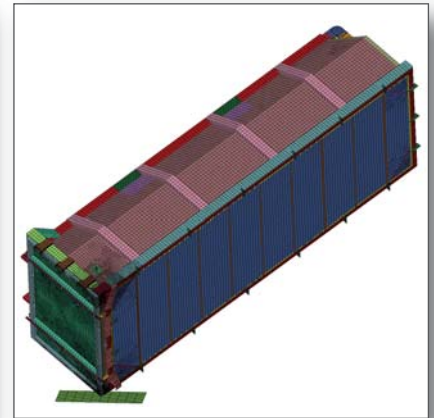
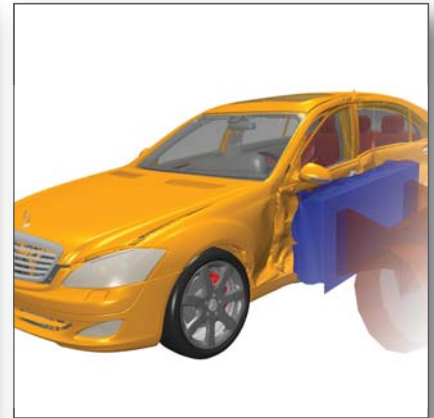
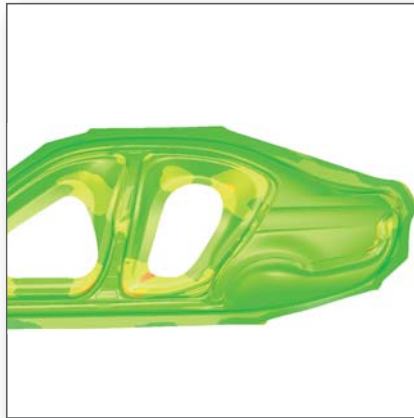


LS-DYNA®

The advanced simulation tool for nonlinear,
linear, dynamic, and static analysis



Automotive

Defense

Aerospace

Manufacturing

Research

Consumer Goods

Transportation

Civil Engineering

Packaging

Images by courtesy of Toyota Motor Corp., BMW Group, Daimler AG, Hilti Entwicklungsgesellschaft mbH, Johnson Controls GmbH, Predictive Engineering Inc. (from top left to bottom right).



Vehicle Model
By courtesy of General Motors



Vehicle Model
By courtesy of Chrysler Group LLC

Introduction

LS-DYNA is a highly advanced general purpose nonlinear finite element program that is capable of simulating complex real world problems. The distributed and shared memory solver provides very short turnaround times on desktop computers and clusters operated using Linux, Windows, and UNIX. With LS-DYNA, Livermore Software Technology Corporation (LSTC) aims to provide methods to seamlessly solve problems requiring

“Multi-Physics”, “Multi-Processing”,
“Multiple Stages”, “Multi-Scale”.

LS-DYNA is suitable to investigate phenomena involving large deformations, sophisticated material models and complex contact conditions for structural dynamics problems. LS-DYNA allows switching between explicit and different implicit time stepping schemes. Disparate disciplines, such as coupled thermal analyses, Computational Fluid Dynamics (CFD), fluid-structure interaction, Smooth Particle Hydrodynamics (SPH), Element Free Galerkin (EFG), Corpuscular Method (CPM), and the Boundary Element Method (BEM) can be combined with structural dynamics.

By determining product characteristics before a prototype is built, for many products LS-DYNA is the key to reducing time to market. Carrying out investigations with the aid of LS-DYNA supports the design of robust products with superior performance. For pre- and post-processing, LS-DYNA comes with the LS-PrePost tool. LS-PrePost can be utilized to generate inputs and visualize numerical results. The software package LS-OPT for optimization and robust design is also supplied with LS-DYNA. With the option of multidisciplinary simulations, LS-DYNA significantly increases potentials for developing innovative products. These advantages contribute towards reducing development costs. All above-mentioned features and software packages are supplied as a single unit. LS-DYNA is not split for special applications, and the licensing scheme enables the different disciplines to be combined without limitations.

LS-DYNA has been developed in California for more than 20 years. It is the most frequently-used code for many complex applications in structural nonlinear dynamics. Its usage is growing rapidly due to LS-DYNA's flexibility, enabling it to be applied to new disciplines. The new developments are driven in co-operation with leading universities from all over the world and new requirements requested by the vast customer base.

“With LS-DYNA we have excellent access to the vast developments in finite element technology for crash analysis.”

T. Frank, Daimler AG

“We continue to use LS-DYNA in a wide variety of applications and appreciate the timely and professional technical support.”

B. Hansen, Takata Corporation

LS-DYNA in vehicle design

For many automotive companies, LS-DYNA is an indispensable tool for understanding the mechanisms associated with the deformation of such complex systems as vehicle structures in a crash.

LS-DYNA is used to determine the behavior of a vehicle even before the first prototype is built. As a rule, far more crash scenarios can be investigated numerically than physical tests can be performed. A further benefit is that the time to market can be reduced significantly by applying LS-DYNA during product development.

LS-DYNA is equipped with many features specifically designed for automotive applications, e. g. spot welds, airbag models, seat belt models and retractors. Currently more than 15 large car manufacturers use LS-DYNA intensively for crash applications. The majority of automotive features are developed on customer request. For example, three different analysis methods are available for investigating airbag deployments, with each method addressing different approximation levels for the bags. The initial deployment can thus be analyzed in reasonable detail, in very high detail or only with the resolution required to predict the behavior of the unfolded airbag. As a result, LS-DYNA is used to analyze out-of-position situations, to design a turning baffle in a gas generator or to look at a stand interaction of an occupant with an almost completely deployed airbag.

To facilitate the development process, a range of models of standard test devices, such as dummies and barriers, can be utilized. Many common models are available to all LS-DYNA licensees free of charge. A broad selection of highly validated models developed by third party user groups can be purchased additionally.

As failure and post-failure prediction play an important role in crash applications, the manufacturing history of components is also highly relevant. LS-DYNA is capable of analyzing a vast range of manufacturing processes and seamlessly integrating the information gained.

Besides crash applications, LS-DYNA is also highly suitable for handling the dynamic and static load cases typically considered in vehicle development processes. With very few adjustments, an existing model initially generated for a crash analysis can be re-used to estimate vehicle behavior during a roof crush, door sag or abusive loading, or to determine load distribution in a later fatigue analysis.

LS-DYNA is used to assess the robustness of the end product. This enables manufacturing tolerances to be selectively determined in order to enhance product performance and reduce final costs.



Vehicle Model
By courtesy of Geely Holding Group



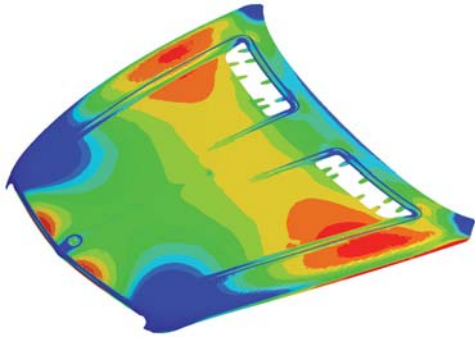
Vehicle Model
By courtesy of Dr. Ing. h.c. F. Porsche AG

“LS-DYNA was effectively used for all our cars from concept to production.”

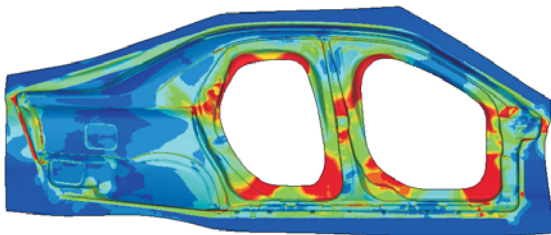
T. Zeguer, Jaguar Cars Ltd.

“LS-DYNA is the main code that we use effectively and reliably for the vast majority of our FE analysis – explicit as well as implicit.”

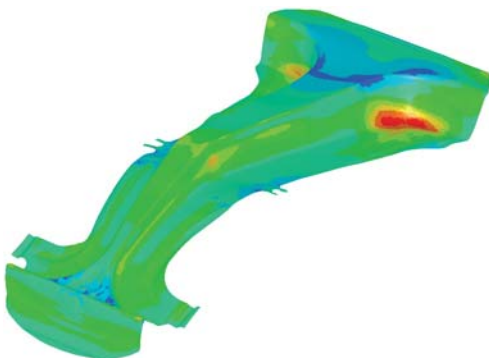
F. Shokoohi, Autoliv, Inc.



Forming Simulation
By courtesy of Daimler AG



Forming Simulation
By courtesy of Volvo Car Corporation AB



Forming Simulation
By courtesy of ThyssenKrupp Steel Europe AG

LS-DYNA in metal forming

The main application of LS-DYNA in metal forming is sheet metal stamping. The incremental approach of LS-DYNA allows the user to simulate multi-stage sheet metal stamping processes with a high degree of accuracy. The multiple core technology implemented, enables even large components with very high accuracy requirements to be simulated within just one hour. In addition, the simulation of the forming process can be complemented by simulating the trimming and springback of the part.

The simulation may have different targets. One of them could be to determine the feasibility of a part in a forming process and its final geometry on completion of the various manufacturing processes. The information gained enables process parameters, forming sequences and optimal tool geometries to be determined. As a result, the part can be manufactured with a more accurate shape and better surface quality using fewer forming steps, thus lowering the cost per part.

Another target could be to design a hot forming process. The program allows the user to determine metal phase transformations encountered during cooling. Heating due to heat flow and radiation before, during, and after the forming process can all be analyzed. Thus, an analysis of the entire process can be carried out, from heating through forming right up to cooling, and only one model is required to predict the time needed for heating and cooling, the press requirements and part performance.

In addition to sheet metal forming, LS-DYNA is also capable of effectively analyzing other forming applications such as tube forming, cutting, extruding, impulse forming, forging, rolling, welding, hemming, flanging, electromagnetic forming and bending. Different disciplines are coupled for many of these applications. Features such as re-meshing, meshless methods, switching time-stepping schemes, ALE, thermal capacities, rigid body dynamics, among others, can be used simultaneously.

Many specific sheet metal stamping features come with LS-DYNA and the pre- and post-processing tool LS-PrePost, which is included in the software package. The LS-DYNA solver has also been integrated into various forming simulation tools. These tools are provided by third party companies which supply highly effective support for specific forming applications and localization. A one step solver is currently under preparation and will soon be available in the standard LS-DYNA version.

LS-DYNA – a multi-purpose program for automotive suppliers

LS-DYNA is essential for the virtual testing of various components in vehicles. The explicit and implicit time stepping schemes are capable of simulating static and dynamic tests using the same model. Component manufacturing processes are investigated by LS-DYNA using the metal forming and thermal capabilities. Hence, only one model is required to consider different problems. Ultimately, this results in lower costs for training and model creation compared to other solutions.

One example of the successful application of LS-DYNA is seat design. Seat manufacturers are able to consider static and dynamic load cases for seat frames as well as analyze the stability of belt anchorage points. LS-DYNA enables them to determine maximal locking mechanism loads or failure loads of seat tracks. LS-DYNA allows to investigate the influence of the seat on an occupant in a crash as well as the stamping process of a gear wheel. To enhance design and find a robust solution, this user group also often utilizes LS-OPT, a state-of-the-art optimization tool.

Other examples of similar beneficial applications of LS-DYNA are the design and manufacture of crash boxes, bumpers, front ends, dashboards, trimmings, and tires.

LS-DYNA in aerospace and defense

LS-DYNA is a state-of-the-art program which can simulate high speed impacts, blasts and explosions. ALE and SPH methods are well suited for investigating high speed impacts on textiles, metal sheets and composites. The large library of constitutive equations with multiple options for material failure and non-localization complete the features required for many defense and aerospace applications.

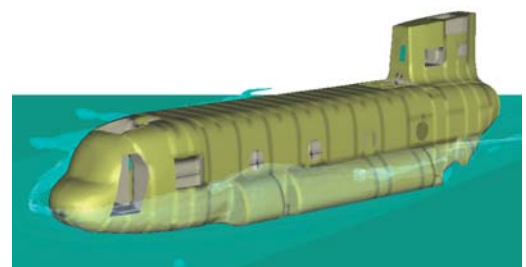
Additionally, 2-D capabilities and automatic re-meshing and rezoning enable users to investigate axi-symmetric problems. The multi-physics capabilities of LS-DYNA, in conjunction with features developed for the automotive industry, facilitate the investigation of splashdown loads on tanks and rockets and emergency airplane landings. These features can also be used to optimize the design of airplane turbines and their blades with regard to bird collision.



Tire Simulation
By courtesy of Dunlop



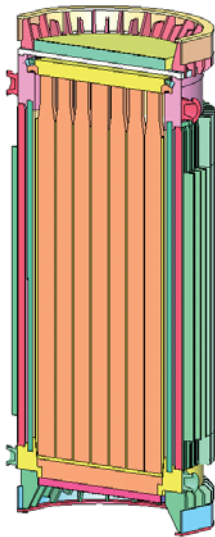
Helicopter Model
By courtesy of NASA Langley Research Center



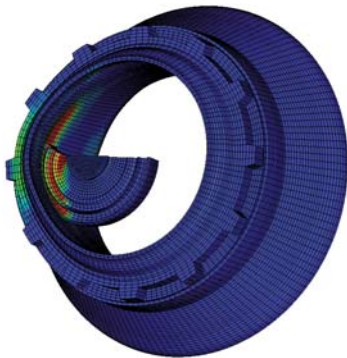
Helicopter Water Impact Simulation
By courtesy of The Boeing Company



Model for Drop Test Simulation
By courtesy of
Sony Ericsson Mobile Communications AB



Container Model
By courtesy of Sarov Labs



Model of Disc Impacting Wall of Turbine
By courtesy of Turbomeca, Safran Group

LS-DYNA for drop test analysis

LS-DYNA is used to investigate the behavior of products under impact conditions due to dropping. The application range includes consumer products, tools and also container design. For example, in the field of packaging design LS-DYNA helps to develop food containers capable of sustaining dynamic loading conditions during transport and storage.

Besides the broad spectrum of material models equipped with complex failure mechanisms, the flexible coupling and switching capabilities of LS-DYNA are essential for many applications. For instance, a liquid in a container can be modeled with the ALE or SPH method coupled with the structure. This allows the behavior of the liquid to be modeled accurately during impact.

To investigate cracks, the Element Free Galerkin (EFG) method can be used to eliminate mesh influence during crack propagation. To determine steady state deformation effectively, LS-DYNA provides the flexibility to switch time-stepping scheme arbitrarily between explicit and implicit. Furthermore, LS-DYNA also enables parts to be altered from rigid to deformable and vice versa. This feature is often used to determine the position of one part in relation to another during a falling phase before the main impact occurs.

LS-DYNA for containment

In certain industries, there is a risk of accidents causing severe damage to communities or the environment. LS-DYNA acts as a tool to reduce such risks by generating knowledge about how a system may fail. Thus, design changes can be made to reduce or even eliminate risks associated with the load cases considered.

One example is containers utilized to transport nuclear fuel elements. It is essential that containers remain closed and tightly sealed in the case of any predictable accident which might occur during transport. LS-DYNA is used to design the transport container, its interior and the energy-absorbing buffers around the enclosing hull of the container.

Another example is the high-speed impact on objects, like a turbine blade separating from a turbine that may not damage the embankment dam. LS-DYNA allows the user to estimate the damage caused by a turbine blade hitting the turbine housing. As such types of simulation require the exact prediction of the post-failing phase, extensive preliminary material testing is needed. However, due to the high potential of severe damage, this effort is well spent.

LS-DYNA for manufacturing

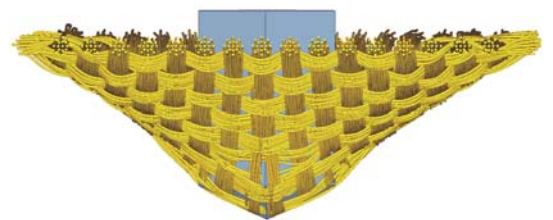
In the commodities manufacturing industry, the reliability and speed of production and packaging steps play a crucial role in determining product costs. Fabrication processes generally involve nonlinear steps and use different physical effects. Its nonlinear capabilities and ability to couple different numerical schemes make LS-DYNA a unique tool to find solutions to queries associated with the layout of manufacturing processes.

For example, LS-DYNA can be utilized to investigate the deformation of a container during filling, handling, closure, packaging, and stacking. The performance of a snap fit after a series of opening and closings can be analyzed as well as manufacturing tolerances and handling or transportation influences. Other applications may include folding tissues and packing bulk or granular goods.

Due to the short development times of some commodities, rather than being entirely verified the simulation is only used to understand physically relevant parameters and their impact on the process under consideration. Manufacturing processes are optimized, enabling a greater number of parts to be produced in a shorter time with a higher quality and improved reliability. In this way, even small savings per part can add up to a huge total.



Models of Embossed Cans
By courtesy of Alcoa Inc.



Detailed Model of Fabric
By courtesy of ITV Denkkendorf

LS-DYNA for research applications

New technology is continuously being incorporated into LS-DYNA. For instance, new methods such as Element Free Galerkin (EFG) and Smooth Particle Hydrodynamics (SPH) are now available in LS-DYNA.

For many research applications, it is important to be able to investigate multi-physics problems by coupling the different methods. For example, Eulerian and Lagrangian formulations can interact in one simulation. Solutions for thermal analysis and Computational Fluid Dynamics (CFD) or the Boundary Element Method (BEM) are provided in LS-DYNA. The development of new constitutive equations is facilitated by providing an interface that allows new material routines to be incorporated.

The excellent parallelization on MPP machines allows researchers to work with highly detailed models whilst keeping hardware costs low. LS-DYNA is extensively used in various research applications. One example can be found in the biomedical field. Here, questions related to whiplash, bone fractures, and the operating modes of heart valves or ankles are addressed. LSTC is dedicated to providing LS-DYNA for educational purposes.



Heart Valve Model
By courtesy of The University of Sheffield



Vehicle Model
By courtesy of Adam Opel AG



Vehicle Model
By courtesy of Jaguar Cars Ltd.



Vehicle Model
By courtesy of Volvo Car Corporation AB

Main areas of application

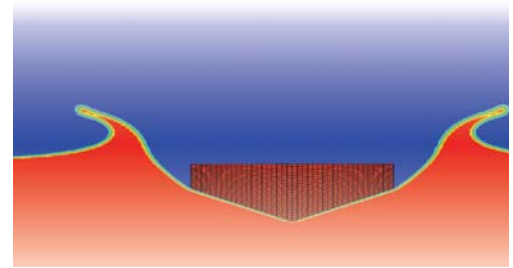
The numerous features of LS-DYNA enable the software to be employed in many different fields. A list of common applications is given below:

- Crashworthiness simulations of automobiles, trains, and ships
- Emergency airplane landings
- Occupant safety analysis
- Pedestrian safety analysis
- Automotive parts manufacture
 - Car bodies
 - Seats
 - Roofs
 - Doors
 - Hoods
 - Bumpers
 - Crash boxes
 - Girders
 - Steering wheels
 - Steering columns
 - Dash-boards
 - Padding
- Metal forming
 - Rolling
 - Extrusion
 - Forging
 - Casting
 - Spinning
 - Ironing
 - Superplastic forming
 - Sheet metal stamping
 - Profile rolling
 - Deep drawing
 - Hydroforming
 - Multi-stage processes
 - Springback
 - Hemming
- Metal cutting
- Glass forming
- Biomedical applications
- Stability/failure investigations
- Drop tests
 - Consumer products
 - Nuclear vessels
- Earthquake engineering
- Bird strike
- Jet engine blade containment
- Penetration
- Plastics, mold, and blow forming
- Blast loading
- Spot welded, riveted and bolted structures
- Shipping containers
- Can and container design

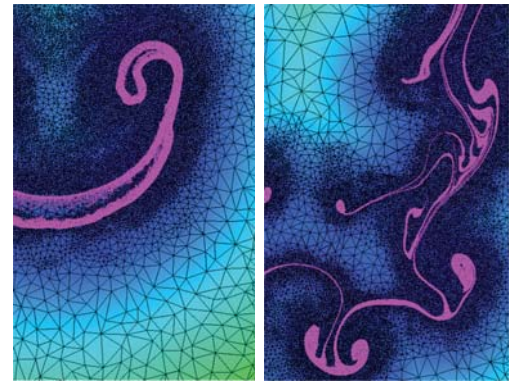
Analysis capabilities

Different applications utilize one or a combination of the features listed below:

- Nonlinear dynamics
- Coupled rigid body dynamics
- Quasi-static simulations
- Normal modes
- Linear and nonlinear statics
- Eigenvalue analysis
- Thermal analysis
- Fluid analysis
- Eulerian capabilities
- Arbitrary Lagrangian Eulerian (ALE)
- Fluid-structure interactions
- Underwater Shock Analysis coupling (USA)
- Failure analysis
- Crack propagation
- Real-time acoustics
- Multi-physics coupling
- Structural-thermal coupling
- Adaptive re-meshing
- Rezoning
- Smooth Particle Hydrodynamics (SPH)
- Element Free Methods (EFG)
- X-FEM
- CSE solver
- 2-D and 3-D formulations
- Nastran reader
- Arbitrary rigid to deformable switching
- Arbitrary implicit to explicit switching
- Dynamic relaxation



Fluid-Structure Interaction (ALE)

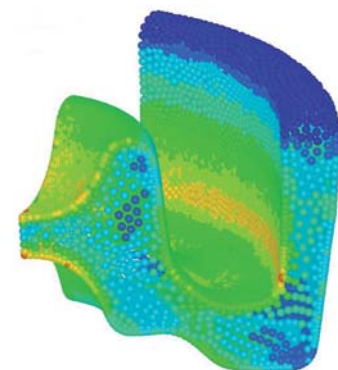


Fluid Simulation

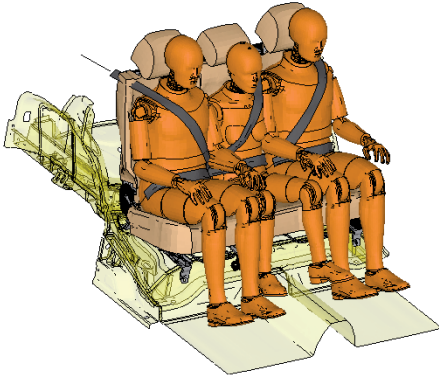
Library of material models

LS-DYNA provides over 130 metallic and non-metallic material models, many of them equipped with failure criteria. Frequently used modeled materials include:

- Metals
- Plastics
- Visco-elastic
- Elasto-viscoplastic
- Glass
- Foams
- Fabrics
- Elastomers and rubbers
- Honeycombs
- Composites
- Concrete and soils
- High explosives
- Viscous fluids
- Biomedical models
- User-defined materials



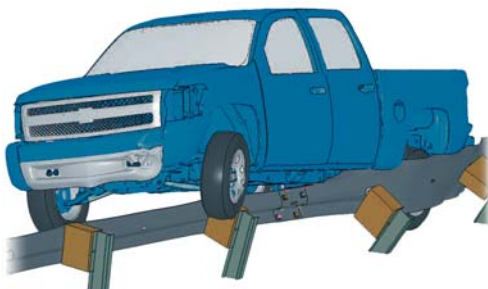
Forging Model with Element Free Galerkin Method
By courtesy of Alcoa Inc.



Seat and Dummy Models
By courtesy of Faurecia Autositze GmbH



Model of Tank Occupants
By courtesy of Rheinmetall Landsysteme GmbH



Road Side Model
By courtesy of University of Nebraska

Large element library

LS-DYNA has an extensive element library with both under-integrated and fully-integrated element formulations. The lower-order finite elements in LS-DYNA are accurate, efficient, and robust. For the under-integrated shell and solid elements, zero-energy modes are controlled either by viscosity or stiffness hourglass control formulations. The element list includes:

- Different solid elements
- 8-node thick shells
- Different 3- and 4-node shells
- Beams
- Welds
- Discrete zero length beams
- Trusses and cables
- Nodal masses
- Lumped inertias
- Arbitrary Lagrangian Eulerian elements
- Eulerian elements
- Element Free Galerkin formulations
- SPH elements
- Elements for 2-D analysis
- User-defined elements

Contact algorithms

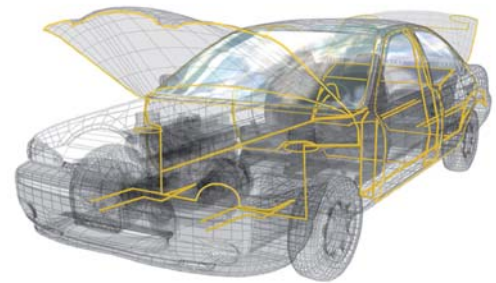
Constraint and penalty techniques have worked extremely well over the past 20 years in numerous applications. Coupled thermo-mechanical contact can also be simulated with over 25 different contact options available. The options deal primarily with the contact of deformable to deformable bodies, single surface contact in deformable bodies and deformable or rigid to rigid body contact. The range of contact surfaces which can be defined is outlined below:

- Single surface contact
- Contact with rigid walls
- Edge-edge contact
- Beam-beam contact
- Eroding contact
- Contact with CAD surfaces
- Tied surfaces
- 2-D contact
- Shell edges tied to shell surfaces
- Resultant force contact
- Fluid-structure interfaces
- Pinball contact
- Friction models:
 - Static and dynamic Coulomb
 - Viscous friction
 - Pressure dependent friction
 - User-defined friction models

Rigid body dynamic features

Many features used in multi-body applications also come with LS-DYNA. A selected range of features is listed below:

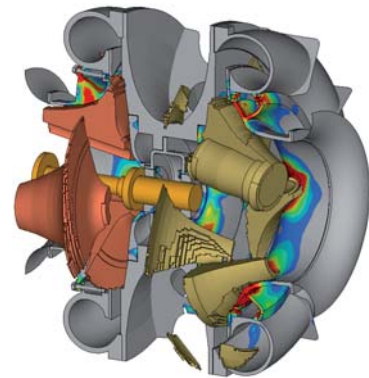
- Rigid bodies
- Rigid to deformable switching
- Deformable to rigid switching
- Joints
 - Spherical joints
 - Revolute joints
 - Cylindrical joints
 - Translational joints
 - Locking joints
 - Motor joints
 - Pulley and screw joints
 - Cardan joints
 - Flexion/torsion joints
- Contact
 - Rigid body to deformable body contact
 - Rigid body to rigid body contact
- Multiple discrete elements (granular)



Bond Line Model
By courtesy of Dow Automotive Systems

Platforms

LS-DYNA is ported to all common HPC platforms. Massive parallel versions (MPP – Message Passing Programming), a shared memory version (SMP – Symmetric Memory Processing) and a hybrid version (SMP on a CPU and MPP across the CPUs) are available as well as single and double precision versions. Detailed information regarding the availability of the platform and operation system required can be obtained from your local distributor.

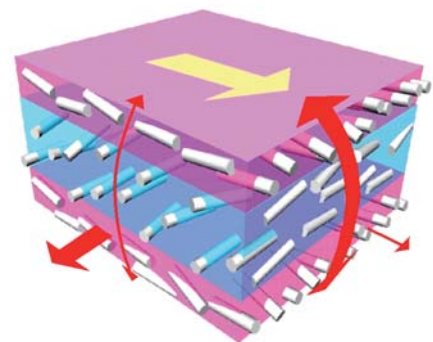


Turbo Charger Model
By courtesy of Inprosim GmbH

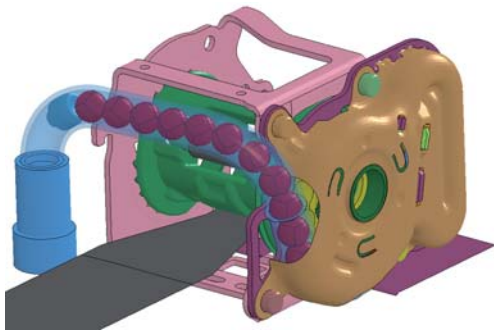
Specialized metal forming features

Specific features developed in LS-DYNA permit metal forming to be simulated. These features are tailored to achieve accurate results efficiently.

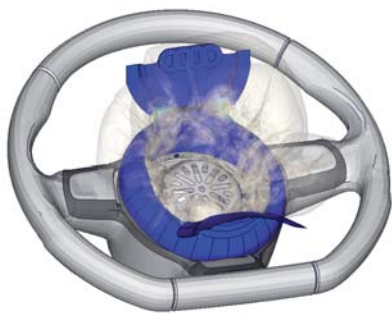
- IGES/VDA-contact
- Rigid tooling
- Thermal contact
- 2-D re-meshing and remapping
- Implicit springback
- Trimming
- Adaptive mesh refinement
- Mesh coarsening
- Look-ahead adaptivity
- Analytic drawbeads
- Complex sliding algorithms
- Anisotropic plasticity (Hill, Barlat)



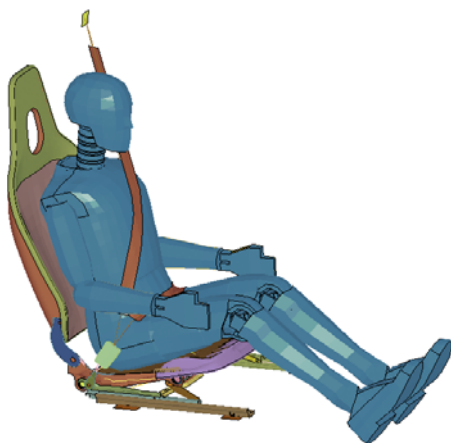
Fiber Reinforced Material Model
By courtesy of BASF SE



Detailed Retractor Model
By courtesy of TAKATA-PETRI AG



Detailed Airbag and Cover Model
By courtesy of Autoliv B.V. & Co. KG



Seat and Dummy Model
By courtesy of
C. Rob. Hammerstein GmbH & Co. KG

Specialized automotive features

LS-DYNA provides many features developed as a result of specific requirements within automotive applications. A selection of features is listed below:

- Seatbelt
- Slip ring
- Pretensioner
- Retractor
- Sensor
- Accelerometer
- Airbag reference geometry
- Inflator models
- Uniform pressure model for airbag simulation
- Corpuscular method for out-of-position simulations
- ALE method for out-of-position simulations
- MADYMO-coupling

Models for automotive applications

Finite element models for almost all standard parts in automotive testing are available as pre-prepared input files. Depending on requirements, different levels of details and different degrees of validation are available. The models are often third party products and usually come with software support from your local distributor. LSTC makes a conscious effort to provide free basic models for frequently-used dummies and barriers. These models are available to all LS-DYNA licensees and a selection of them is listed below:

- Hybrid III dummies
- SID-IIs dummy
- P and Q child dummies
- USSID dummy
- Eurosid dummy
- ES-2 dummy
- ES-2re dummy
- BioRID dummy
- WorldSID dummies
- Head forms
- Pedestrian impactors
- THOR-NT dummy
- Human models
- NHTSA barriers
- NCAP barriers
- IIHS barrier
- ECE barriers
- Euro-NCAP barrier
- Simple vehicle models
- Roadside models

LS-OPT®

LS-OPT is an optimization tool which interfaces perfectly with LS-DYNA, allowing the user to structure the design process, explore the design space and compute optimal designs according to specified constraints and objectives. The program is also highly suitable for solving system identification problems and stochastic analysis.

Optimization

- Response surface technologies
- Genetic algorithm
- Multi-Disciplinary Optimization (MDO)
- Multi-Objective Optimization (MOO)
- Reliability Based Design Optimization (RBDO)
- Mixed discrete/continuous variables
- Shape optimization

DOE Studies – Design Exploration

- Design Of Experiments (DOE)
- Meta-models to explore design space
- Global sensitivity analysis

System Identification

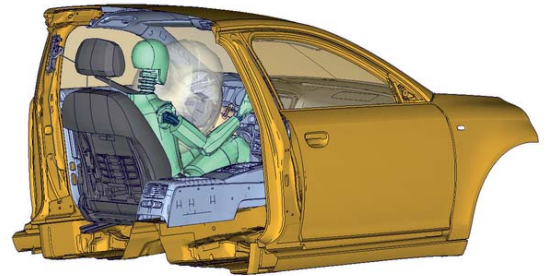
- Identification of system/material parameters
- Visualization of fitting history for curves

Stochastic Analysis

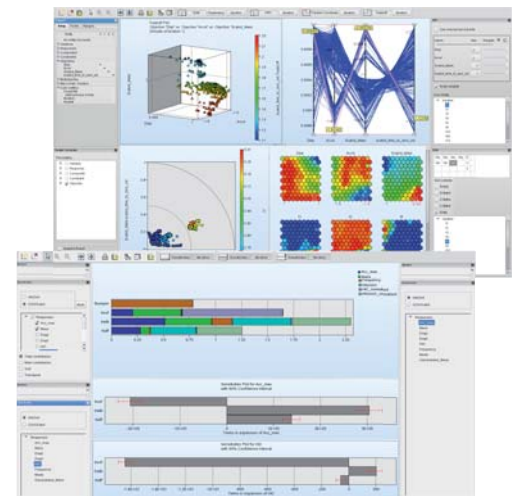
- Monte Carlo investigations
- Estimation of mean, standard deviation, correlation
- Reliability studies (FOSM, FORM)
- Visualization of statistical results on the FE model

Post-processing

- Meta-model visualization (2-D/3-D)
- Sensitivities, correlation matrix
- Scatter/history plots
- Pareto optimal solutions



Optimization of Restraint System
By courtesy of Audi AG



Evaluation of Multi Objectives and
Sensitivity Analysis - Variable Screening

LS-TaSC™

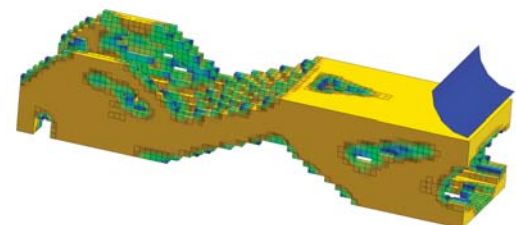
This tool is used to optimize the topology of parts for nonlinear problems involving dynamic loads and contact conditions. It can be implemented to find a concept design for structures analyzed using LS-DYNA.

General capabilities

- Solid design using hexa and tetra elements
- Shell design using quad and triangular elements
- Global constraints

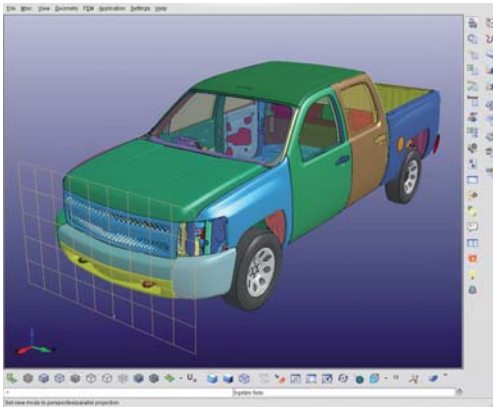
Geometry definitions

- Multiple parts
- Constraints: extrusions, casting, symmetry

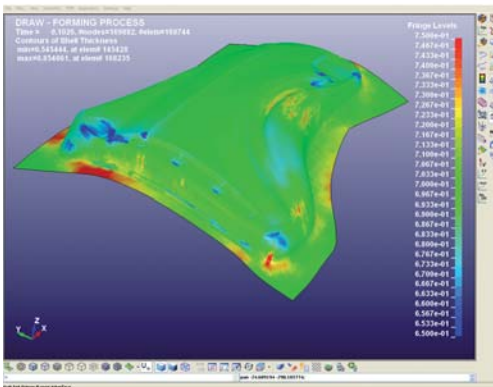


Topology Optimization

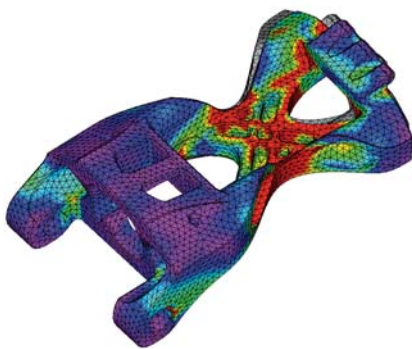
PACKAGES INCLUDED



LS-PrePost During Pre-Processing



LS-PrePost During Post-Processing



Model for Stress Analysis
By courtesy of 4a Engineering GmbH

LS-PREPOST®

LS-PrePost specializes in importing, editing, and exporting LS-DYNA models based on keyword input files. The latest versions feature a redesigned graphic user interface which maximizes the graphics area by intuitively grouping program functions into icon-based toolbars. LS-PrePost supports the latest OpenGL standards to provide fast rendering of fringe plots and animation results. In order to keep pace with enhancements to LS-DYNA, the software is under constant development. Since no license file is required, LS-PrePost can be easily installed onto any machine operated using Windows or Linux.

General Features

- Comprehensive support for LS-DYNA input and output files
- Image output formats: PNG, TIFF, JPG, BMP, PCX, PS, PSIMAGE, GIF, VRML2
- Movie output formats: MPEG, AVI, animated GIF
- Command line interface

Pre-Processing Features

- Other FE input formats
- CAD input formats: IGES, STEP
- CAD geometry data creation and manipulation, including cleaning, healing and simplification
- Mesh generation
- Mesh manipulation, creation and modification
- LS-DYNA entity (keyword) creation: coordinate systems, sets, parts, masses, CNRBs, boxes, spot welds, SPCs, rigid walls, rivets, initial velocity, accelerometers, cross sections

Special Applications

- Airbag folding
- Dummy positioning
- Seatbelt fitting
- Metal forming
- Roller hemming
- Model checking

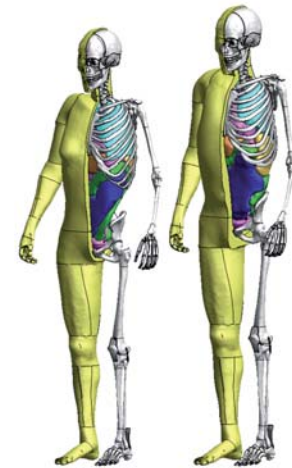
Post-Processing Features

- 3-D animation
- Time history plots
- XY plots
- Contour plots
- Overlay plots
- Vector plots
- Fringe plots
- Particle visualization
- Fluid visualization
- DYNAIN file generation
- Section analysis

Websites

In addition to the information supplied by your distributor and the support hotline, a substantial amount of information is also available on the Internet. Technical papers, FAQs, how-tos, tutorials, models, examples, manuals and detailed descriptions can be found at the URLs below. All sites are accessible without a login.

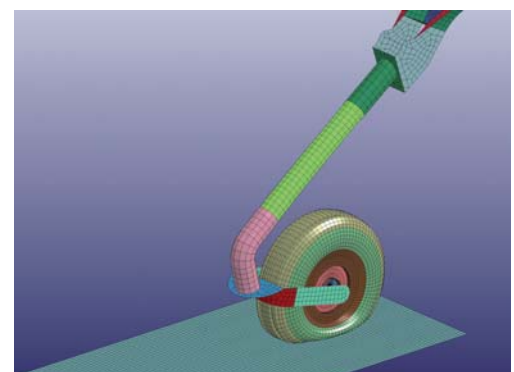
- www.lstc.com
The website of the code developer LSTC.
 - www.feainformation.com
Site with general information and AVI library of different simulations.
 - www.dynasupport.com
The official support site of LS-DYNA. Here you find tutorials, FAQs, release notes of LS-DYNA and manuals available for downloading.
 - www.isoftware.com
The official support site of LS-OPT. Users may find news, how-tos, FAQs, and examples of LS-OPT.
 - www.dynalook.com
This site contains technical papers from international and European LS-DYNA conferences from the last 10 years. More than 950 papers are available.
 - www.dynaexamples.com
Here, users can download class notes and examples of different LS-DYNA training classes.
 - www.topcrunch.org
Benchmark results of LS-DYNA on different hardware platforms are available at this site. The information can be used to access and compare hardware performance.
 - blog.d3view.com
Various comments and details on LS-DYNA features can be accessed at this site.
 - www.ncac.gwu.edu/vml/models.html
This site is maintained by the NCAC. It provides finite element models for various vehicles and road side structures.
 - www.dummymodels.com
Here, LS-DYNA dummy models are presented and details given about their validation level.
- Additionally, users may join a user group such as:
- <http://tech.dir.groups.yahoo.com/group/LS-DYNA/>
 - http://groups.google.com/group/Isopt_user_group



THUMS – Total Human Model for Safety
By courtesy of Toyota Motor Corp.



Impact on Ski Safety Net
By courtesy of DJC DALLOZ



Airplane Landing Gear Application
By courtesy of Korea Aerospace Research Institute



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