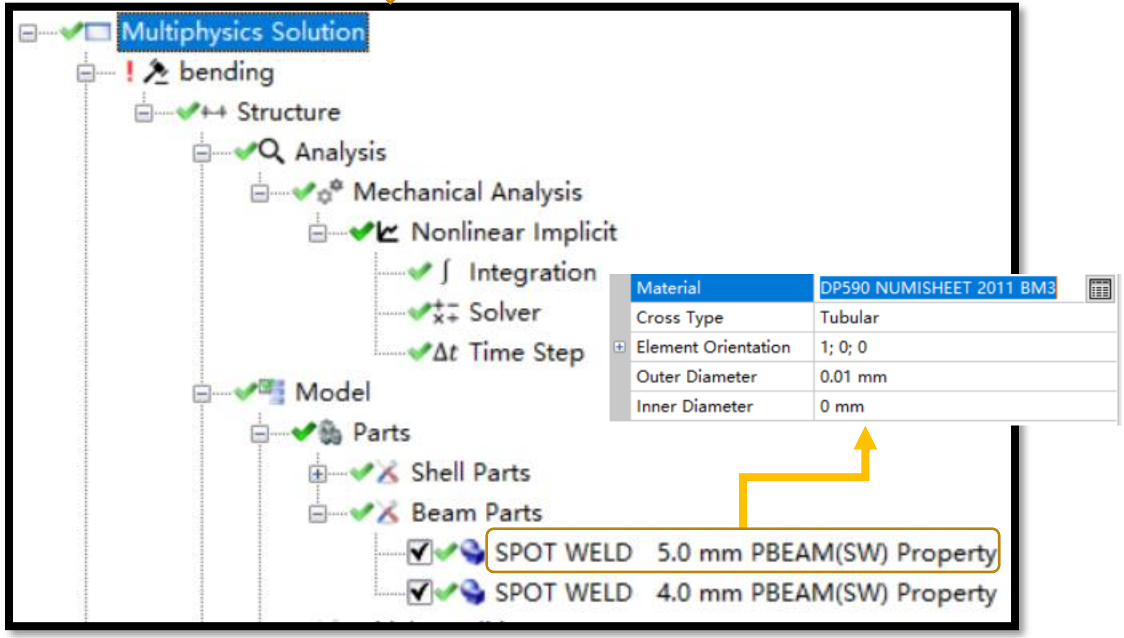
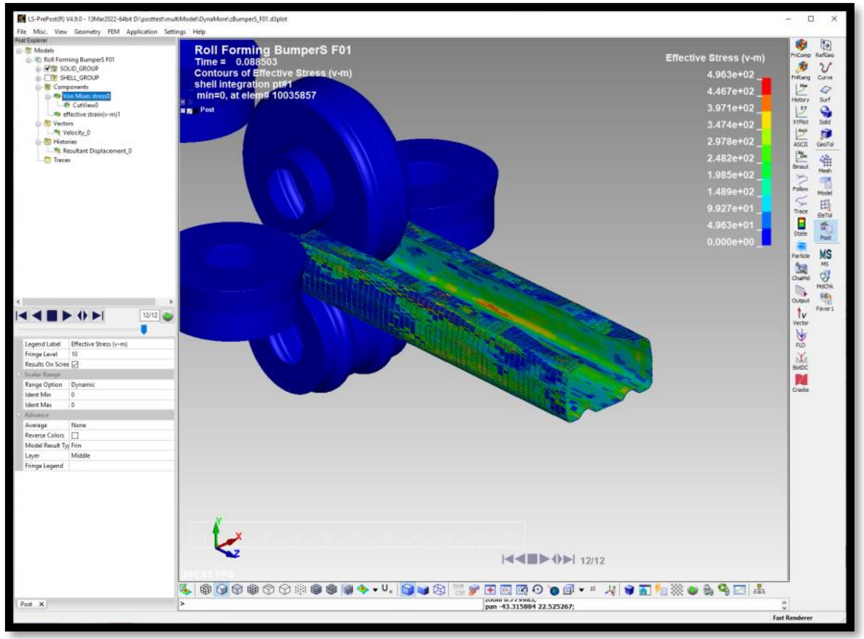
Complementary Tools Supporting LS-DYNA – LS-PrePost

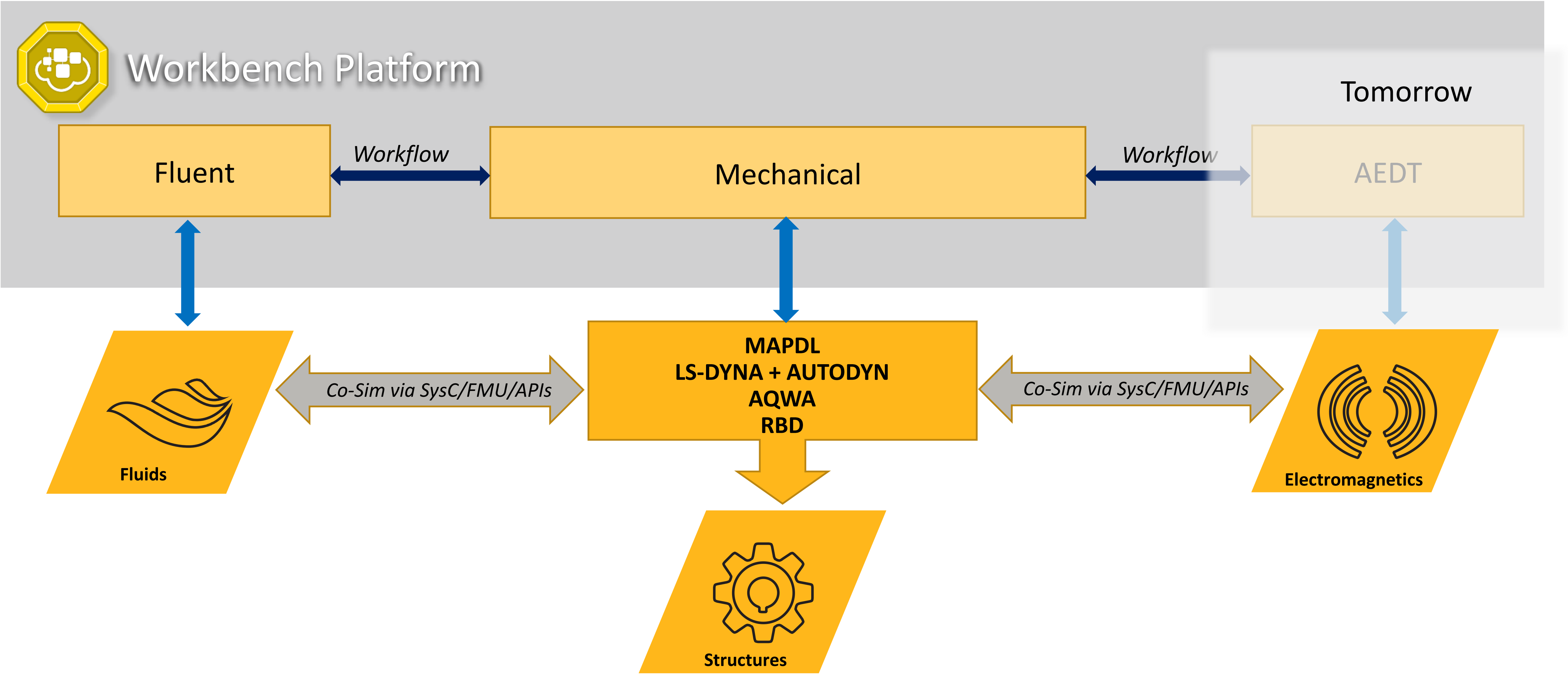
- Pre-Processing
  - Exposes latest LS-DYNA functionalities.
  - Improved performance & robustness.
  - Easy pre-processing through solution explorer.



- Post-Processing
  - Several new features/enhancements
  - Easy post-processing using Post explorer.

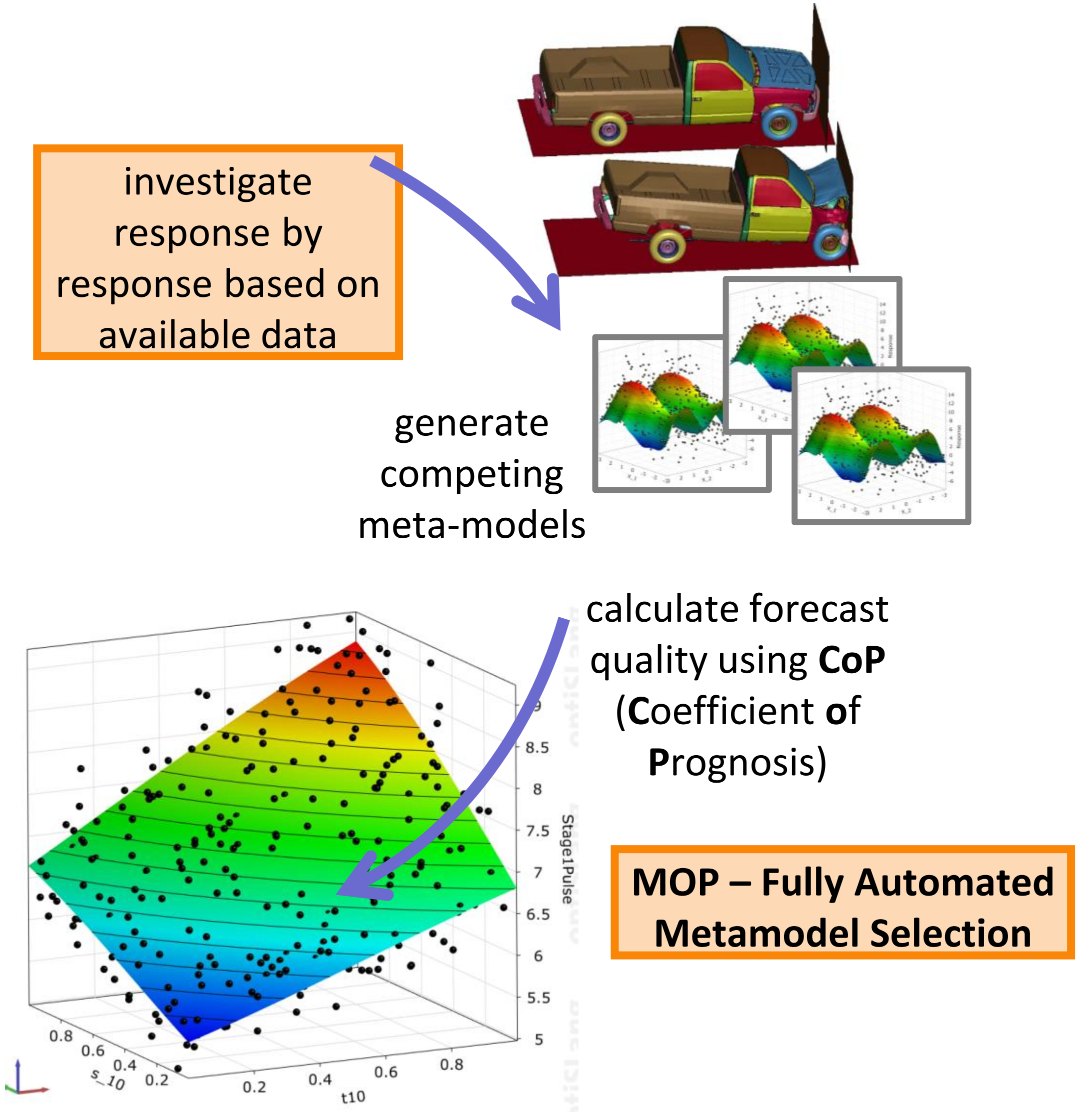


Complementary Tools Supporting LS-DYNA – Mechanical



Complementary Tools Supporting LS-DYNA – LS-OPT

- Introducing LS-OPT Pro
  - Exposes Metamodel of Optimal Prognosis (MOP) inside LS-OPT.
  - MOP includes metamodels from both LS-OPT & optiSLang.
  - Checks out optiSlang Pro paid license.
  - Free LS-OPT in maintenance mode, still available for LS-DYNA customers.
- LS-OPT uses Twin Builder ROM as LS-DYNA surrogate to accelerate analysis.

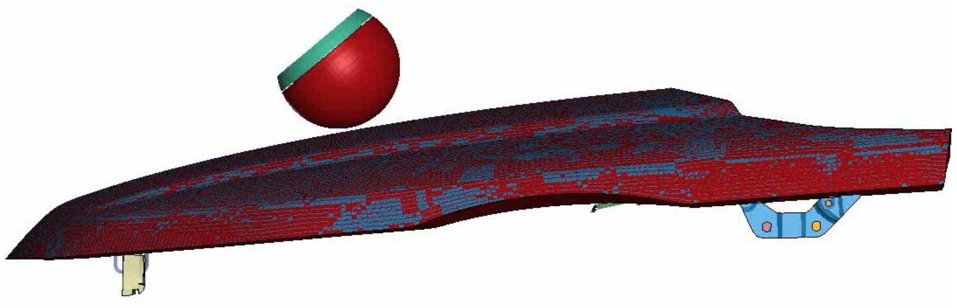


Complementary Tools Supporting LS-DYNA – LS-TaSC

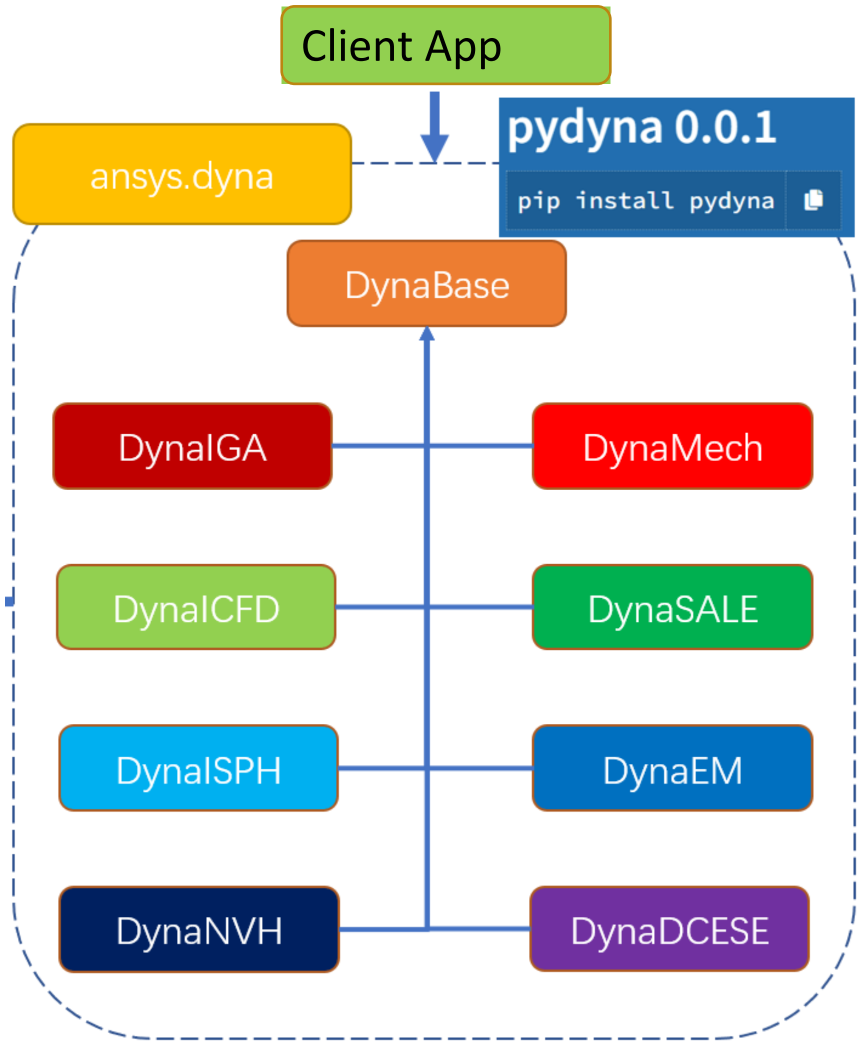
Multi-Disciplinary Optimization (MDO) for Solids and Shells.

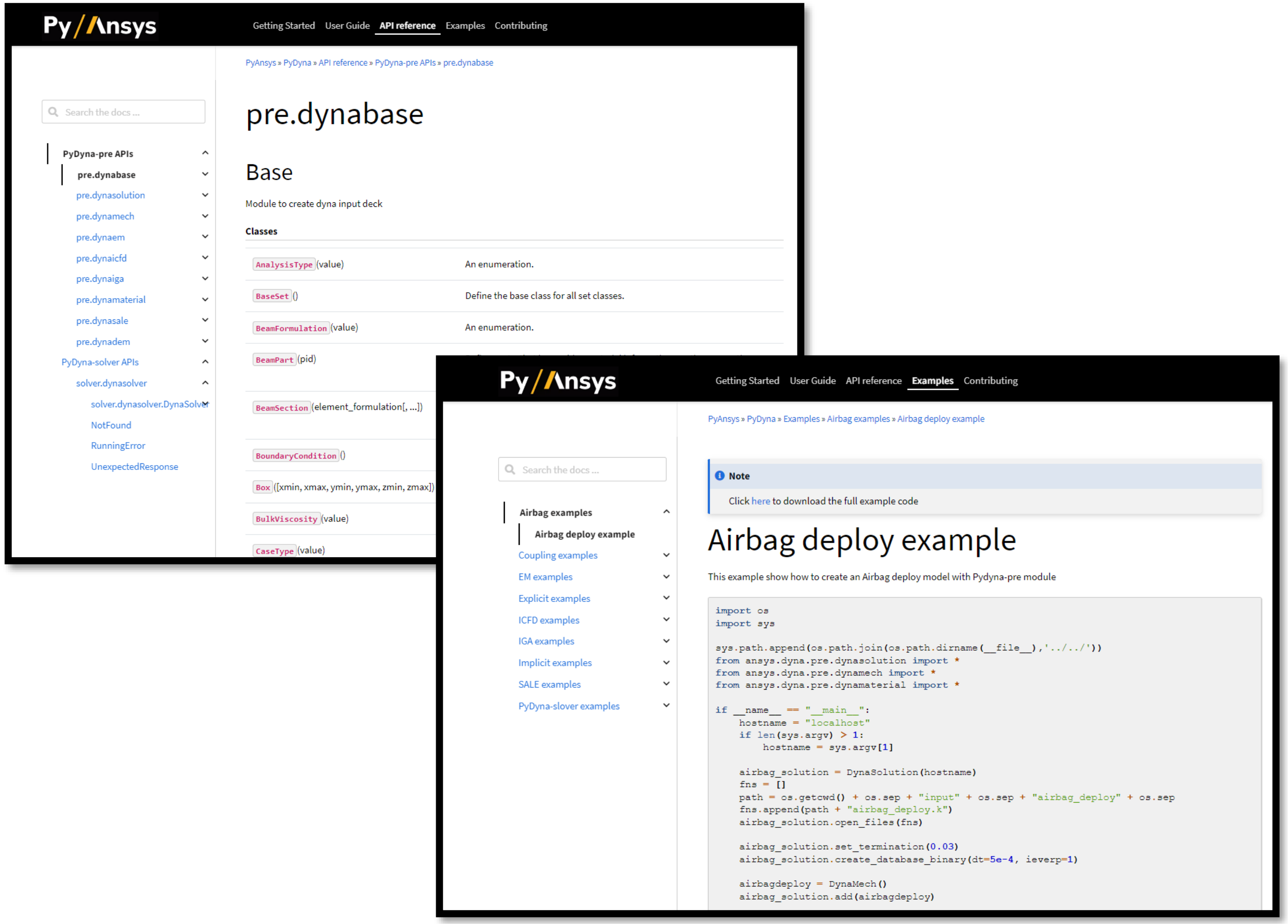
- Support for NVH, impact and statics.
- Many different constraints such as
  - Displacement.
  - Head Injury Criterion.
  - Fundamental frequency.

  etc.
- Application areas: Hood design, mega casting etc.



pyAnsys/pyDyna





Driving the Innovation

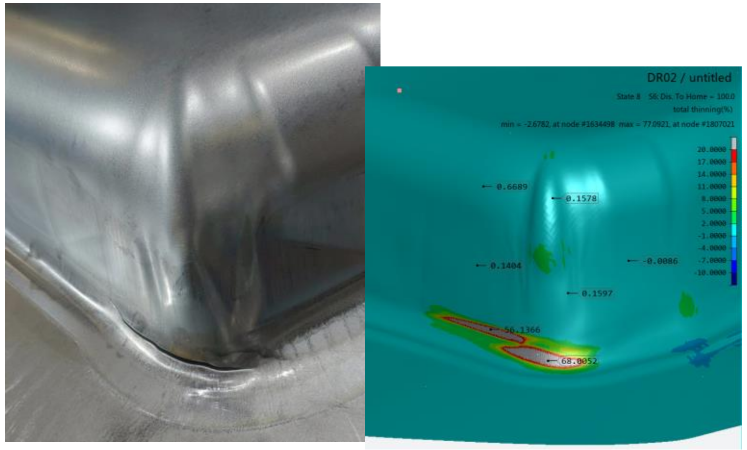
Release Management & Quality

- One major release, one minor release/year, service packs as needed.
  - Product naming convention: Year + R1 (January) or R2 (July).
  - LS-DYNA and all other tools are released at the same time.
- Committed to high quality product releases.
  - Build automation.
  - Increased QA resources & expanded regression testing.
  - Ansys ACE teams help in production testing & reporting bugs.
  - Beta version of LS-DYNA released to customers for input.
- Seek your help in running production cases for early defect detection & correction.

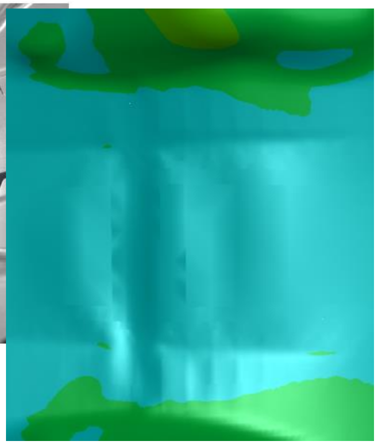
Ansys Forming

Pre-Processing → Job Submission → LS-DYNA Solve → Post-Processing

- A process-centric solution for metal stamping simulation.
- Easy to setup multi-stage forming simulations.
- Customizable templates for easy setup of forming processes.
- Easy job submission and monitoring.
- Integrated Post processing.



Accurate Failure Prediction (Test vs Simulation)



Accurate Wrinkle Prediction (Test vs Simulation)

Ansys Forming Roadmap

Maturity				
2023 R1	**2023 R2**	**2024 R1**	**2024 R2**	**Areas**
●	●	●	●	Multi-stage simulation
●	●	●	●	Springback with Clamping
●	●	●	●	Trim curve development
●	●	●	●	Springback compensation
●	●	●	●	Assembly management

Airbag Enhancements

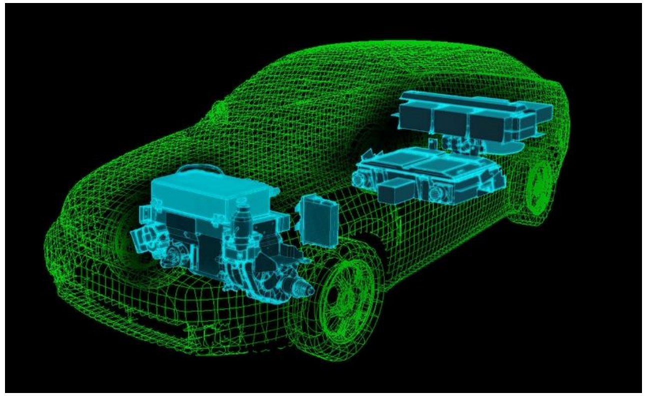
- R14 (2013 R1)
  - Blockage evaluation for external vent
  - POPP for external/internal vent
  - CPM-Thermal solver coupling
- Future: Improved Airbag models, using continuum-based particle methods

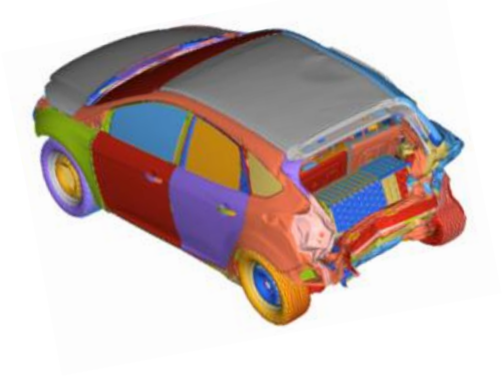
Modular Contact

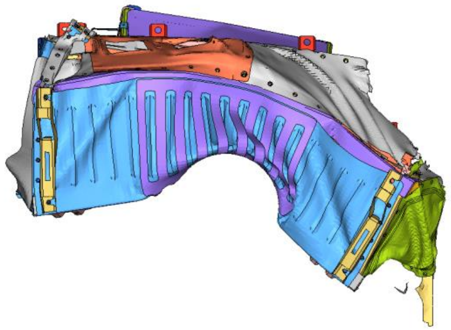
- A new implementation of contact to support MPP, Hybrid, and SMP.
- Simplified input format with best practice default options.
- Designed for flexibility, scalability, and speed.
- Increased use of asynchronous communication for better performance and scalability.
- Simpler, more focused subroutines for better code reuse and easier development.

Ansys Battery Abuse Program

- A framework of battery safety modeling that couples mechanical, thermal, electrical and electrochemical responses of batteries.
- Development is working in collaboration with industry.
- Calibration of simulation solver is effective only when industries & academia shares experimental test data.

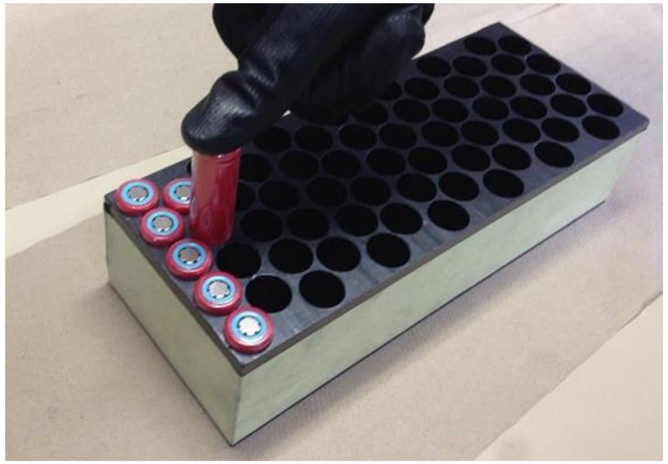




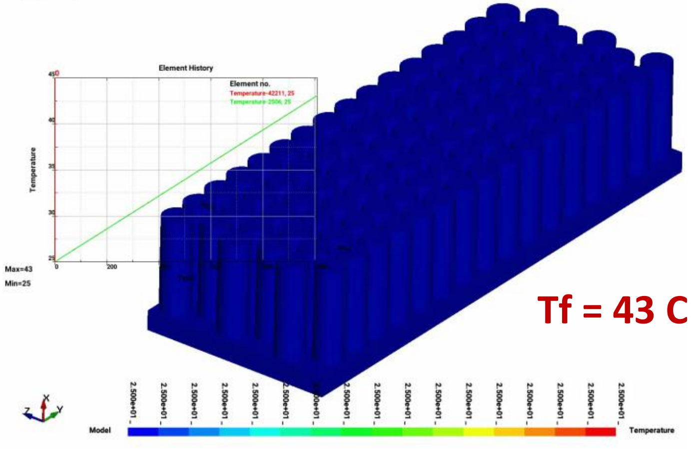


Thermal Management and Cooling

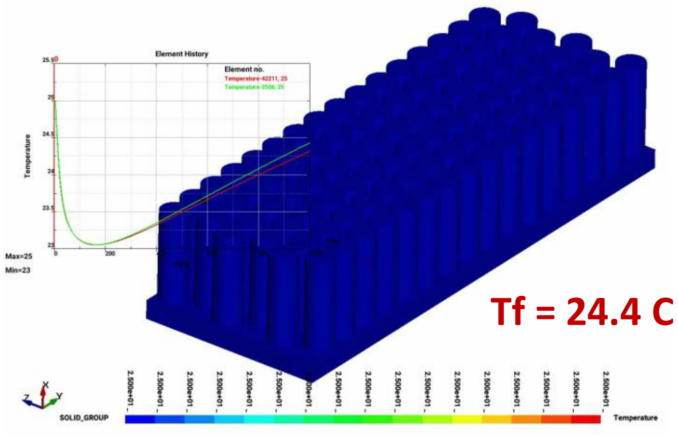
Pack of 96 cylindrical cells cooled by



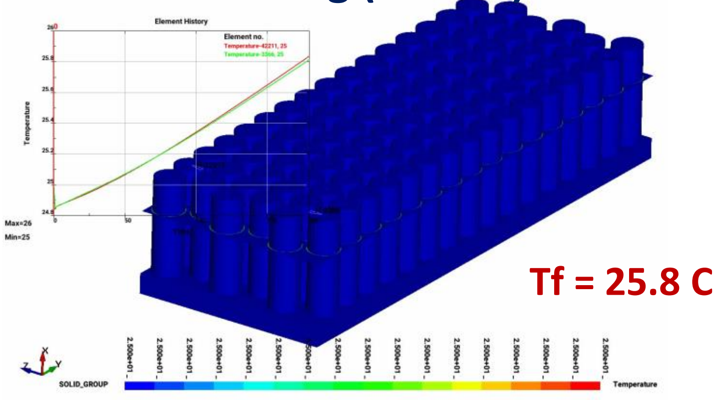
No cooling



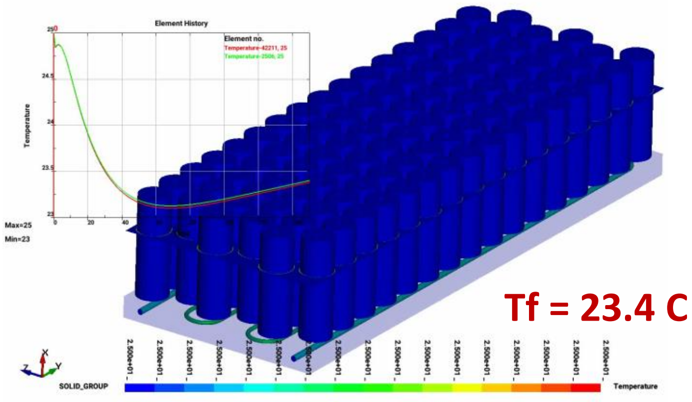
Liquid cooling
(by water-glycol at 20 C)



Air cooling (at 20 C)



Air + liquid cooling (at 20 C)



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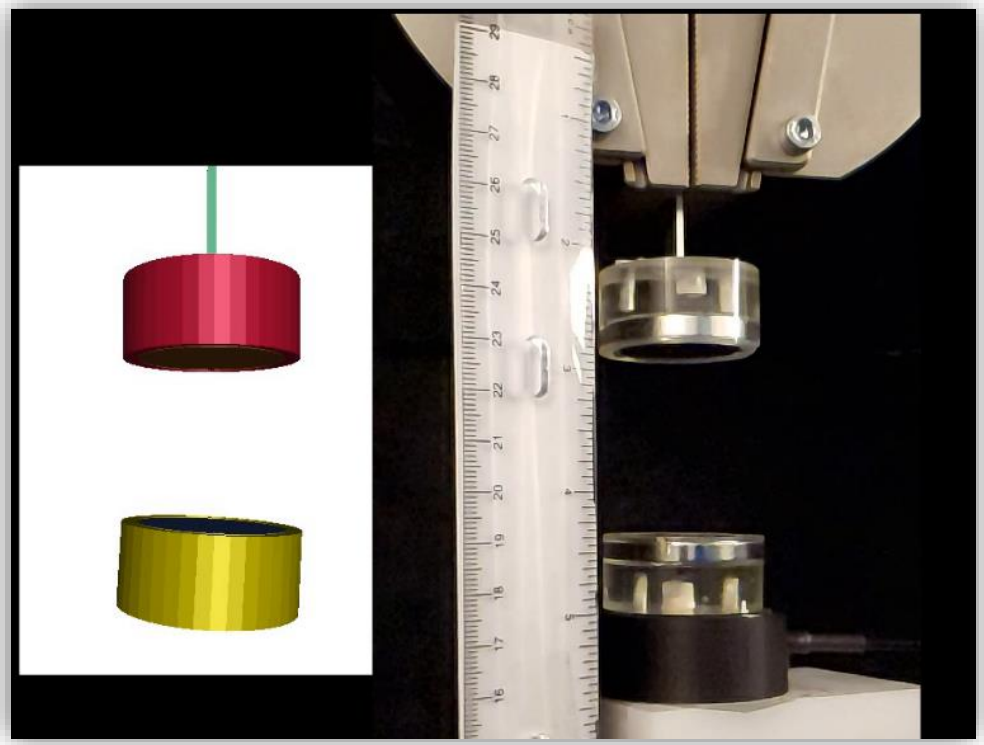
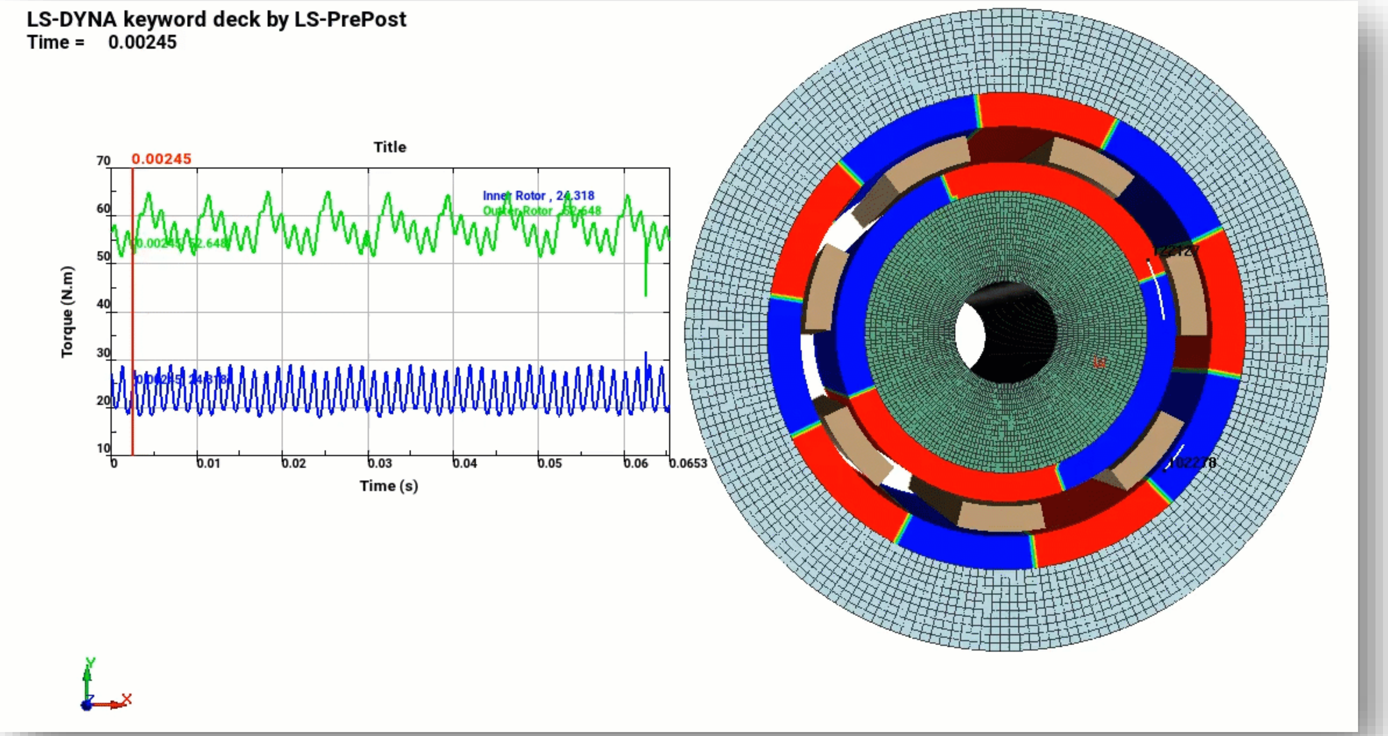
Magnet Simulations

Magnetostatic capabilities



Simulation **V/S** **Experiment**

Magnets in magnetic gear applications



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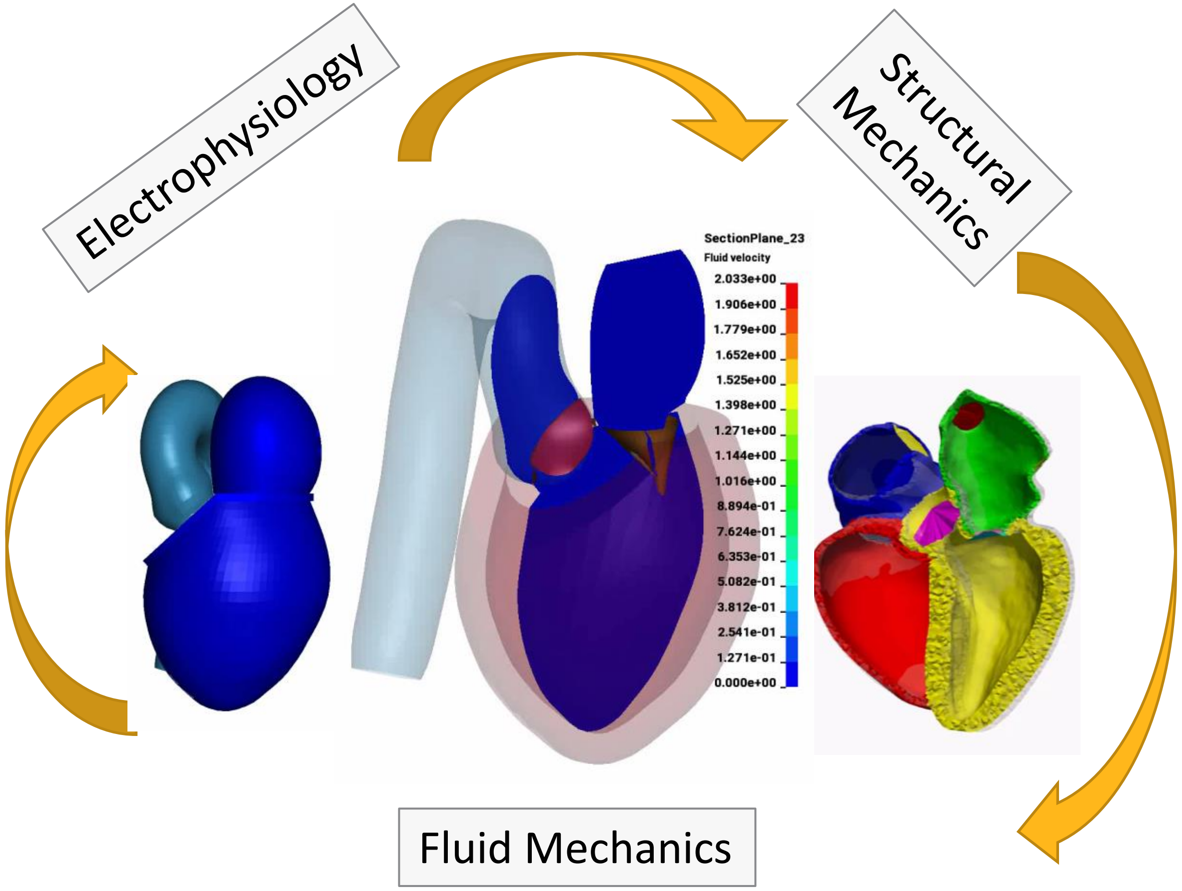
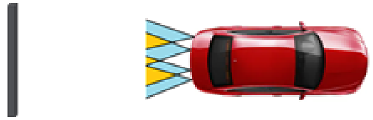
Healthcare: Electrophysiology (EP)

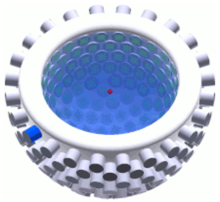
- Voltage-defined stimuli, Limit cycle and initial state.
- Cellular automata models.
- Mechano-electric feed back.
- Purkinje-myocardium coupling.
- Generation of EKG from EP waves.
- Intelligent pacemaker / coupling between 2 pacemakers.
- Coupling of EP with IGA



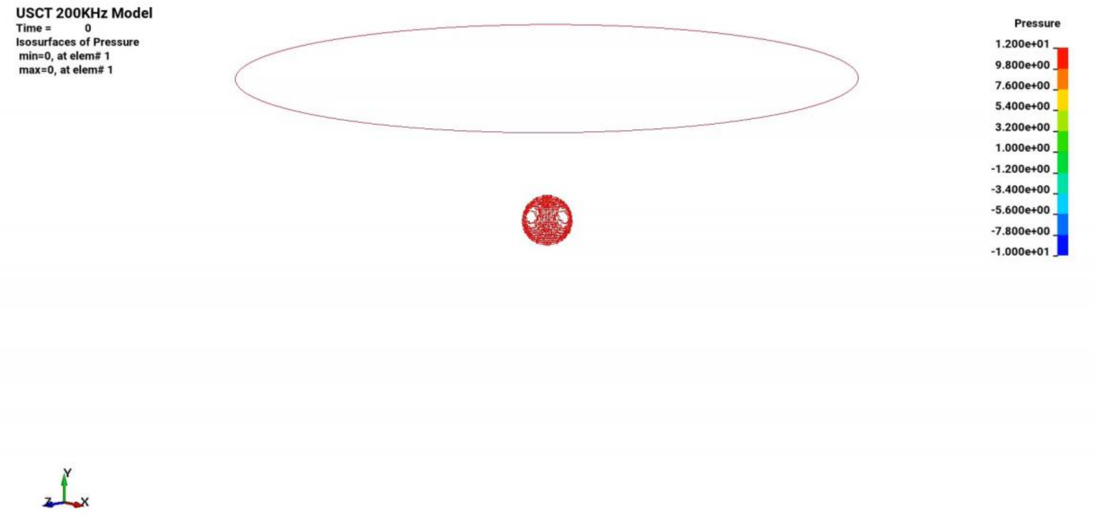
Transient Acoustics by Spectral Element Method

- Model acoustic wave propagation, its absorption & reflection from boundaries.
- Capable of high accuracy with manageable resource requirements.
- Well suited for high frequency and ultrasonic applications (e.g. Ultrasonic sensors).



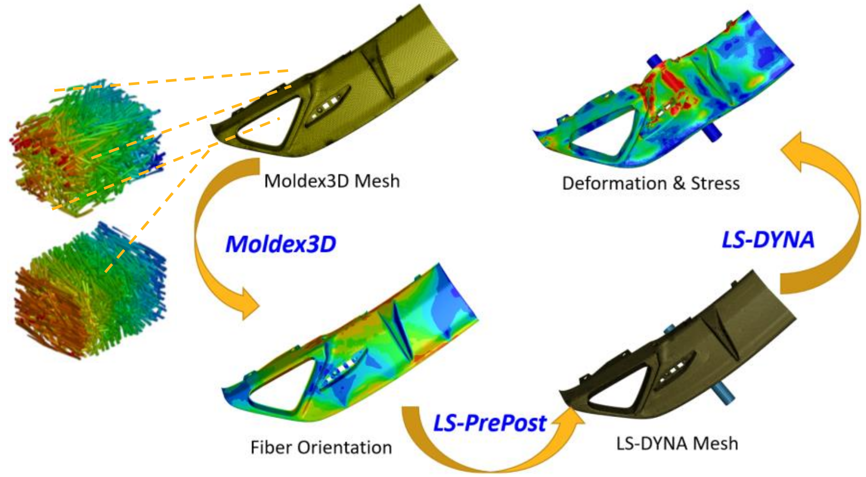


Ultrasound Computer Tomography

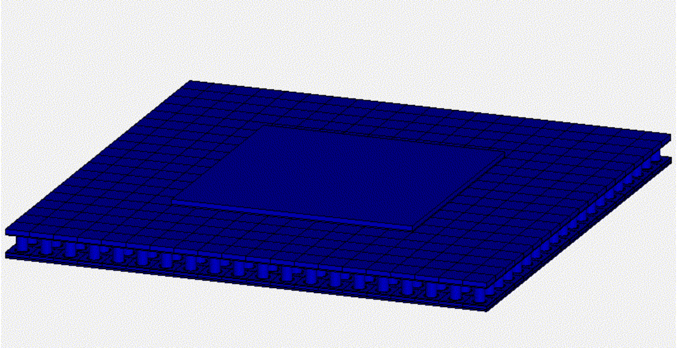


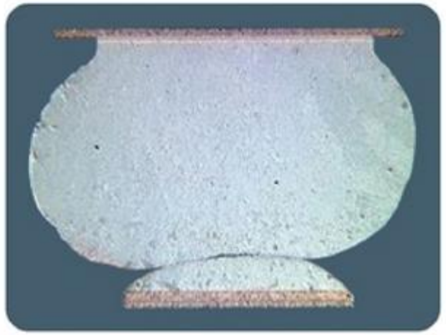
Multiscale Simulation

Composite Failure Analysis



Defect prediction in large scale reflow soldering simulation





Micro-scale failure analysis

Material Failure Analysis

Implant migration analysis in fractured bone

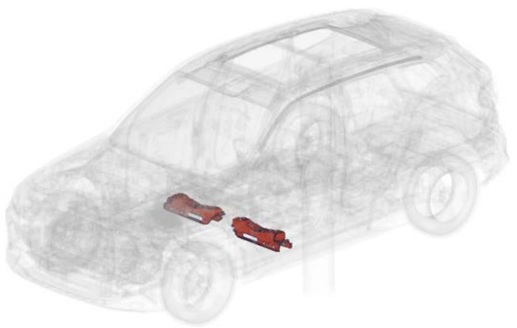
Isogeometric Analysis – Current Status

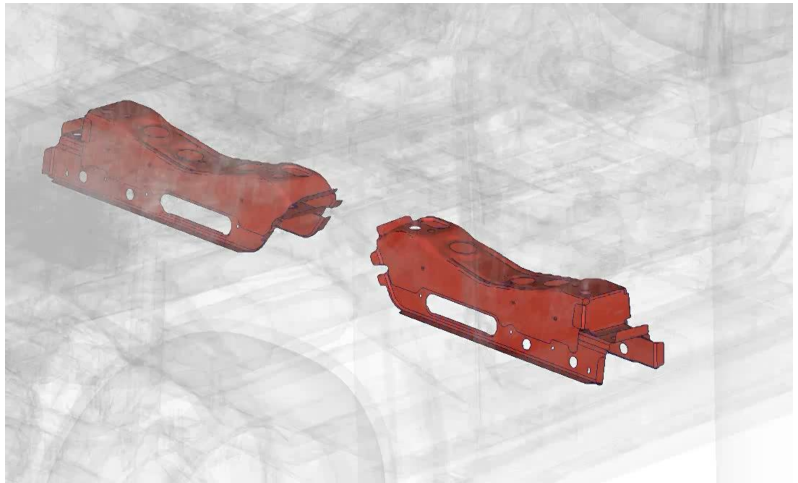
- Explicit, implicit dynamics and modal analysis.
- Structured and unstructured discretization.
- Shell, continuum shell and solid elements.
  - Reduce utilized memory, speed up computation *without* compromising on accuracy
- Coupling with other solvers e.g., ICFD, acoustics
- Standard LS-DYNA and user defined material models.
  - Failure and element erosion.
  - Spatially varying baseline orientation using point cloud and field for non-isotropic materials.

First full body in white IGA using trimmed NURBS.
courtesy of K TAKADA, Honda (2019)

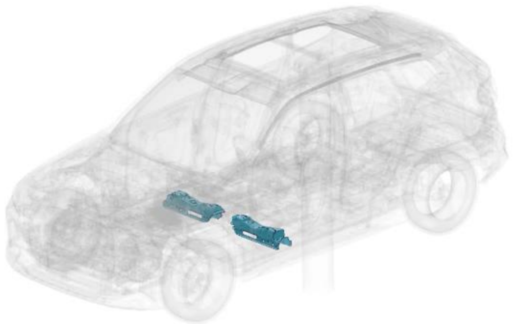
Hybrid Models – A Comparative Study

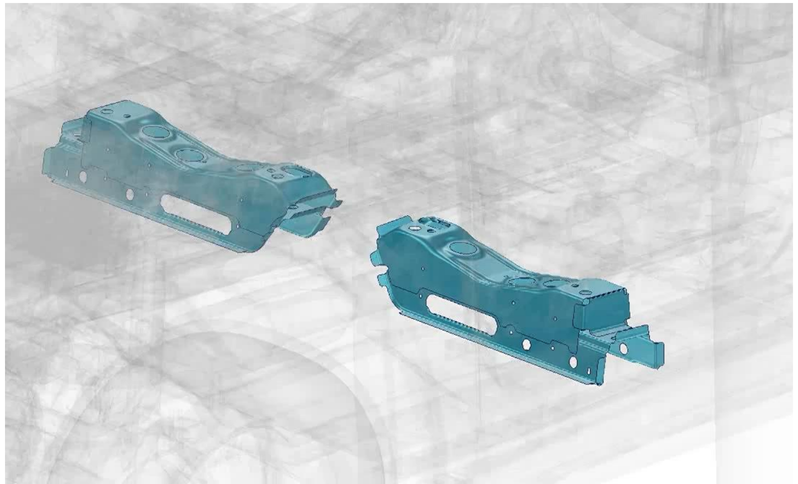
FEA

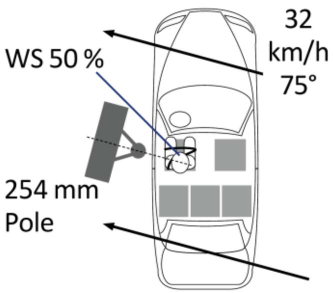




FEA & IGA



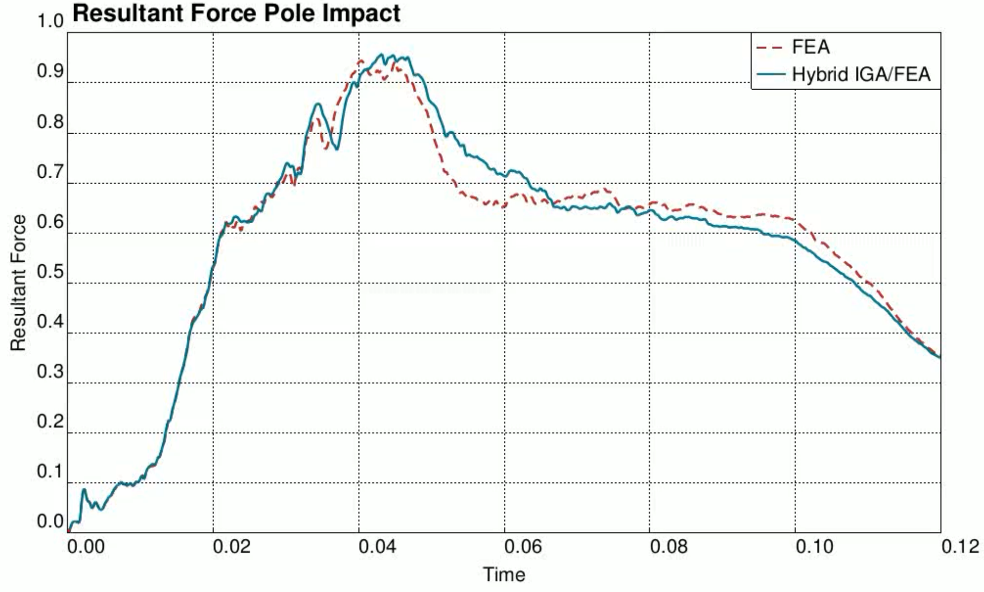




IGA seat cross-members

Two trimmed patches connected by virtue of penalty coupling

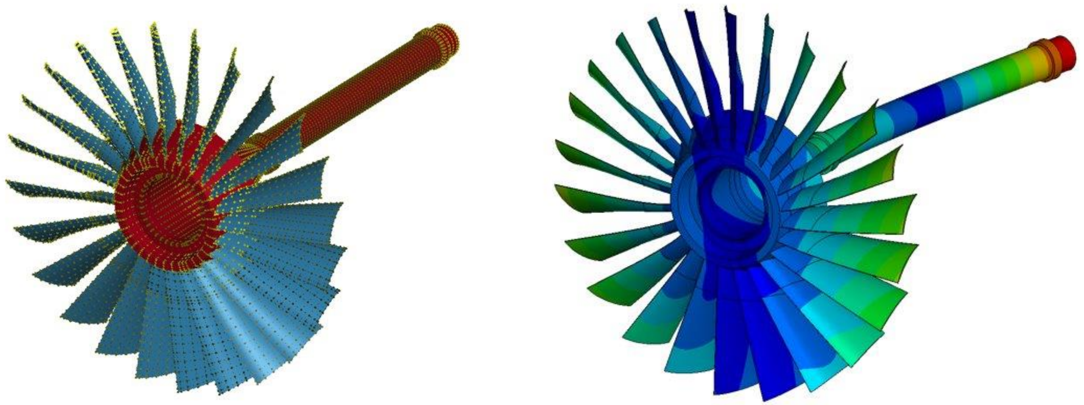
Spot welds and bolts



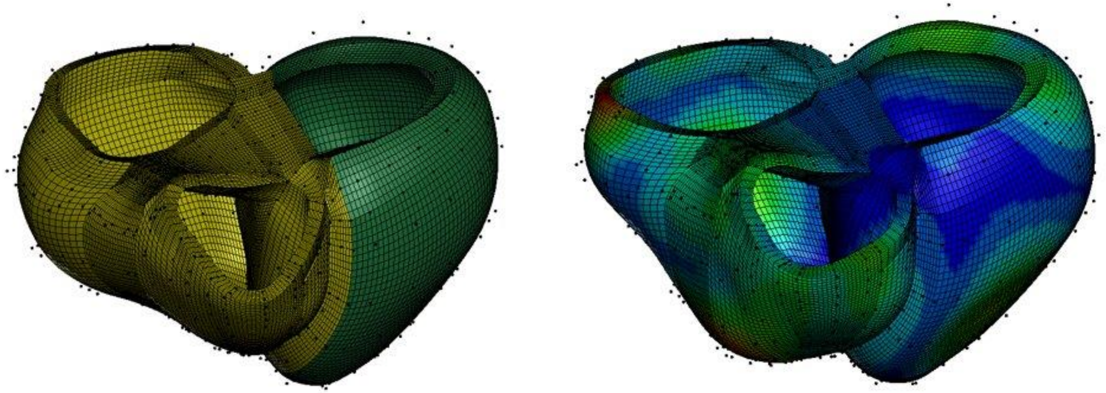
courtesy of BMW (2022)

Isogeometric Analysis – What is next?

- Improved boundary conditions.
- Shells of spatially variable thickness.
- IGA-electrophysiology coupling.
- Direct coupling with fatigue and NVH.
- Iterative solver for shells for Implicit metal forming.
- Improved post-processing.



Aerospace Working Group fan blade, hub and shaft assembly courtesy of G Blankenhorn (2021)



Biventrical heart model courtesy of C Maurath (2022)

Key Takeaways

- Ansys is committed to helping customers achieve their simulation needs.
- LS-DYNA solver is moving towards enabling Digital experiments & certification.
- We appreciate the importance of customer engagement and collaboration.

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