UNIVERSITÀ DEGLI STUDI DI BERGAMO
Dipartimento di Progettazione e tecnologie

Complementi di Scienza delle Costruzioni (LS Edile/Meccanica)
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Annuncio di Seminario

Current Issues in Explicit FE Simulations with Emphasis on Closing the Process Chain

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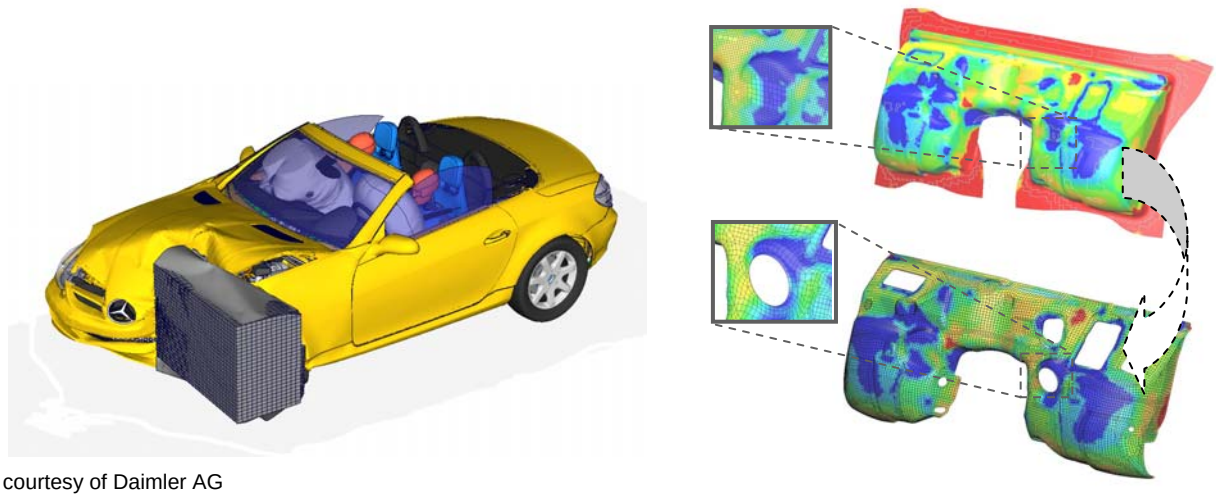
Lunedì 18 maggio 2009
Fac. di Ingegneria (Dalmine), Aula 10, 12:30-13:30

Nowadays simulations of **sheet metal forming** processes as well as **crash simulations** are done on a very high level of sophistication. During the past two decades both simulation disciplines developed a strong research and application basis that build a sound foundation for every day engineering design decisions. However, from a numerical point of view, the constitutive approach in both fields is quite different. In sheet metal forming the dominating effect to predict sheet thinning, **plasticity**, **failure** and **damage** is due to the anisotropy of the rolled sheet metal. Hence applied plasticity models are based on the Hill criterion and were subsequently enhanced by many researchers. On the contrary, in crash simulations isotropic material models, based on classical von Mises plasticity, enhanced by **strain-rate dependency** and damage formulations are widely used. In both applications an initially undamaged, elastic reference state with constant sheet thickness is generally assumed.

Since the simulation models in both disciplines are driven to increasing predictability in terms of deformations, damage evolution and failure, the question arises whether and how the results from forming simulations need to be taken into account in the crash simulation. First steps in this direction are implemented in the finite element program LS-DYNA. After a rather general overview on various current issues in automotive **explicit simulation applications**, the present contribution addresses the question of the ***inclusion of forming results into the crash simulation to predict failure in numerical crashworthiness investigations***.



courtesy of Daimler AG

DYNA*more* GmbH

Presentation

University of Bergamo

Dynamore GmbH
Industriestraße 2
D 70565 Stuttgart
http://www.dynamore.de

Outline

- Short introduction of DYNAmore
- Overview on Applications of LS-DYNA in industry
- Current issues in automotive industry
- Closing the link between forming simulation and crash simulation

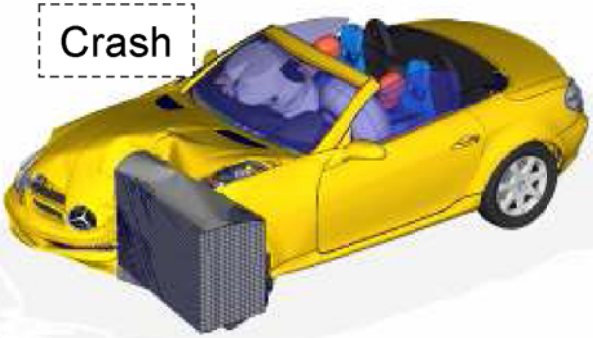
DYNA*more* at a glance

Facts

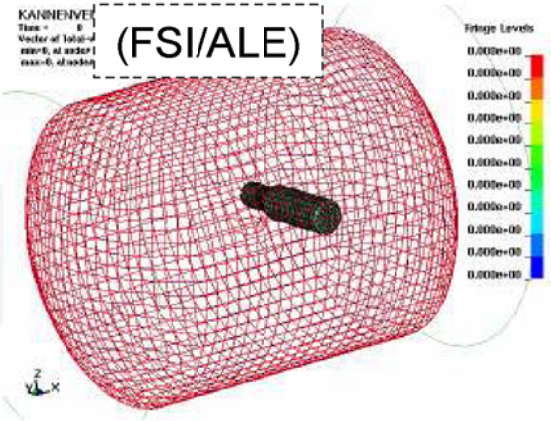
- 43 employees in 2009
- more than 250 customers in D, A, CH, E, NL, B, PL, P,TK, …
- LS-DYNA distribution rights for Italy since 3/2007
- additional customers from US, Asia, Australia
- several thousand LS-DYNA licenses are maintained by DYNA*more*
- employees with vast experience in nonlinear FE applications
- headquarters located in Stuttgart/Vaihingen
- office in Langlingen (Wolfsburg)
- office in Ingolstadt (Audi)
- office in Dresden
- on-site office in Sindelfingen (Mercedes passenger cars)
- on-site office in Untertürkheim (Mercedes comm. veh.)
- on-site office in Weissach (Porsche)

LS-DYNA product information - overview

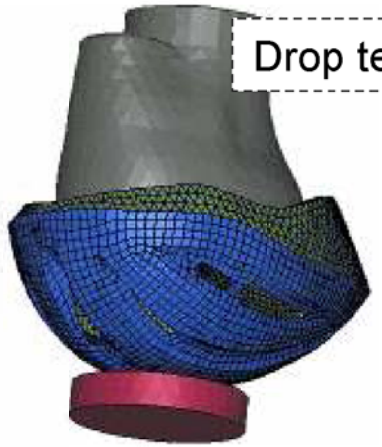
Crash

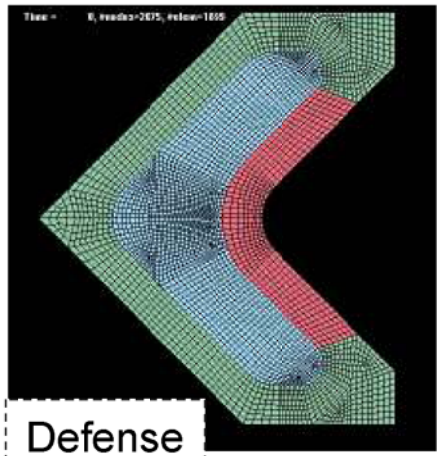


(FSI/ALE)

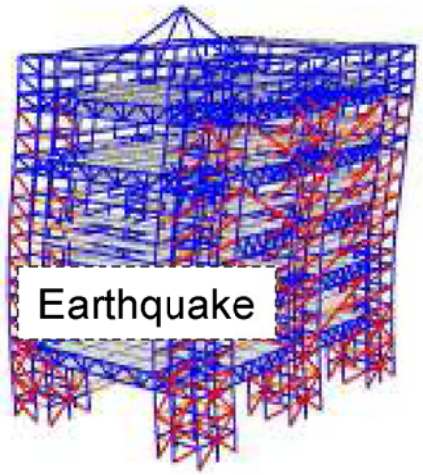


Drop test

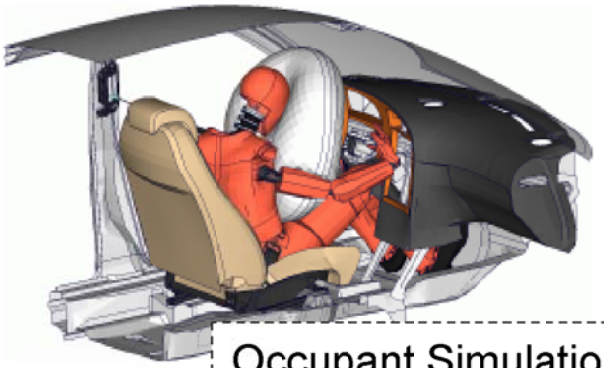




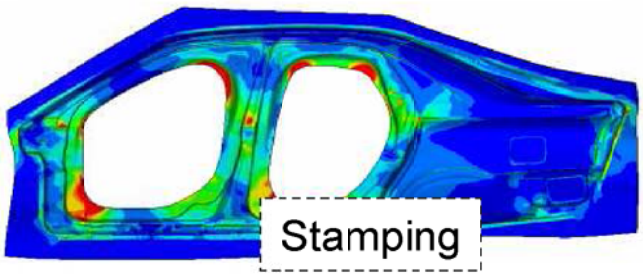
Defense



Earthquake



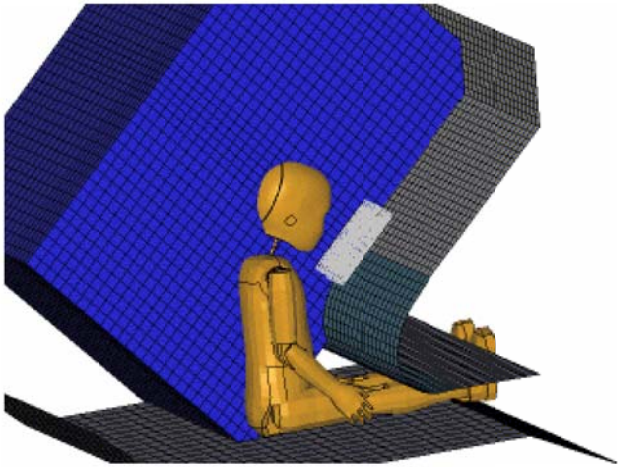
Occupant Simulation

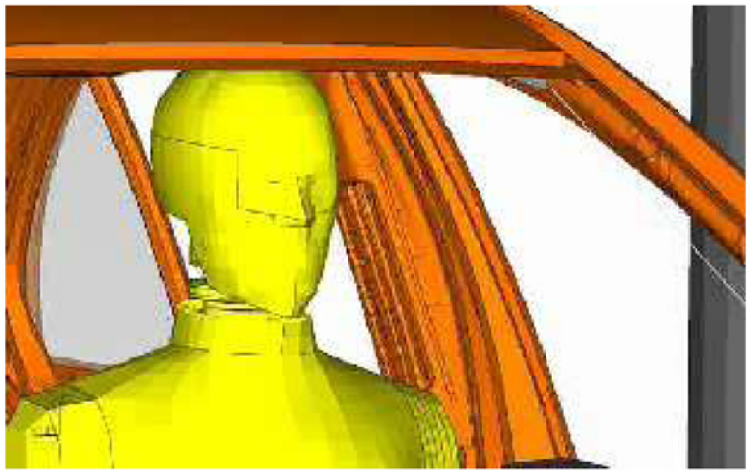


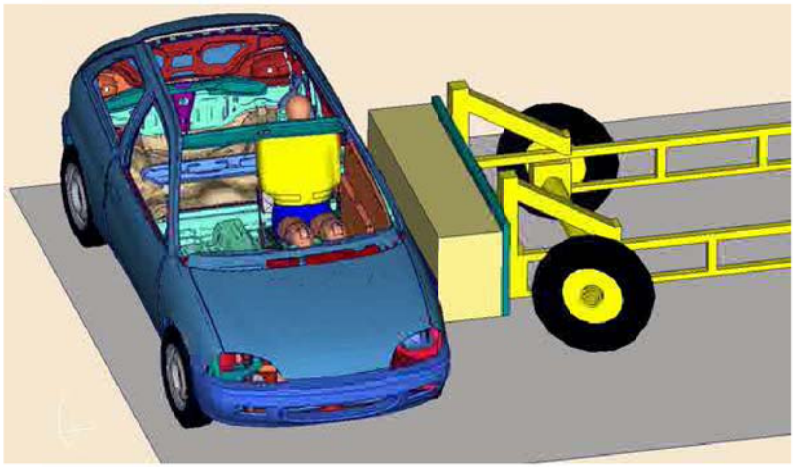
Stamping

LS-DYNA product information – crash simulation

- front, side and rear crash
- pole test
- occupant analysis
- pedestrian safety
- seat design

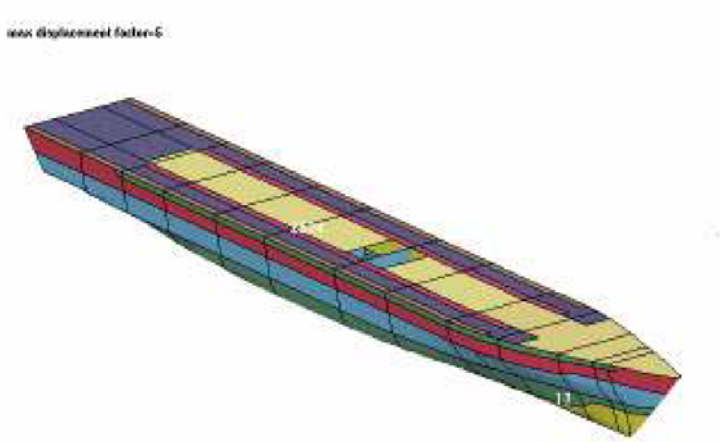


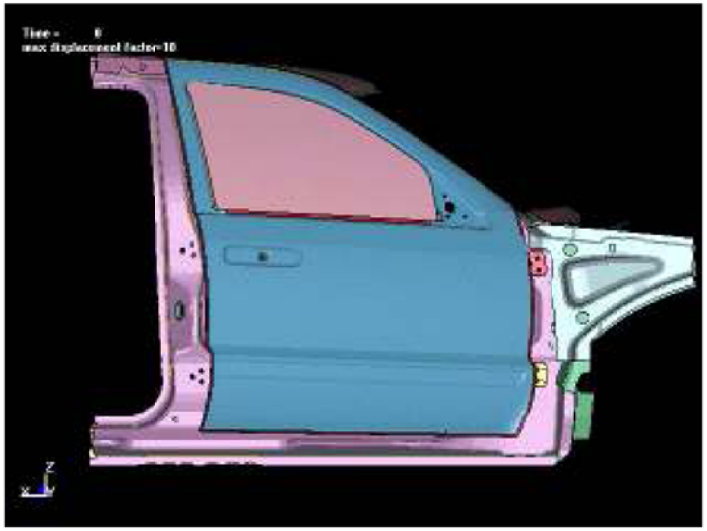


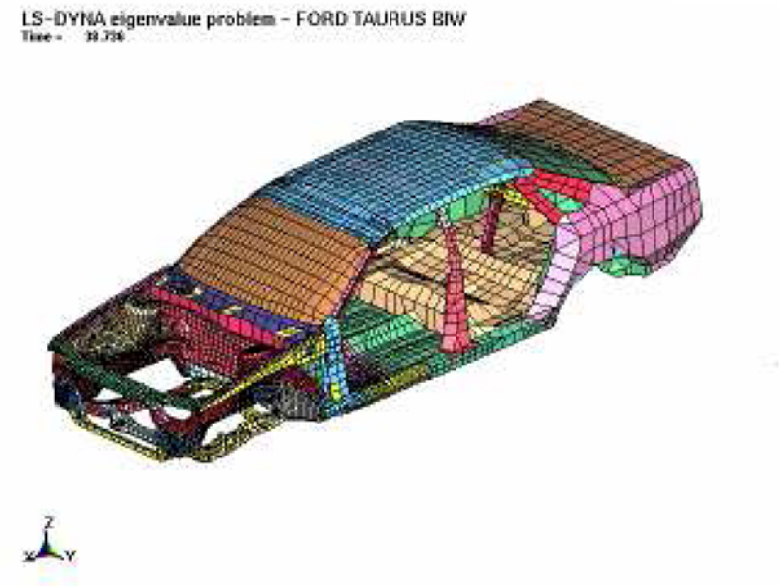


LS-DYNA product information – implicit applications

- frequency response
- static analysis
- implicit dynamic analysis
- non-linear analysis
- transient dynamic implicit analysis

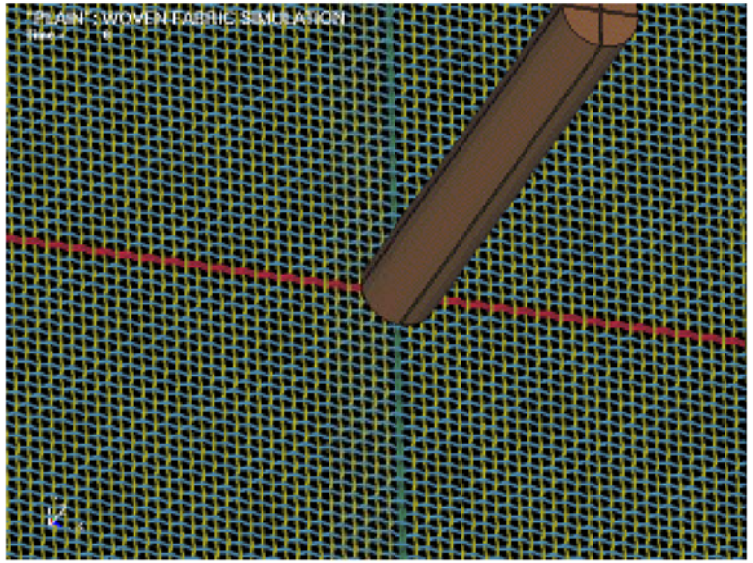


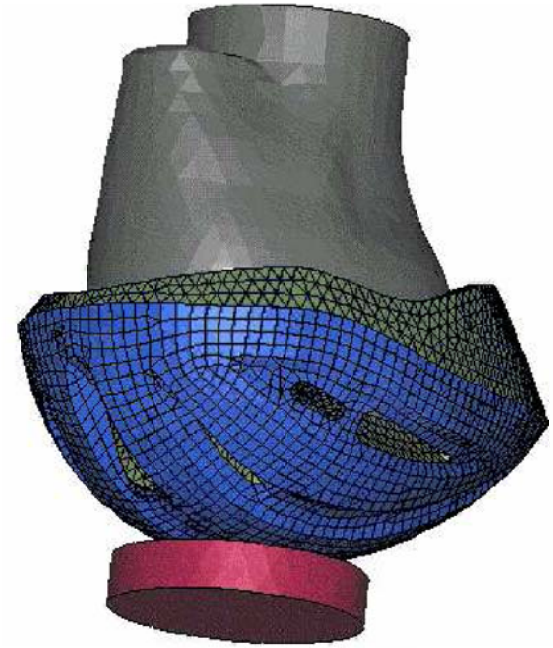


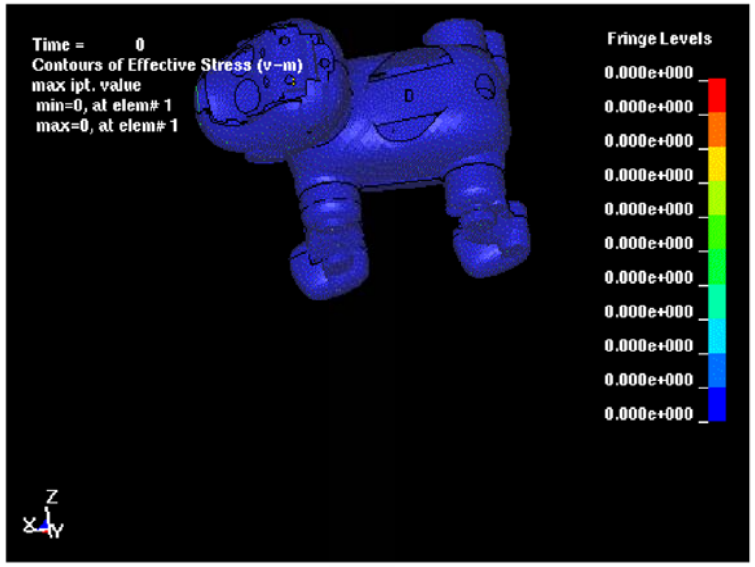


LS-DYNA product information – other applications

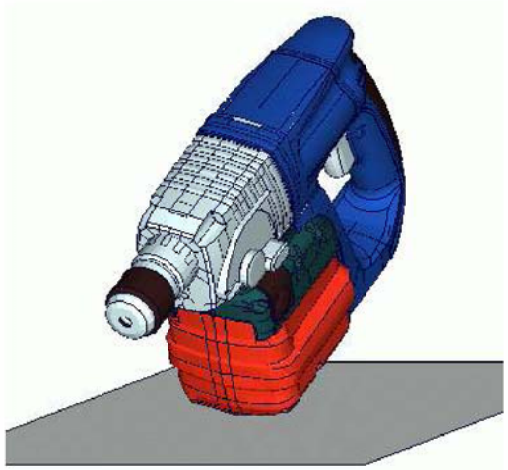
- drop tests
- impact
- rigid body dynamics
- explosives
- …

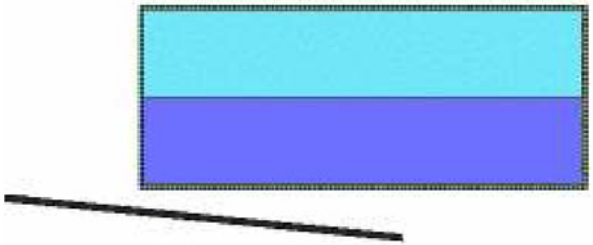


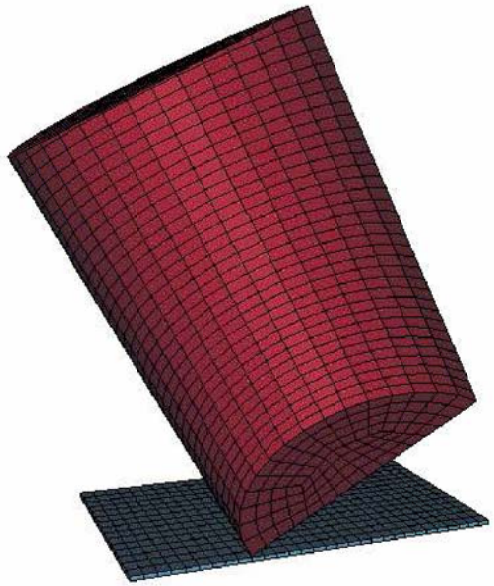




LS-DYNA product information – drop test

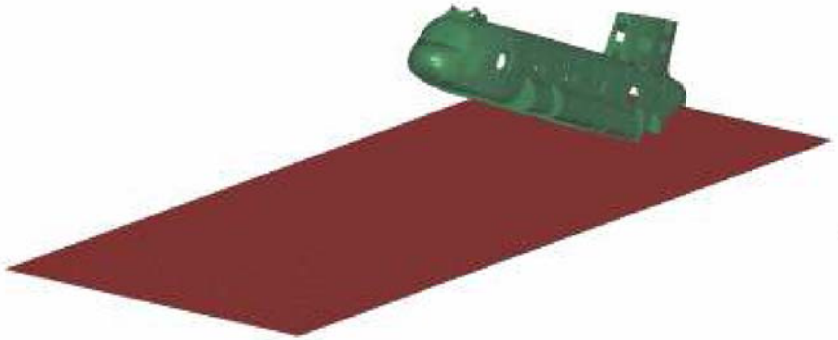


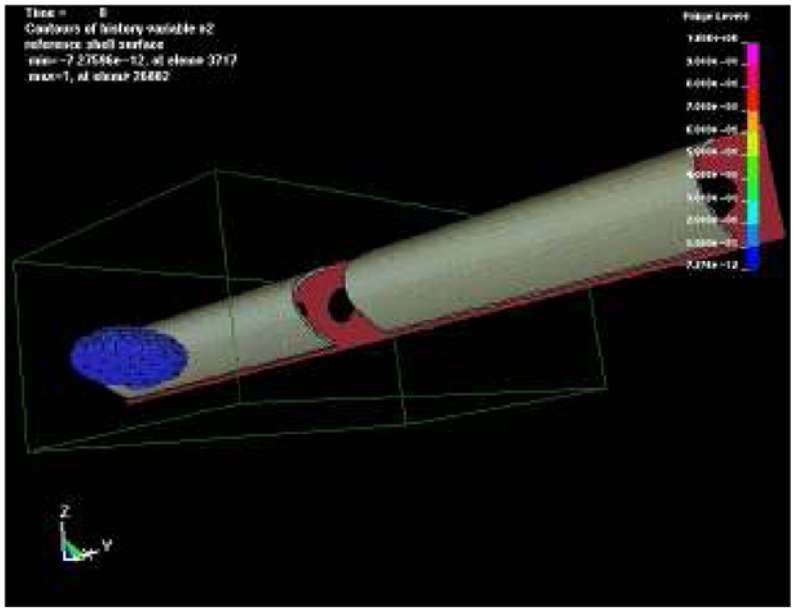


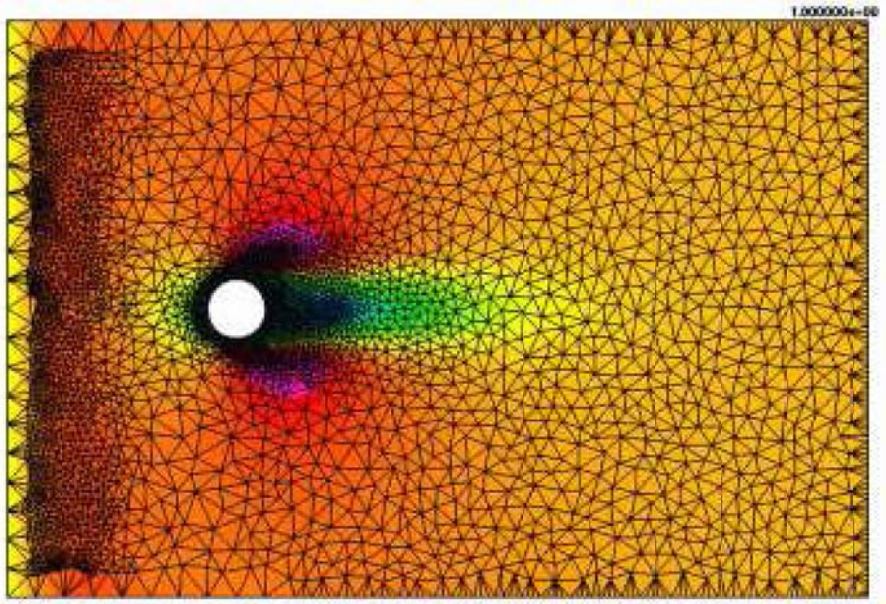


LS-DYNA product information – recent developments

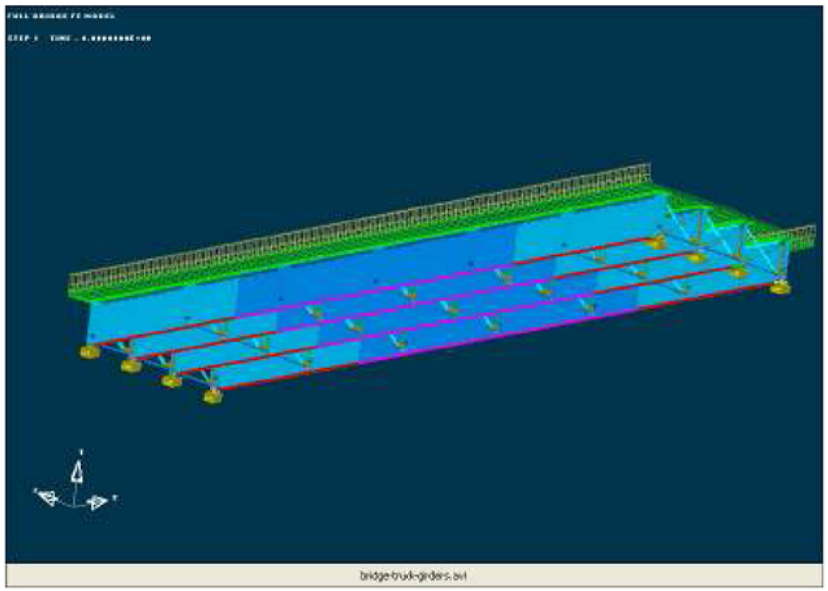
- multiphysics (coupling structural, thermal, fluid, acoustic analysis)
- Arbitrary Lagrangian-Eulerian (ALE)
- Smooth Particle Hydrodynamics (SPH)
- Fluid-Structure-Interaction (FSI)

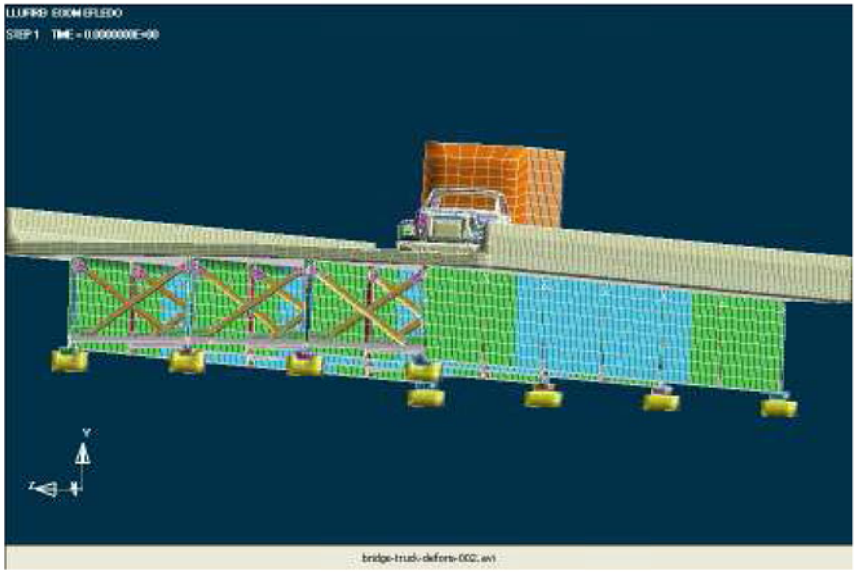




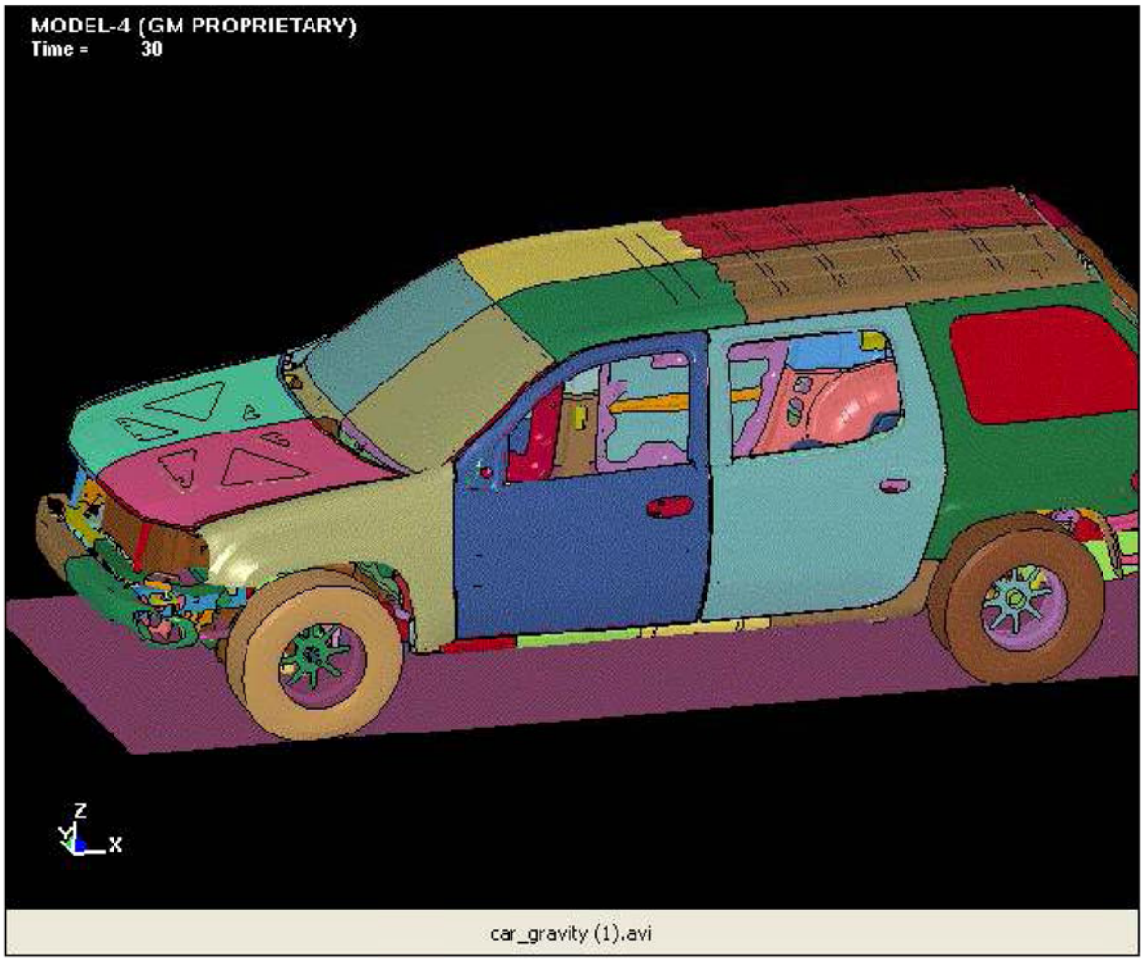


Evaluation of Bridge Structure

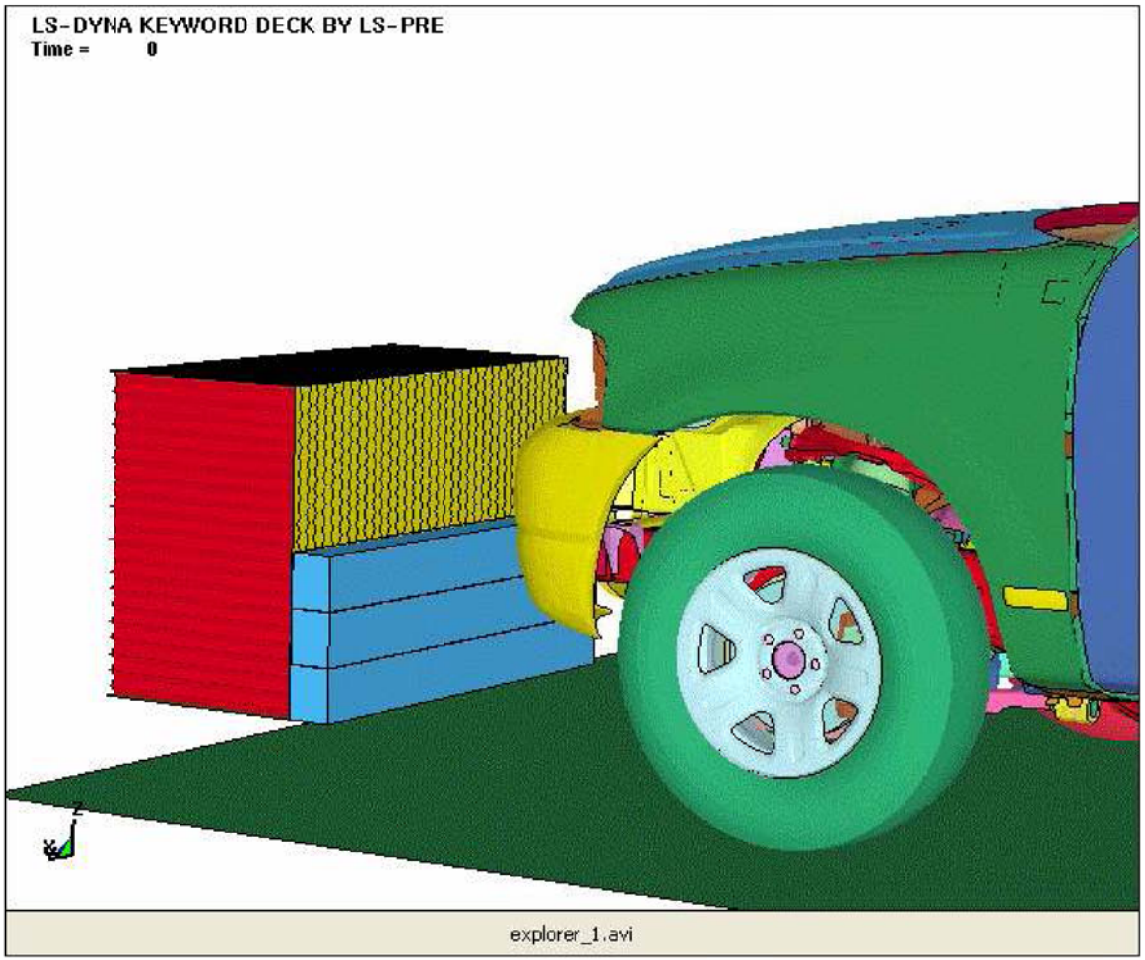




Gravity Loading

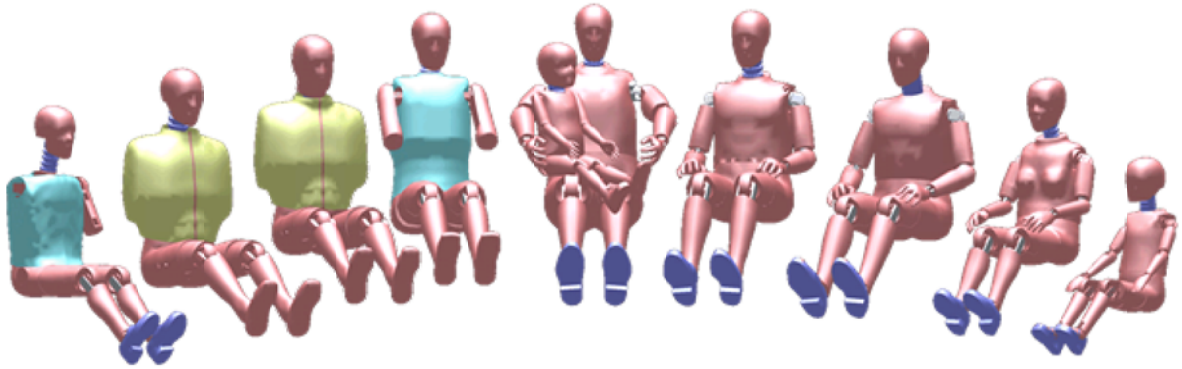


Barrier Modeling



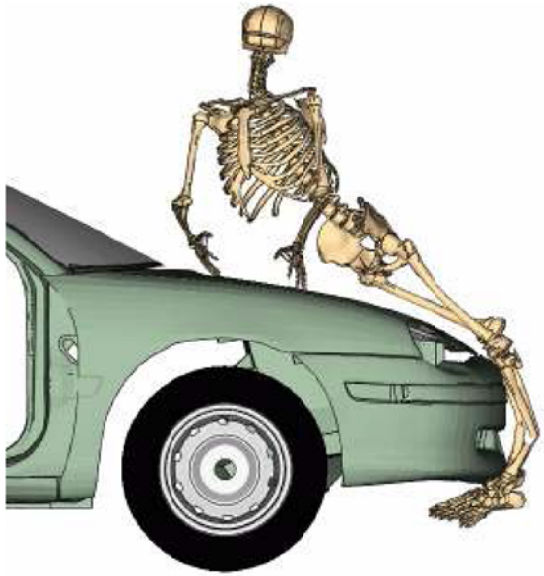
Model Overview

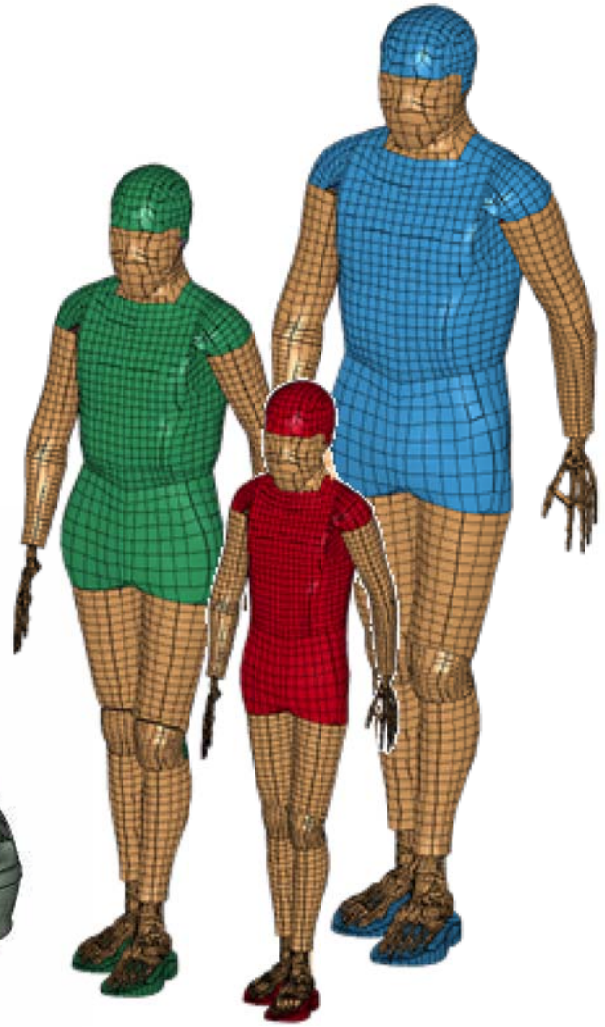
- FAT dummy models (owned by DYNAmore)
- PDB dummy model (owned by DYNAmore)
- LSTC dummy models
- FTSS dummy models
- THUMS human model (Toyota)
- other models (Barriers, Impactors)
- moose model
- for all models test license are available



THUMS models product information - THUMS

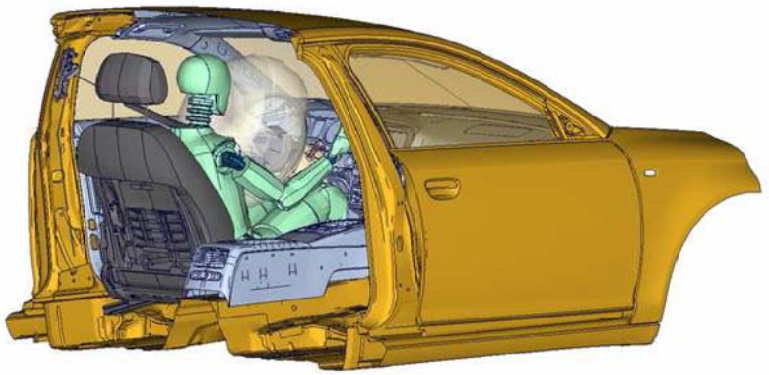
- developed by Toyota
- DYNAmore distributor of THUMS model
- commercial projects with 3 OEMs with THUMS
- licensed to research departments
- work on material modeling for tissues, ….





LS-OPT product information

- LS-OPT can be linked to any simulation code
- stand alone optimization software
- suitable for non-linear problems
- methodologies, features:
  - Successive Response Surface Method (SRSM)
  - reliability based design optimization (RBDO)
  - multidisciplinary optimization (MDO)
  - multi-objective optimization (Pareto)
  - discrete optimization
  - numerical/analytical based sensitivities
  - analysis of variance (ANOVA)
  - stochastic/probabilistic analysis
  - Monte Carlo Analysis using meta models
  - …



LS-OPT product information

- job distribution - interface to queuing systems
  - PBS, LSF, LoadLeveler, AQS, etc.
- LS-OPT might be used as "process manager"
- shape optimization
  - -interface to SFE-Concept, Hypermesh, ANSA, DEP-Morpher
  - -user-defined interface to any pre-processor
- parameter identification module
- visualization of statistical quantities on the FE-model
- additional tool D-SPEX