LS-DYNA and more

FINITE ELEMENT SOLUTIONS

DYNAmore

DYNA
MORE

DYNAmore

DYNAmore is the largest distributor of LS-DYNA simulation software worldwide. But we offer far more in the way of services: in addition to our guaranteed, expert support in all areas of application for the LS-DYNA and LS-OPT software packages, we offer FEM calculation services as well as general consulting on any questions concerning structural dynamics. What is more, our fields of expertise include pilot and development projects for simulating nonlinear dynamic problems, software development for solver technologies and simulation data manage-

ment as well as consulting and support for modern, massively parallel computer systems.
More than 800 customers, both in Europe and abroad and from industry and research are convinced by our expertise – they include numerous automotive manufacturers and suppliers.
DYNAmore's head office is located in Stuttgart, but we also have offices in Berlin, Sindelfingen, Wolfsburg, Dresden, Langlingen and Ingolstadt and sudsidiaries in Sweden, France, Italy, Switzerland and the USA.

Portfolio

- Software solutions
- Method development
- Support and consulting
- Engineering services
- IT solutions for CAx and data management processes
- Training and information sessions
- Conferences

Facts

- Approx. 150 employees
- Subsidiaries in Germany, Sweden, Italy, France, Switzerland and the USA
- Offices in Ingolstadt, Dresden, Berlin, Langlingen, Wolfsburg, Linköping, Gothenburg, Turin, Versailles, Zurich and Dublin/Ohio
- 5 service centers at customers' sites
- More than 800 customers from industry and research, both in Europe and abroad (including many OEMs)
- Worldwide use of our ATD models
- FEM experience since the early 1980s
- Ongoing development of LS-DYNA and LS-OPT

LS-DYNA

LS-DYNA is one of the world's leading finite element software systems. It is used for mathematical simulation of profoundly nonlinear physical problems in industry and research. LS-DYNA is suitable for investigating the phenomena of structural-dynamic problems such as large deformation, material failure and complex contact conditions. Typical areas of application for the solver are:

- Crash
- Passenger safety
- Metal forming
- Collision and drop tests
- Penetration problems
- Perforation problems
- Fluid-structure interaction
- Thermal-mechanical coupling
- Explosion

In addition, we offer linear and nonlinear FEM as well as particle methods, EFG, SPH, SPH and DEM, electromagnetic solvers and fluid solvers for explicit and implicit time integration.

LS-DYNA is primarily used in the automotive, aviation and aerospace industries. However, LS-DYNA is also increasingly employed in the fields of biomechanics, shipbuilding, rail vehicle construction and the building industry, as well as in the defense and consumer goods industry.

One-Code-Strategy

One of LS-DYNA's unique selling points is the One-Code-Strategy. This allows many features to be combined with each other, frequently making effective cross-process simulation viable. This is due to seamless integration of different solution algorithms, requiring the following software properties:
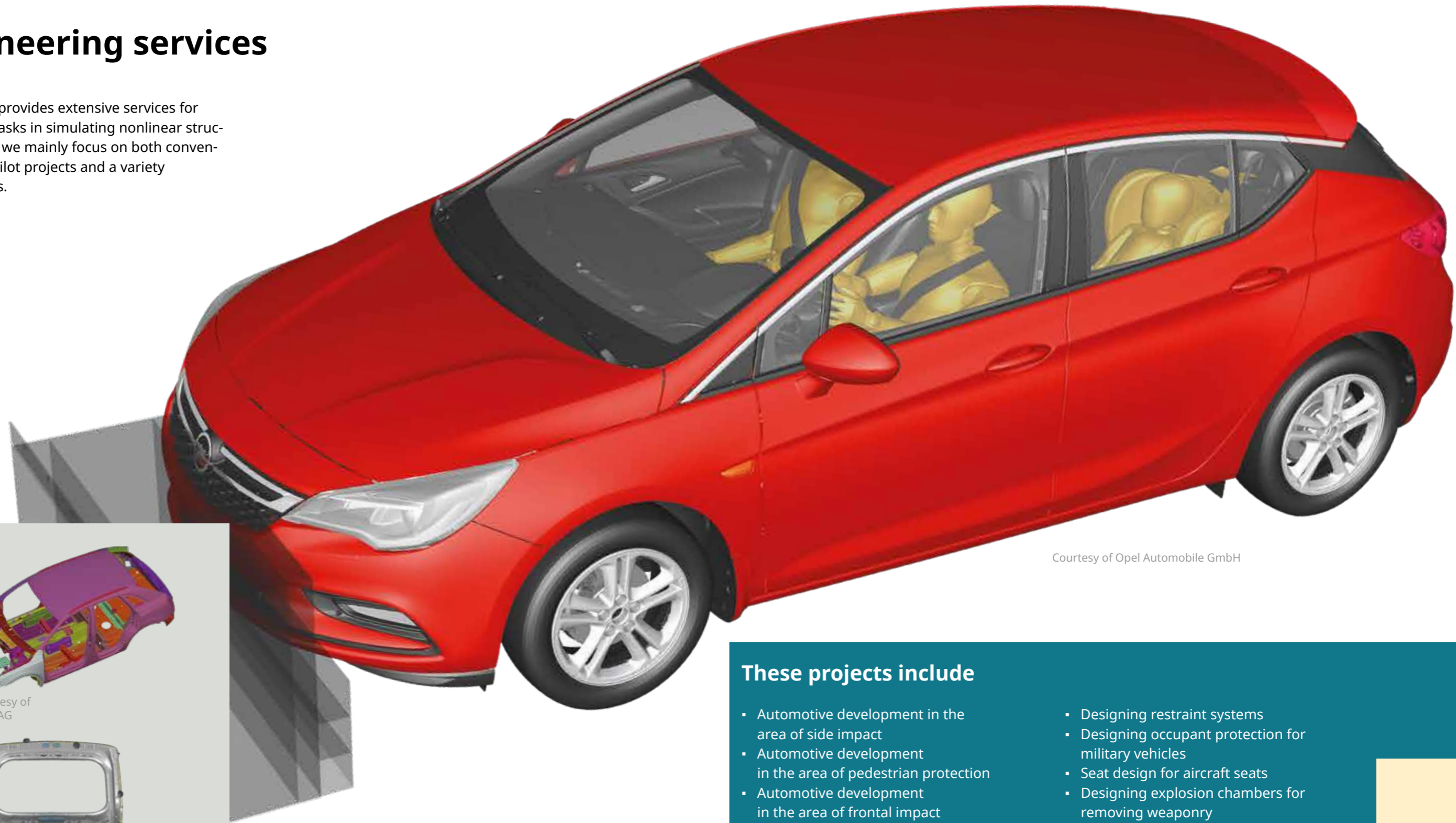
- Multi-physics
- Multi-stage
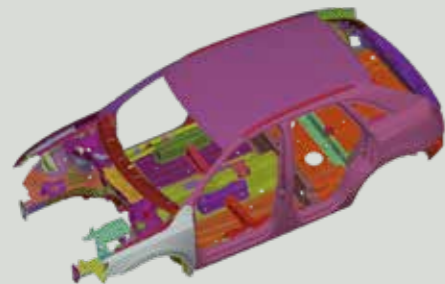- Multi-processing
- Multi-scale
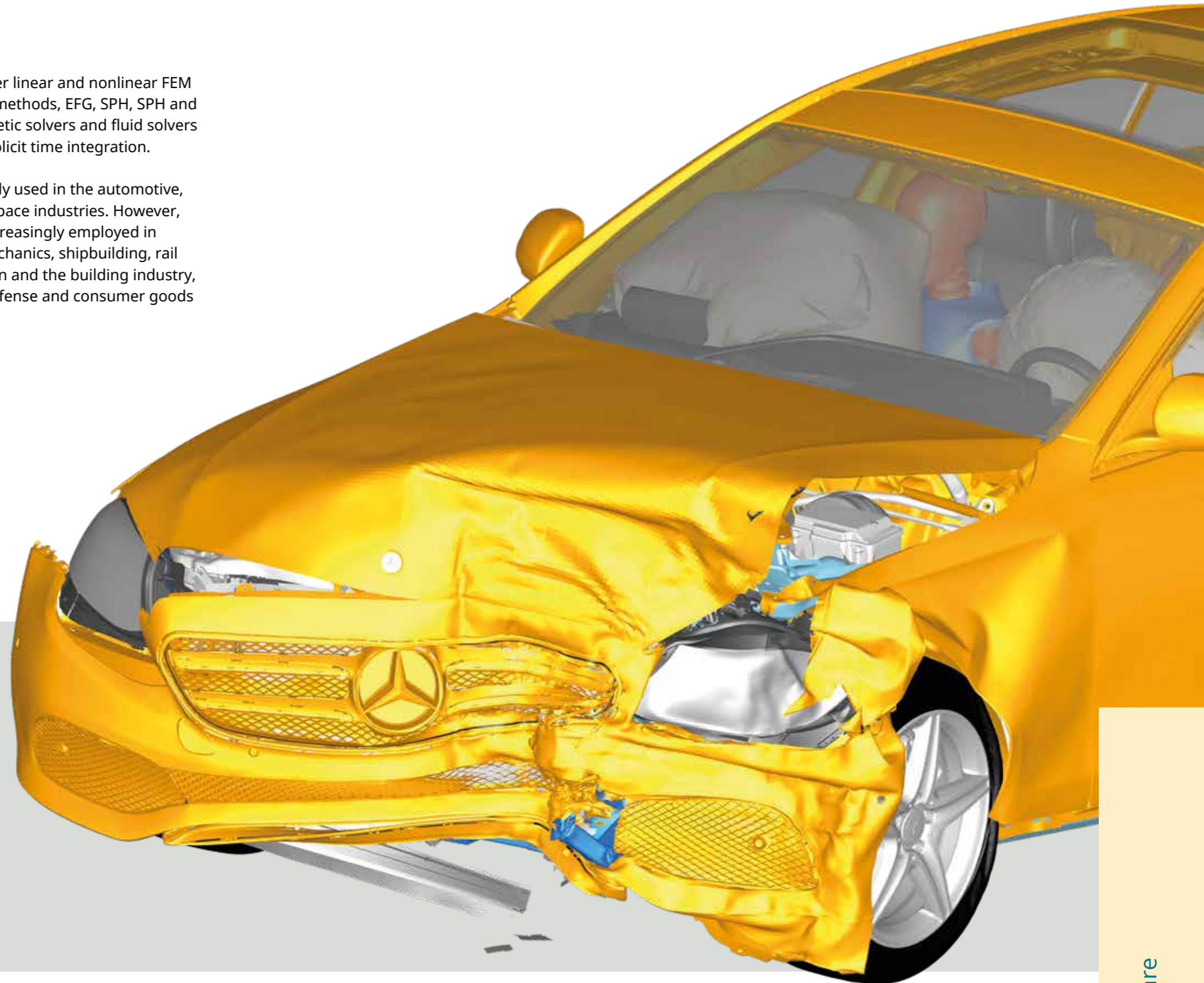
Courtesy of Daimler AG

Engineering services

DYNAmore provides extensive services for numerous tasks in simulating nonlinear structures. Here, we mainly focus on both conventional and pilot projects and a variety of industries.
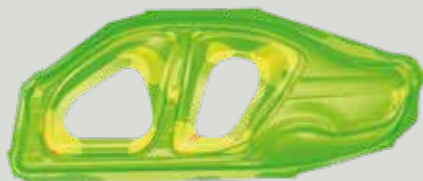
Courtesy of Opel Automobile GmbH

Courtesy of
Audi AG

Courtesy of
Ford Forschungszentrum Aachen GmbH

Courtesy of
BMW Group

These projects include

- Automotive development in the area of side impact
- Automotive development in the area of pedestrian protection
- Automotive development in the area of frontal impact
- Automotive development of seat models
- Simulations for designing drivers' cabs for utility vehicles
- Designing a brake for freight trains
- Designing child seats
- Research work in biomechanics
- Designing presses and tools for deep-drawing

- Designing restraint systems
- Designing occupant protection for military vehicles
- Seat design for aircraft seats
- Designing explosion chambers for removing weaponry
- Designing crash barriers to achieve optimum absorption of energy in collisions
- Modelling injuries in human-robot interaction
- Developing active hood systems for pedestrian protection
- Developing seats to minimize whiplash injuries

Engineering

BETA products

BETA CAE Systems products, the ANSA pre-processor/ EPILYSIS solver and META post-processor suite, and SPDRM, the simulation-process-data-and-resources manager, hold a worldwide leading position across a range of industries, including the automotive, railway vehicles, aerospace, motorsports, chemical processes engineering, energy, electronics, heavy machinery, power tools, and biomechanics.

- ANSA Pre-processor
- META Post-processor
- EPILYSIS Solver
- SPDRM Simulation-process-data-management
- and more..

ANSA - The advanced CAE pre-processing software for complete model build up
ANSA is an advanced multidisciplinary CAE pre-processing tool that provide all necessary functionality for a full-model build up, from CAD data to ready-to-run solver input files, in a single integrated environment.

META - The high performance multi-disciplinary CAE post-processor.
META offers all you need from an advanced yet easy to use post-processing platform. Combining the outstanding performance and smart functionality in handling large models, with the advanced process automation, and the GUI customization capabilities, you will significantly accelerate your post-processing.
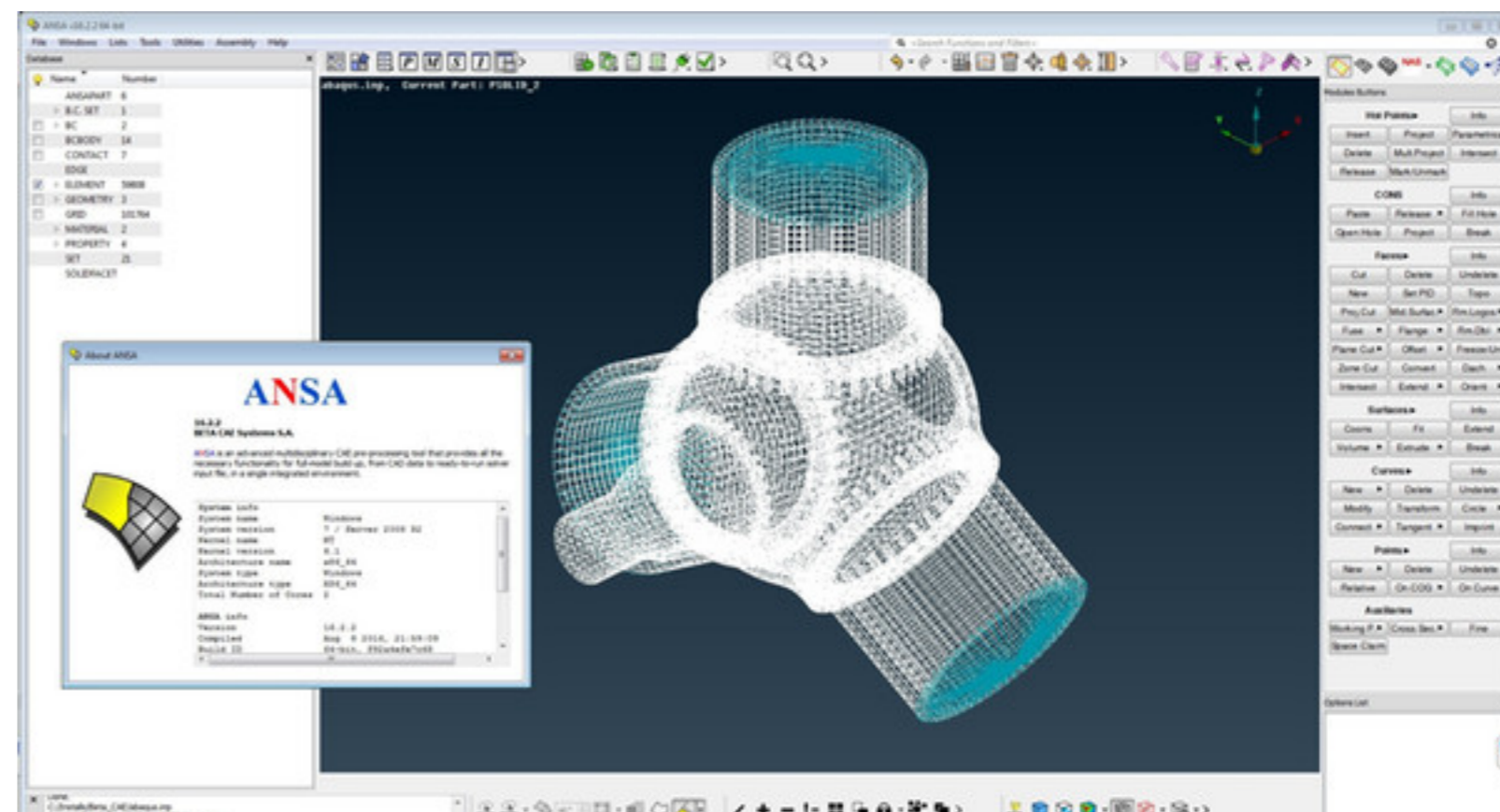
BENEFITS

- efficient data handling for intricate model structures
- fast and high quality modeling of complex geometries
- capability to interoperate between models built for different solvers
- highly automated processes and model set-up tools in one environment
- reduced user-dependent error-prone operations
- complete model build-up for numerous solvers in one environment
- unique capability for building a common model as a basis for modeling for different disciplines

- significant modeling time reduction and quality increase
- short learning curve and deployment time

Software

LS-PrePost

The pre and post-processor LS-PrePost can be used to modify input decks and visualize the results calculated in LS-DYNA. An intuitive graphical interface makes the program extremely user-friendly. LS-PrePost benefits from ongoing further development and improvements. This allows quick and uncomplicated integration of the newest trends and developments. No separate license is required for LS-PrePost – the program can be used together with LS-DYNA at no charge.

Scope of functions

- Import of Nastran, IGES, VDA, I-DEAS-Universal and Step files
- Print formats: PNG, TIFF, JPG, BMP, PCX, PS, PSIMAGE, GIF, VRML2
- Video formats: MPEG, AVI
- Command line interface
- Loading and editing of LS-DYNA key words
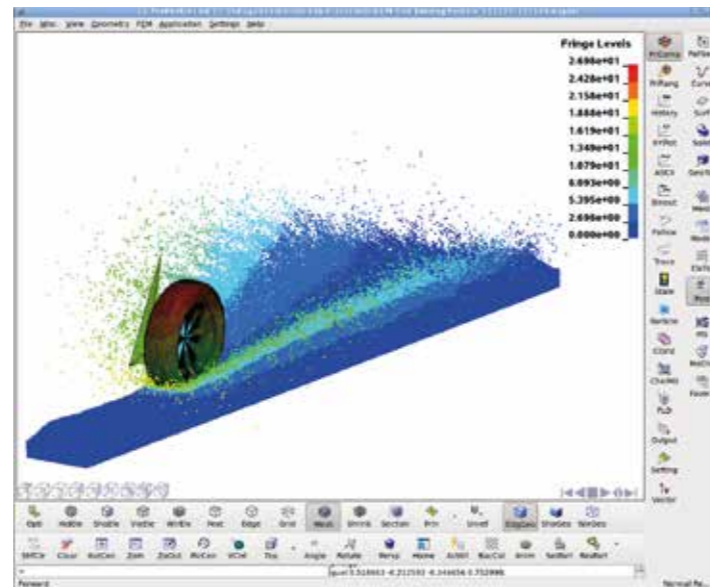
DYNAFORM

DYNAFORM from eta is an integrated pre and post-processor system for forming processes. It reduces the time needed for preparation and consequently the costs incurred for the tooling design and the development cycle. DYNAFORM impresses with its ease of operation and numerous automated functions. This means simulation setup is fast, even in the case of complex forming processes. Furthermore, new tool designs can be created and existing designs can be imported.

Features

- Auto setup
- Automatic mesh generation
- Drawbead definition
- Process definition
- Automatic contact definition
- Tailor-welded blanks modeling
- Range of functions can be expanded
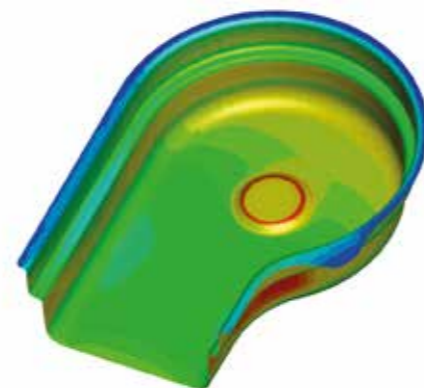
Courtesy of Egro Industrial Systems AG

PRIMER

Oasys PRIMER from Arup is a pre-processor developed exclusively for LS-DYNA. The advantage is that all data from the keyword file are understood and no data can be accidentally lost or corrupted.
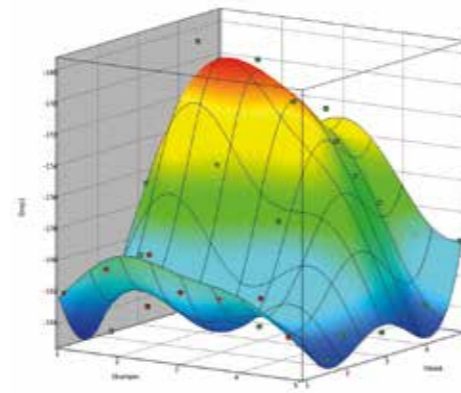
Benefits

- Data security
- Easy to find and fix modeling errors
- Saves CPU and operating time
- Easy and quick to access all LS-DYNA data
- Rapid understanding of the model structure
- Special tools, such as:
  - Spot weld generation
  - Airbag folding
  - Seatbelt fitting
  - Mechanism (e.g. for seat adjustability)
  - Replacement of parts, etc.
- Easy to learn and operate
- Reduces time spent on assembly and modifications
- Increases number of fault-free LS-DYNA runs
- Multiple users can work on different components at the same time
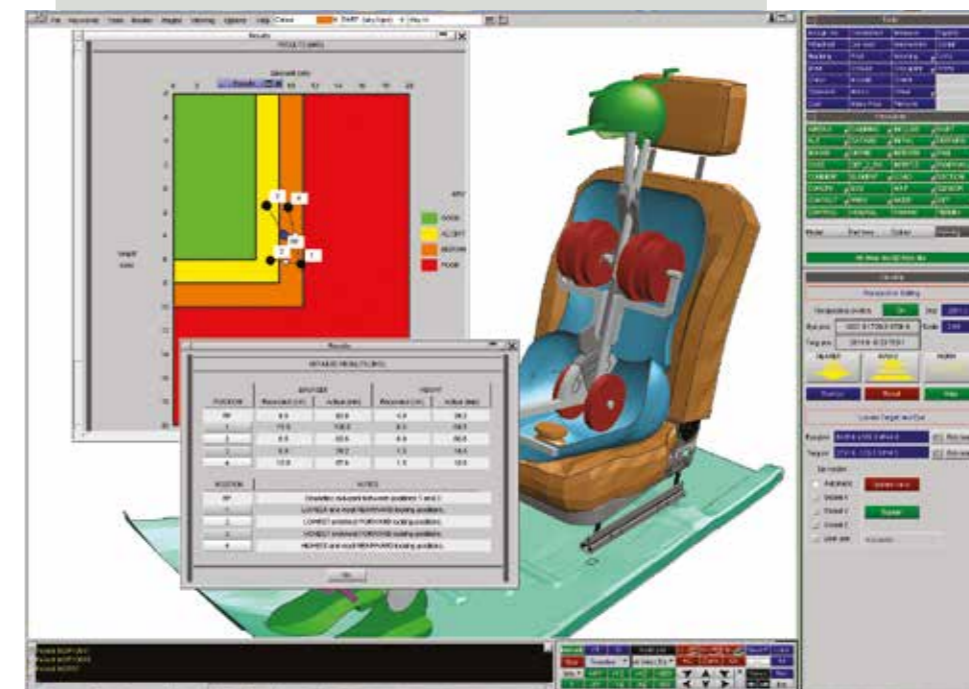
LS-OPT

LS-OPT is LSTC's standalone program for optimization. It is eminently suitable for resolving highly nonlinear optimization problems and therefore ideal for use in combination with LS-DYNA. It is however possible to combine LS-OPT with any other software package at any time. Multidisciplinary problems can thus also be solved. The program is also suitable for solving system identification problems and for stochastic analysis. The main application areas for LS-OPT are:

- Optimization
- System- and parameter identification
- Design exploration
- Sensitivity studies
- Robustness analyses

Forming Technologies

Founded in 1989, Forming Technologies (FTI®) is the world's leading provider of software solutions for the design, feasibility, and costing of sheet metal components.
FTI® has provided OEMs and suppliers in the automotive, aerospace, electronics, and appliance industries with innovative solutions designed to reduce development time and material costs.

- FASTFORM Advanced
- FORMINGSUITE Professional
- COSTOPTIMIZATION
- COSTOPTIMIZATION Advanced
- and more..

LS-TaSC

The LS-TaSC topology and design calculation tool has been developed by Livermore Software Technology Corporation. LS-TaSC is used for topology optimization of nonlinear problems involving dynamic loads and contact conditions. LS-TaSC aims to obtain a structure with uniform distribution of energy density that is suitable for crash applications.
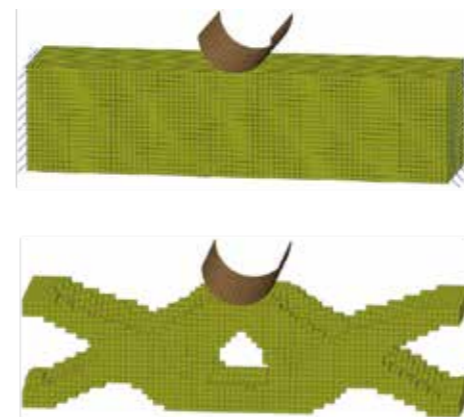
Applications

- Topology optimization
- Topometry optimization
- Free surface design

HPC - Computers

The DYNAmore ReadyToRun Linux clusters a for running LS-DYNA©, pre- and post-processing software, and storing simulation project data and results. It is a complete solution - Ready to Run!
Designed and built by DYNAmore - we use LS-DYNA every day. The system works with client laptops and workstations (Windows or Linux). An easy to use scalable solution, from 40 to more than 1000 cores.
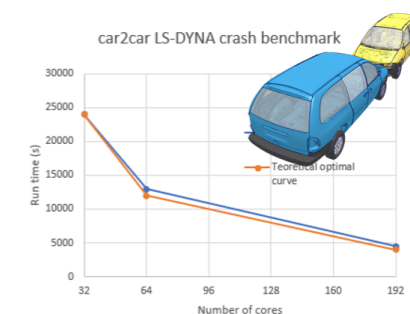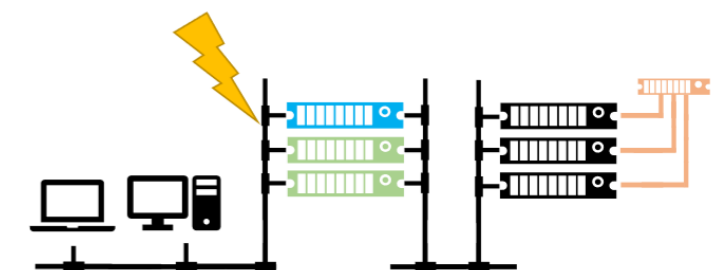
Benefits

- A modern state of the art solution
- Mobility - work from almost anywhere
- Performance - state of the art
- Economic and less administration
- Security against data loss and theft
- Tried out solution - developed in corporation with heavy CAE users.

car2car LS-DYNA crash benchmark
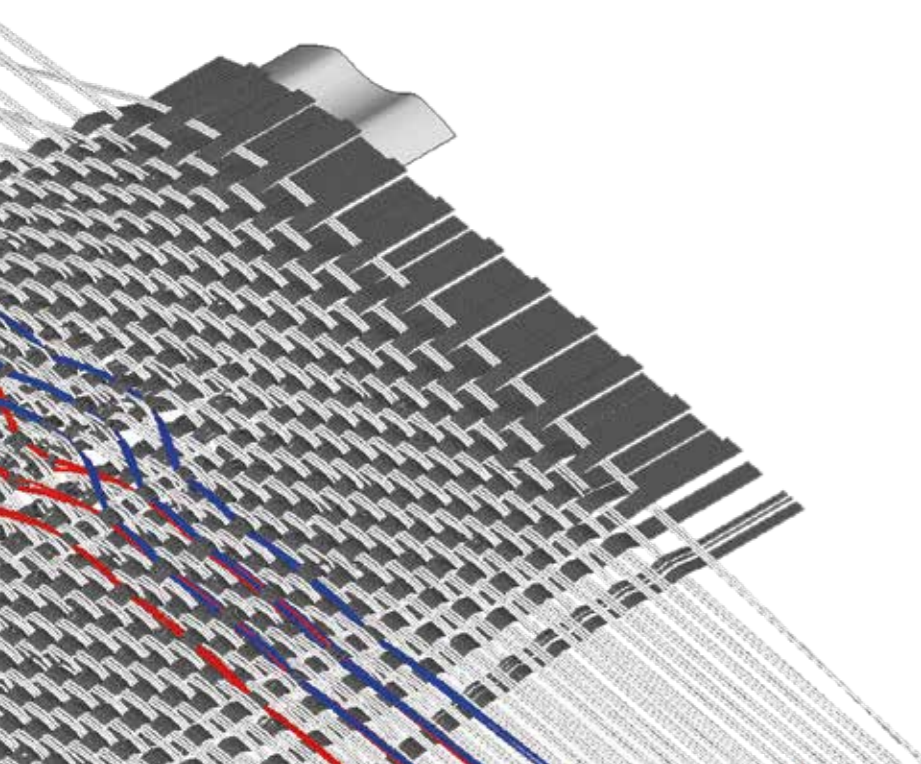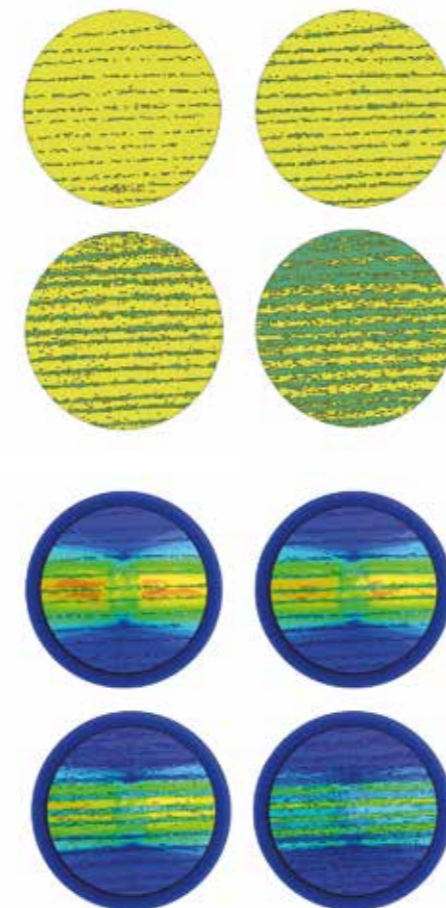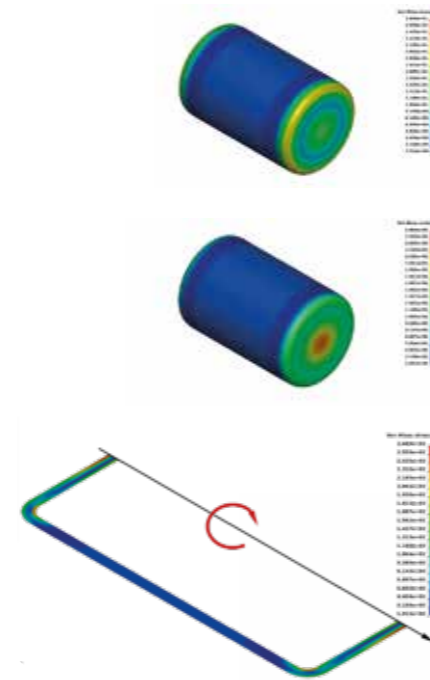
Optimization, HPC , Forming

Envyo

The Envyo multi-purpose mapping tool has been specially developed by DYNAmore for LS-DYNA. It allows simulation results to be transferred and manipulated between differently discretized meshes and from different solvers to the LS-DYNA special input format.

Arbitrary point cloud data (e.g. results from experiments) provided in csv format or through clustering methods, based on gray-scale images may also be taken into account in subsequent simulations. This is why Envyo provides an option for taking any type of previous results into consideration in subsequent numerical simulations and, consequently, cover the complete simulation process using LS-DYNA.
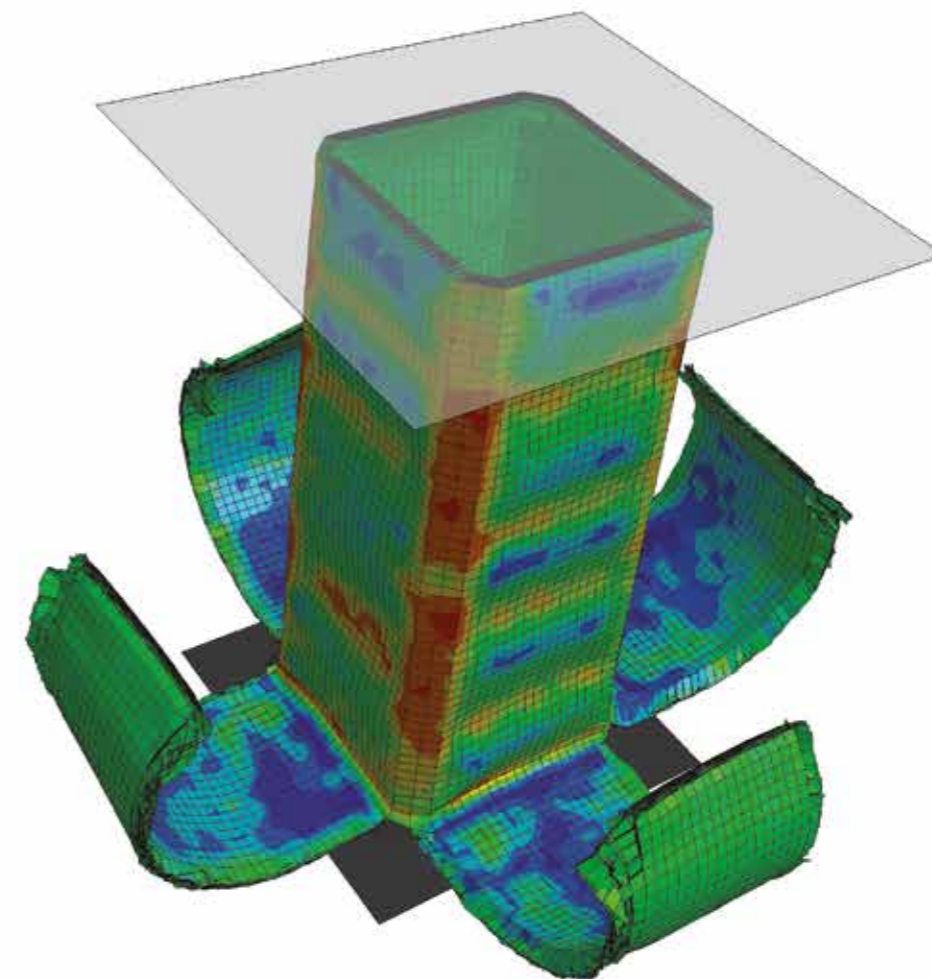
Common mapping methods

- Injection molding
- Sheet-metal forming
- Bake hardening
- Micro and mesoscopic models
- Axisymmetric simulation results

DIGIMAT

DIGIMAT from MSC Software is a state-of-the-art, nonlinear multi-scale platform for modeling materials and structures, which helps engineers to design and optimize composite materials fast and cost-effectively. From small-scale nanocomposites and honeycombed sandwich panels through to fiber-reinforced plastics, rubber and hard metals, DIGIMAT software covers a large variety of materials used in automotive, aerospace, consumer and industrial equipment industries.

Features

- Mean-field homogenization for fast and accurate prediction of nonlinear behavior
- Finite element analysis of representative volume elements (RVE)
- Material exchange platform for DIGIMAT users and vendors of materials
- Coupling of FEA software to enable a multi-scale analysis of composite materials and structures
- GUI-guided workflow tool for coupled analyses
- Prediction of micromechanical behavior of composite sandwich panels

Courtesy of
Deutsche Institute für Textil- und Faserforschung

Process chain

ATD models and barriers

To assess a vehicle, tests are carried out under comparable conditions. In order to describe the barriers and dummies accurately, they are integrated into test devices. DYNAmore develops and distributes own finite element models and finite element models from Humanetics and LSTC for these test devices. DYNAmore's package includes the following:

- Side-impact ATD models
- Frontal impact ATD models
- Rear-impact ATD models
- Child ATD models
- Pedestrian impact models
- Free-motion head form models
- Side and rear barrier models
- Front barrier models
- Moose model
- Pendulum model
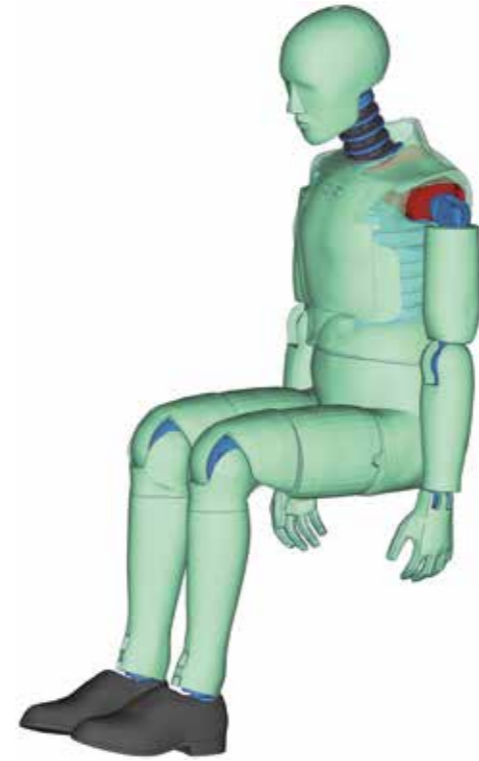
SUFEHM head model

The "Strasbourg University Finite Elemente Head Model" (SUFEHM) is a finite element model of the human head. It can be used to evaluate the risk of injury to the skull and the brain under real head-impact conditions.
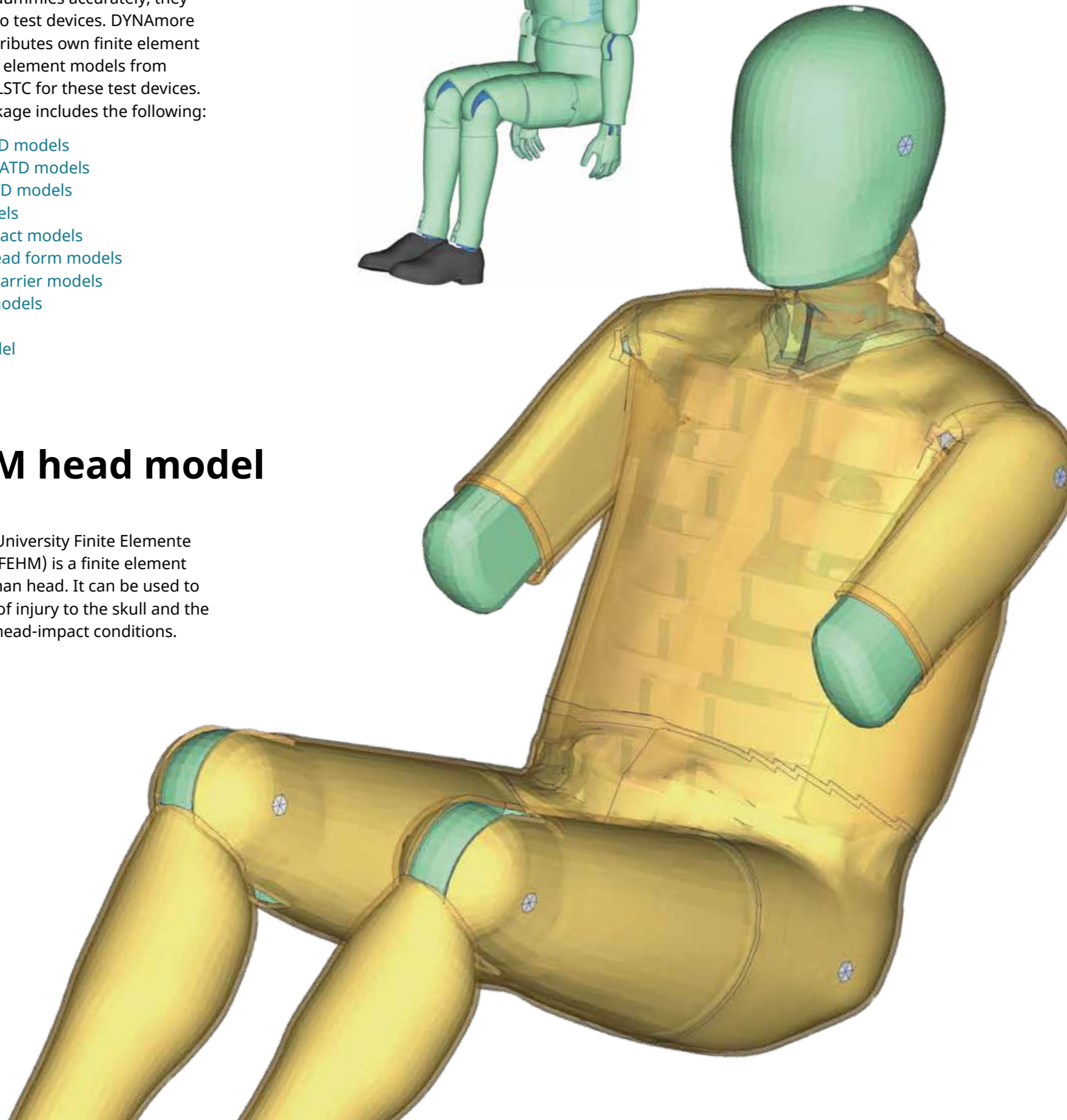
THUMS Human model

The Total Human Model for Safety (THUMS™) is a computational model of the human body and can be used to investigate the human body in various impact scenarios. It has been actively developed by Toyota Motor Corporation and Toyota Central R&D Labs since around 2000 and model updates and new versions are thus provided regularly. The THUMS model is commercially distributed by DYNAmore. Universities and research institutes may obtain a non-commercial license, which is however strictly limited to use in universities and research institutes. The THUMS model is currently available in different versions, for example:

- Female and male occupant model
- Female and male pedestrian model
- Child models

THUMS™, developed by TOYOTA Motor Corporation and Toyota Central R&D Labs

ATD and human models

Development of LS-DYNA and LS-OPT

DYNAmore provides comprehensive simulation and software development services when it comes to finite elements. These include simulation services on commission, collaboration in research and development projects, general consulting and extensions to the LS-DYNA, LS-OPT and LS-PrePost software packages.

Method development

DYNAmore has been working in the field of code development for LS-DYNA for many years. DYNAmore had already implemented material laws for composite materials in the 1990s. Today, a group at DYNAmore, actively involved in Release Management for LSTC, is engaged in implementing new features and methods in LS-DYNA. Our clients are located in the USA, Europe and Asia. Our capabilities and skills cover the entire range of FE technology.

Courtesy of Dr. Ing. h.c. F. Porsche AG

In the past, we have already been involved in

- Development and implementation of spot weld models
- Development and implementation of failure models
- Development of a material model to describe the failure of laminated glass
- Development and implementation of material models for composite fibers
- Development and implementation of material models for high-resilience and rigid foam
- Development of mapping algorithms to enable seamless simulation of component manufacturing

- Development of methods for realistic simulation of airbag unfolding
- Modelling of human models for pedestrian protection
- Complete development of GUIs from LS-OPT
- Complete development of LS-RUN
- Managing development of the thermal solver in LS-DYNA
- Managing development of the implicit features in LS-DYNA

FEMZIP & Diffcrash

The FEMZIP software tool has been specifically developed by Sidact to compress finite element simulation results. The algorithms and processes used focus on the particular characteristics of the LS-DYNA simulation results and therefore lead to exceptionally high rates of compression.

Costs for data management, storage and archiving can be significantly reduced by using the FEMZIP-L data compression tool. Simulation data compressed with FEMZIP are up to ten times smaller than LS-DYNA output files. The high compression factor obtained with FEMZIP yields the following benefits:

- Reduction in archive size
- Accelerated data exchange
- Fast access to data

LS-DYNA Tools

We have developed a series of useful tools for DYNAmore customers, making working with LS-DYNA simpler for end users. You will find tools for data compression, for determining intrusions, for your QA, and much more.

# Material Competence Center
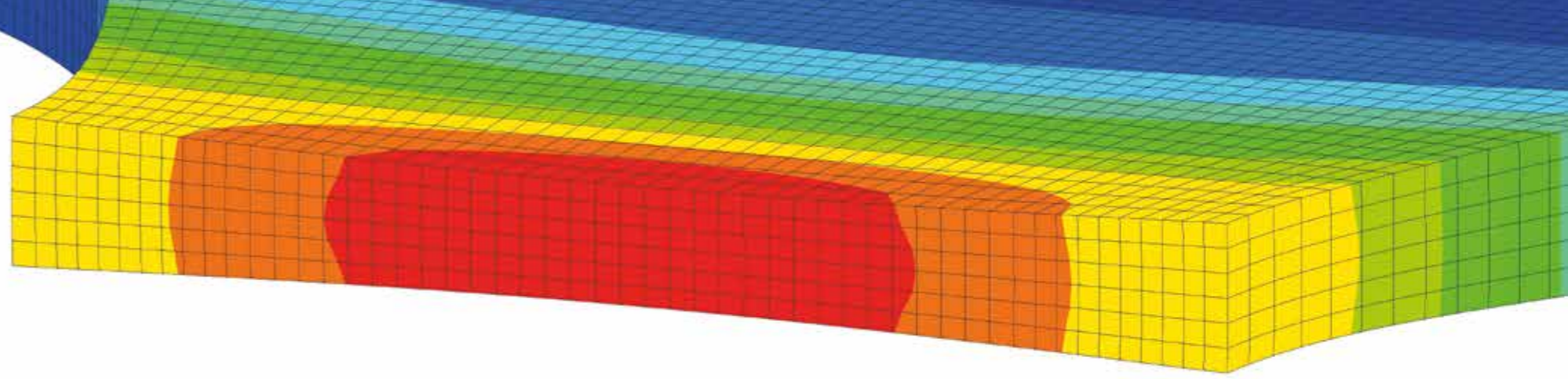
Experiments

The mechanical properties of many materials that are required for simulation are often unknown. Defining these precisely is typically very expensive and often involves a considerable wait. In contrast, the experiments we select in accordance with specific requirements provide a quick and reliable basis for generating predictive material cards for polymers, metals and composite materials.

Material models and calibration

The quality of the material cards has a significant influence on predictability in numerical calculations. In addition to advanced testing processes, our customers benefit from our engineers' many years of experience in the area of numerical description of mechanical material behavior.

Forming behavior

- Viscoelastic and viscoplastic
- Isotropic or anisotropic
- Tensile and compressive-asymmetric
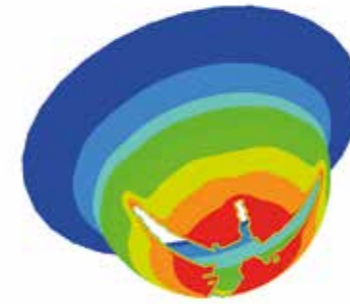
Damage and failure modeling

- GISSMO (Generalized Incremental Stress State dependent damage Model)
- DIEM (Damage Initiation and Evolution Model)
- eGISSMO (Mat Add Generalized Damage)
- Damage development under cyclic load

Research

In cooperation with its partners in industry and academia, DYNAmore is involved in numerous funded research projects in the automotive, aerospace and automation industries as well as in the field of software development.

Research projects

- Simulation approval for the homologation of vehicles (project partners: Audi, Opel, FIAT, BAST)
- Simulation of human interaction with robots (project partners: LMU Munich, ABB)
- Active muscle systems for human models (project partners: vif, Daimler, BMW, Bosch)
- Optimization, robustness, reliability (project partners: BMW, TU Dresden)
- Multi-disciplinary optimization (project partners: Porsche, Daimler, Karmann)
- Topology optimization for crash (project partners: ASCS, HAW Hamburg, SFE)
- Software development - process management for crash load cases (project partner: the Bavarian State Ministry for Economics and Technology)
- Innovative design of forming tools (project partners: Daimler, Thyssen-Krupp, Volkswagen)
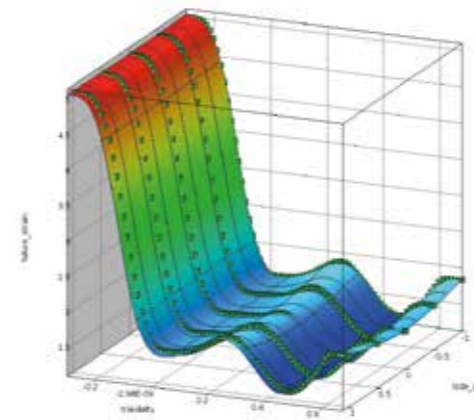- Materials innovation through integration of nanotechnology

Our services

- Static, dynamic and cyclic testing
- Tensile, compression, puncture and bending testing
- Component testing
- Sample conditioning
- Sample processing and collection from components, sheets and panels
- Optical 3D strain measurement and detailed evaluation of local distortion

Your benefits

- Testing and adjustment from a single source
- Minimizes time and costs
- The LS-DYNA developer team is always available

Services

Events

In addition to regular conferences attended by over 500 delegates, DYNAmore organizes free information days, workshops and webinars on different subjects on an ongoing basis in order to encourage knowledge sharing.
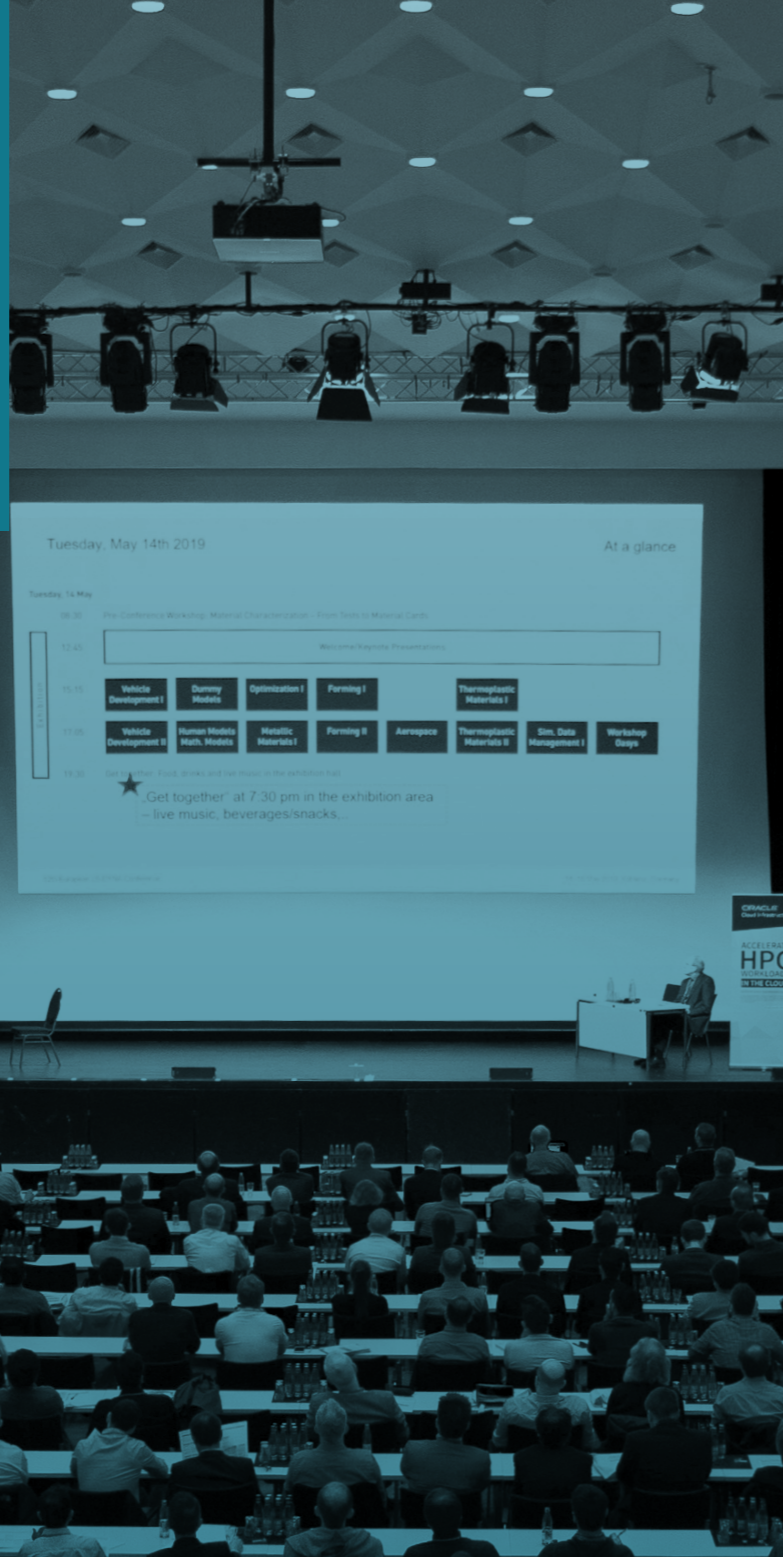

Seminars

DYNAmore offers more than 150 seminars, free information days and webinars on more than 65 topics. Training encompasses numerous courses in the fields of application for LS-DYNA and LS-OPT, as well as the field of pre and post-processors. All seminars can be adapted to meet specific company needs and held on-site in German or in English.

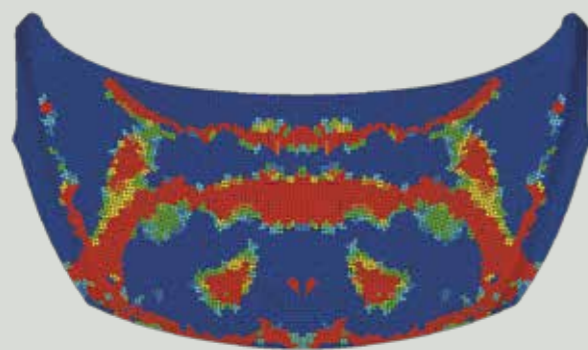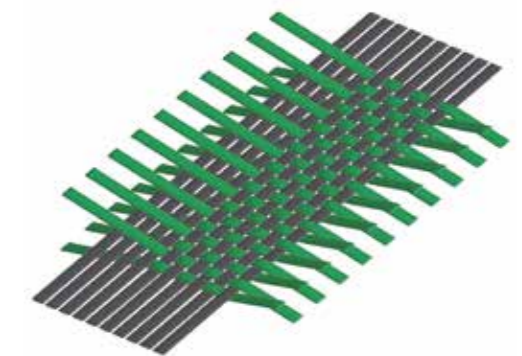We offer courses in the following fields:

▪ Introductory courses
▪ Fundamentals/theoretical knowledge
▪ Crash
▪ Passive safety
▪ Forming/process simulation
▪ Material
▪ Implicit analysis
▪ Particle methods
▪ Multiphysics/biomechanics
▪ High-energy events
▪ Optimization
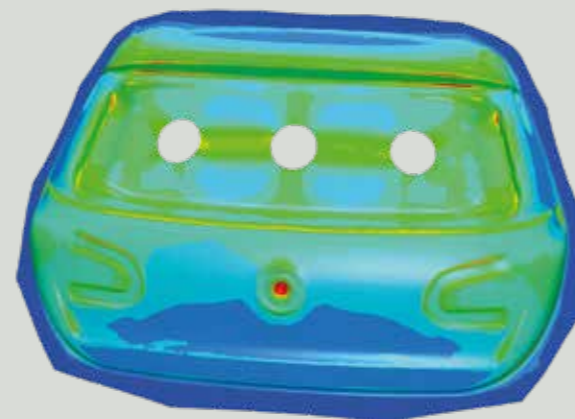▪ Pre and post-processing
▪ CAE/IT
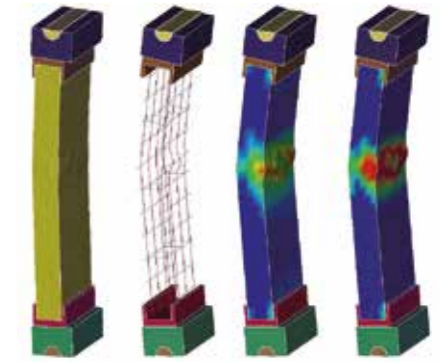
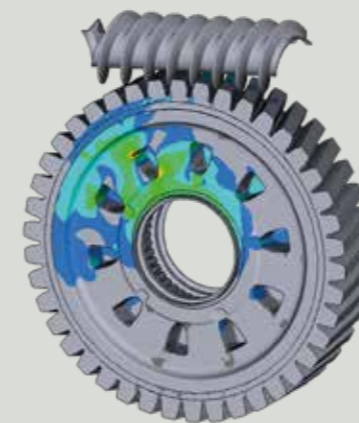Courtesy of
Schwer Engineering
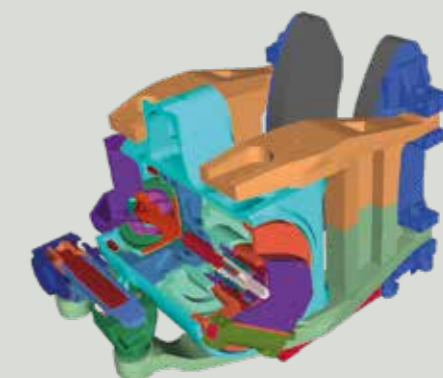
Courtesy of
Honda R&D Americas

Courtesy of
Hyundai Motor Company

Courtesy of
Volkswagen AG

Courtesy of
IMS Gear GmbH

Courtesy of
Knorr-Bremse System für Schienenfahrzeuge

Continuing Education

SCALE

SCALE provides software solutions and IT services for process and data management in the automotive industry and other sectors. As a affiliated company of DYNAmore GmbH, SCALE has a strong background in CAE applications and processes. Services offered by SCALE include, in particular, development of process and data management software, development of the finite element method as well as optimization for the functional design of vehicle components numerically. SCALE's portfolio encompasses CadMe, LoCo, CAViT and Status.E for simulation data, process and requirements management, as well as IT services for bespoke software solutions upon request.

www.scale.eu
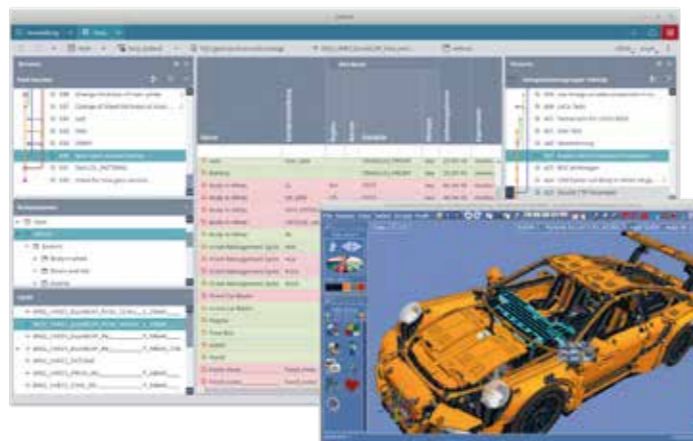
CASCATE

CASCATE GmbH's main focus is on professional consulting for all simulation solutions, in particular complex tasks in the fields of fluid mechanics, structural mechanics and fluid-structure interaction. As a affiliated company of DYNAmore GmbH, CASCATE can draw on its extensive experience in the field of simulation. In founding CASCATE GmbH, DYNAmore GmbH significantly expanded and streng-thened its CFD simulation competence. In particular, an expert team for STAR-CCM+® was set up that was dedicated to addressing customer requirements in this particular area. This team also conducts fluid-structure interactions and flutter analyses.

www.cascate.de

Affiliated companies
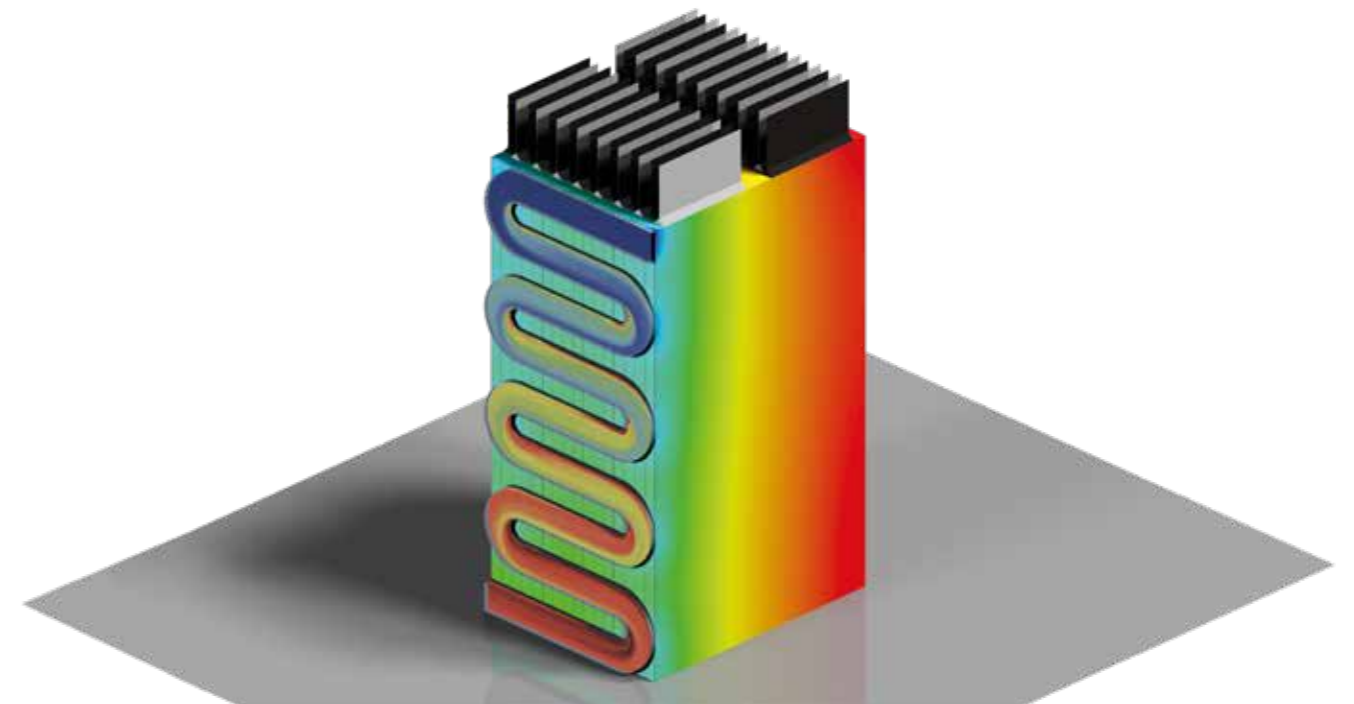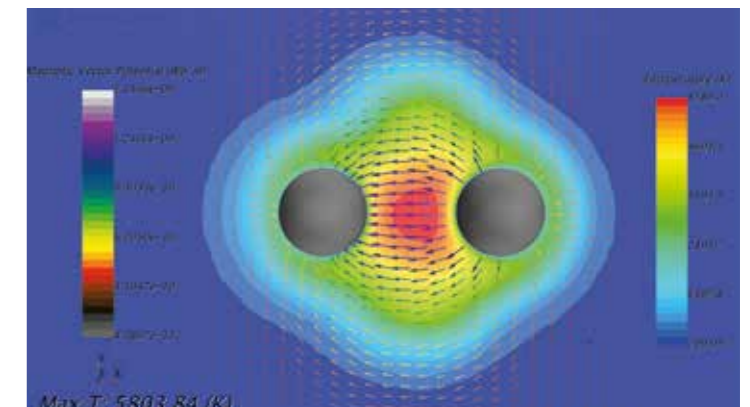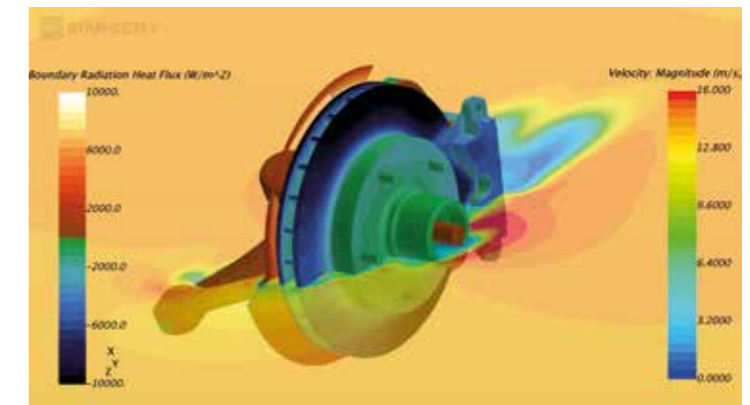
DYNAmore on the web

www.dynamore.se

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/ Current release notes
/ Download area
/ FEM models
/ Registration for seminars

www.dynasupport.com

/ Support information for LS-DYNA
/ FAQs

www.dynaexamples.com

/ More than 500 examples
/ Seminar materials
/ Download area

www.dynalook.com

/ More than 2,250 papers for download at no cost
/ Collection of all papers published at conferences
/ FEA newsletter archive

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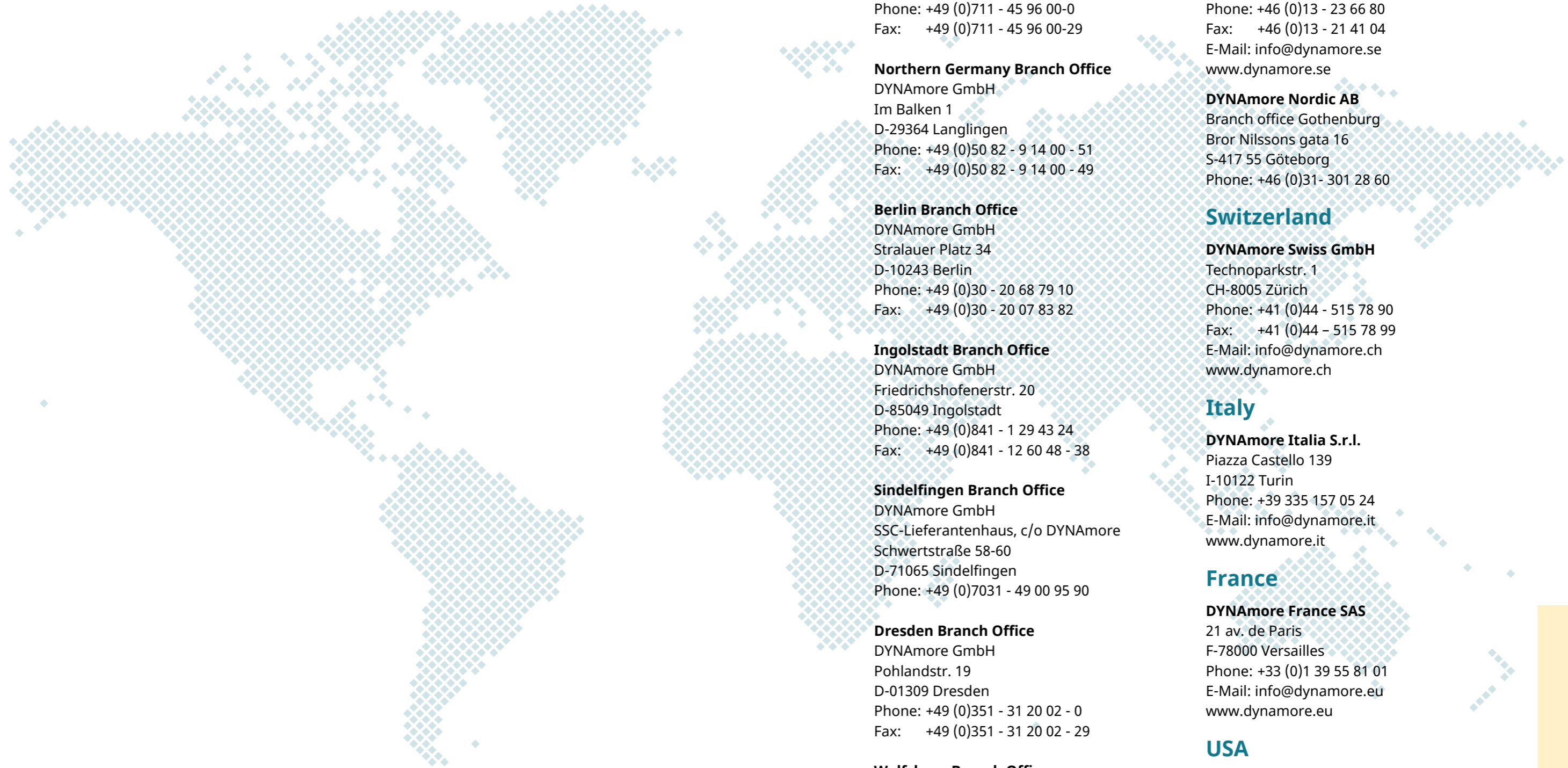## www.ls-dynacloud.com

/ HPC Cloudsolution for LS-DYNA

www.dummymodels.com

/ Overview of all models

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