DYNA
MORE

All seminars are available in English language on demand

2017

Seminars

Information days

Webinars

Support days

Courtesy of Daimler AG

CONTENTS

Seminar descriptions

Info = Free-of-charge information day

Seminars	Information days	Webinars	Support	On site / Individual
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Basics	Implicit	Multiphysics/ Biomechanics	Particle Methods	Optimization
Theory	CAE/IT	High Energy	Civil Engineering	Pre-/Postprocessing

Dear reader,

It seems almost as if the ever-increasing computing power is literally compensated by the basic engineering need for additional and more complex numerical simulations. This is why, in addition to the „classic" fixed-installed computing capacities, cloud solutions are increasingly used, which provide reasonably cheap, add on computing capabilities. With LS-DYNA, you have a powerful finite element solver at your fingertips, which is able to efficiently realize this growing computing performance, such that you can find the answers to your questions even faster.

To obtain ideas and inspiration for the successful simulation of your applications, we cordially invite you to browse through our comprehensive training program. Once again, we have adapted our seminars and free-of-charge information events to current developments as well as our customer requirements. This year the seminar on modeling fiber-reinforced plastics has been modified and expanded by a seminar on short-fiber and continuous-fiber reinforced polymers. The gap between process and usability simulations will be closed by the ENVYO mapping tool developed by DYNAmore, which will also be a subject of the seminars. If you are only interested in the application possibilities of ENVYO, you can find suggestions and answers in the related information day.

If you do not find what you are looking for on the following pages, we will be happy to tailor your training to meet your individual needs. Following this, it is possible to combine course content to adapt it to your requirements and hold it on either our or your company premises. Furthermore, we provide you with personal support during our support days on every third Friday of the month.

Please note that we offer all seminars in German and English. To keep the organization as flexible as possible, the language selection is adapted to the registered customers at short notice. For this reason, please indicate explicitly if you do not want to hear a seminar in German. Otherwise we will assume that you are flexible with regard to the seminar language.

Up-to-date announcements on planned webinars or information days as well as any modification to dates or course contents can be found on our website www.dynamore.de. Moreover, you can directly register for any of our events online or download the presentation slides of past information days. It is therefore worthwhile to take a look from time to time.

We hope to have aroused your interest with our offer and would be delighted to welcome you at our events.

Kind regards,

Dr.-Ing. Nils Karajan

Your contact partner for any questions

Organization

Course Advisor

Carina Sieber

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Dr.-Ing. Nils Karajan

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CAE PROCESSES/SDM/IT							
Introduction to SDM and Process Management with LoCo						1-2	
Info: Process Automation and SDM							

[1] = Date and delegate fee on request
[2] = Topics and dates on web
[3] = Euro per delegate plus VAT

[Ac] = Aachen (D)
[A] = Attendorn (D)
[B] = Berlin (D)
[D] = Dresden (D)
[I] = Ingolstadt (D)
[G] = Göteborg (S)

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					475	16	LS-DYNA Dummy and Pedestrian Impactor Modeling
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					475	20	Introduction to Sheet Metal Forming with OpenForm
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		13			270	28	User Materials in LS-DYNA
		13			–	29	Info: Composite Analysis with LS-DYNA
		13			–	29	Info: ENVYO
	27				–	30	Info: Simulation of Plastics with LS-DYNA
	27				–	30	Info: Dynamic Material Characterization with 4a-Impetus
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		26-27			1,100	32	NVH, Frequency Domain Analysis and Fatigue with LS-DYNA
	18				–	33	Info: Possibilities with LS-DYNA/Implicit
		25			–	33	Info: Fatigue, Acoustics and NVH Analysis with FEM/BEM
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[L] = Linköping (S)   [T] = Traboch (A)   [V] = Versailles (F)
[Sb] = Salzburg (A)   [Tu] = Turin (I)   [Z] = Zurich (CH)

■ INTRODUCTION TO LS-DYNA

Type:
Seminar
Duration:
3 days
Fee:
1,425 Euro
(475 Euro per day,
can be booked
separately)
Lecturers:
Dr. Filipe Andrade,
Dr. Tobias Graf,
Dr. Nils Karajan,
Dr. Steffen Mattern,
all DYNAmore
Dates:
01-03 February [V)]
14-16 February
14-16 March
14-16 March [Z)]
04-05 April [Tu)]*
25-27 April
29-31 May [V)]
20-22 Juny
11-13 July
12-14 September
12-14 September [T)]
04-06 October [Tu)]
10-12 October
14-16 November
14-16 November [I)]
12-14 December
12-14 December [V)]

[I)] Ingolstadt
[Z)] Zürich, Switzerland
[Tu)] Turin, Italy
[T)] Traboch, Austria
[V)] Versailles, France

* Two-day course
  – only basics

Basics (Days 1 and 2)

The introductory seminar gives a quick, comprehensive introduction to the application of LS-DYNA and is recommended for simulation engineers who want to use LS-DYNA as a finite element code to simulate general nonlinear problems. Prior knowledge is not required.

The main application areas of LS-DYNA are crash simulations, metalforming simulations and the simulation of impact problems and other strongly nonlinear tasks. LS-DYNA can also be used to successfully solve complex nonlinear static problems in cases where implicit solution methods cannot be applied due to convergence problems. The seminar participant works on exercise examples independently to help him/her understand the application of LS-DYNA.

Content
■ What kind of problems can be solved using LS-DYNA?
■ What is the difference between implicit and explicit time integration and how are both methods used in LS-DYNA?
■ How is a simulation started in LS-DYNA?
■ What element types are available?
■ How are the various contact definitions implemented?
■ How are crash simulations and other dynamic calculations executed?
■ How can quasi-static problems be handled?
■ What input/ output data is available and what does it contain?
■ How can results be analyzed and compared?

We strongly recommend LS-DYNA novices to attend this seminar. Additionally we recommend the attendance of the seminar "Introduction to LS-PrePost".

Further Topics (Day 3)

To carry out realistic FE simulations, appropriate constitutive models need to be selected with the requirement of an identification of the involved material parameters to reproduce the properties of the materials used. In this regard, there is often a possibility to simplify the overall model if certain areas can be modeled either as rigid bodies or with the aid of discrete elements. Moreover, several components are often joined with connectors which also need to be modeled appropriately, to accurately predict the behavior of the overall system.

The aim of this seminar is to facilitate the novice's first steps in material modeling. Following this, the most common constitutive models for typical applications are presented, such as crash, drop or impact simulations. A wide range of the material properties of simulation models are explained in detail using simple examples, and thus enabling associated engineering problems to be dealt with competently and quickly. If required, basic material theory can also be discussed. Additionally, the course participants learn how to define rigid bodies and discrete elements in LS-DYNA and what they need to bear in mind when doing so.

Finally, modeling techniques for the most common types of connectors such as spot-welds and bolt connections are shown to demonstrate how they can be represented in a finite element model using LS-DYNA.

Content
■ Presentation of the most common material models for metals, foams, elastomers and polymers
■ Composition of a material card for a steel material on the basis of test data
■ Modeling rigid bodies with LS-DYNA
■ Definition of discrete elements and discussion of corresponding material models
■ Modeling techniques for common connectors such as spot-welds, adhesive joins, bolt connections, etc.
■ Consolidation of learned knowledge using simple exercise examples
■ Tips and guidelines regarding the definition of material cards

To attend the module "Further Topics", we recommend prior attendance at the module "Basics".

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

DYNAMORE

■ INTRODUCTION TO LS-PREPOST

LS-PrePost is the pre- and postprocessor of LSTC which can be used to generate or modify LS-DYNA models as well as to visualize the results of finite element analyses that were carried out with LS-DYNA. In particular, LS-DYNA input decks can be loaded into LS-PrePost to edit the keywords cards using the graphical user interface. Over the past years, the capabilities of LS-PrePost have been constantly advanced to account for the latest developments in LS-DYNA. This holds especially for the pre-processing where many new features have been added.
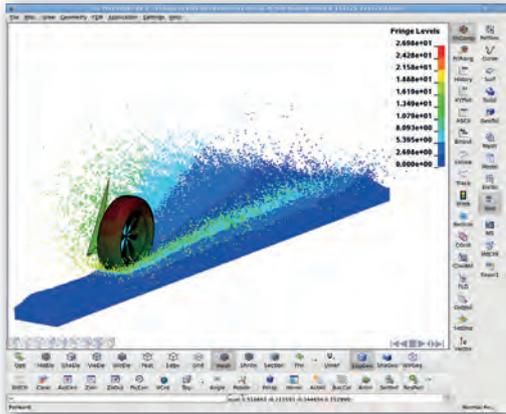
The goal of this one day seminar is to demonstrate the application of LS-PrePost and to explain its practical usage. Attendees will learn how to use the functionality of the graphical user interface with a focus on typical applications.

Content
Preprocessing
- Basic pre-processing operations in LS-PrePost
- Visualizing and editing LS-DYNA input decks
- Working with include structures in the model
- Simple meshing features
- Editing and correction of existing FE meshes
- Checking the quality of the mesh
- Definition of contacts, element types and materials
- Prescribing boundary conditions
- Definition, assignment and visualization of load curves
Postprocessing
- Handling different LS-DYNA output files
- Plot and modification of curves (summation, scaling, filtering)
- Printing and preparing results for presentations
- Color plots of physical quantities on the model (fringe plots)
- Vector plots, cross sections of the model, ...

Type:
  Seminar
Duration:
  1 day
Fee:
  475 Euro
Lecturer:
  Silvia Mandel,
  DYNAmore
Dates:
  13 February
  13 March
  13 March [Z]
  24 April
  19 June
  11 September
  11 September [T]
  09 October
  11 December

[I] Ingolstadt
[Z] Zürich, Switzerland
[T] Traboch, Austria

■ INTRODUCTION TO NONLINEAR IMPLICIT ANALYSES IN LS-DYNA

The implicit solver of LS-DYNA is well suited to handle many challenging applications, thereby coping with large deformations, difficult contact situation and material nonlinearities. With respect to the latter, there are many advanced material models available that are suitable for both explicit and implicit analysis. Moreover, the scalability on many CPU cores is very good, which allows for the treatment of large scale problems.

The goal of this one-day seminar is to present a brief, practical introduction to the implicit capabilities in LS-DYNA with a focus on nonlinear structural analysis. The course is suited for users with some previous experience from using LS-DYNA, or for experienced users of other implicit FE-programs.

Content
- Introduction and when to use the implicit solver
- Differences to explicit time integration
- Switching between implicit and explicit integration
- Material models and elements suitable for implicit analysis
- Loads, boundary conditions and constraints
- Contact definitions
- Further tips and tricks
- Implicit Non-linear static analyses and dynamics
- Troubleshooting convergence problems
- Output format and output files
- Selected workshop examples

We strongly recommend LS-DYNA novices prior attendance of the seminar "Introduction to LS-DYNA". Beginners of numerical simulation we additionally recommend the attendance of the seminar "Introduction to LS-PrePost".
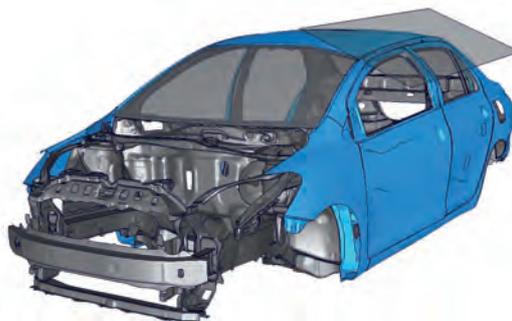
Type:
  Seminar
Duration:
  1 day
Fee:
  475 Euro
Lecturers:
  Dr. Tobias Erhart,
  Dr. Nils Karajan,
  both DYNAmore
Dates:
  17 March [Z]
  06 April [Tu]
  08 May [Sb]
  15 December

[Z] Zürich, Switzerland
[Tu] Turin, Italy
[Sb] Salzburg, Austria

■ INFORMATION DAY: NEW FEATURES IN LS-DYNA AND LS-OPT

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Dates:
  23 May [Tu)]
  22 June [V)]
  19 October [V)]
  10 November [B)]
  01 December [Z)]

[B)] Berlin
[Tu)] Turin, Italy
[Z)] Zürich, Switzerland
[T)] Traboch, Austria

NEW

In the course of this information day, new developments in the multi-purpose computation program LS-DYNA and the associated optimization program LS-OPT will be presented. The purpose of this event is, on the one hand, to inform existing users about new possibilities, and, on the other hand, to provide interested parties who have already gained experience with other software products with a summary of the possibilities offered by LS-DYNA and LS-OPT.

LS-DYNA is one of the world's leading finite element software systems and is ideally suited for computer simulation of highly nonlinear physical problems in industry and research. Typical applications include crash simulation, metal forming, impact and drop tests, detonations, impact, penetration, fluid-structure interaction, as well as thermomechanical and electro-magnetically coupled problems.

In addition to explicit and implicit time integration and classical FEM, many particle methods such as EFG, SPH, SPG and DEM as well as isogeometric methods are also available. Moreover, the „One Code Strategy" allows many features to be easily interlinked, which means that a simulation can often effectively cover the overall process chain.

LS-OPT, on the other hand, is the independent optimization program of LSTC. It is ideally suited for the solution of highly nonlinear optimization problems and is thus ideally suited for application in conjunction with LS-DYNA. However, LS-OPT can be combined with any other software package. Thus, multidisciplinary problems can be solved.
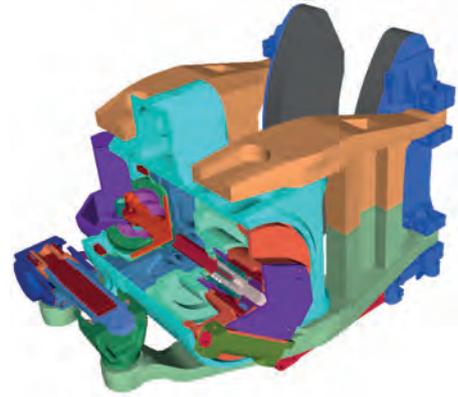
Courtesy of Knorr-Bremse Systeme für Schienenfahrzeuge GmbH
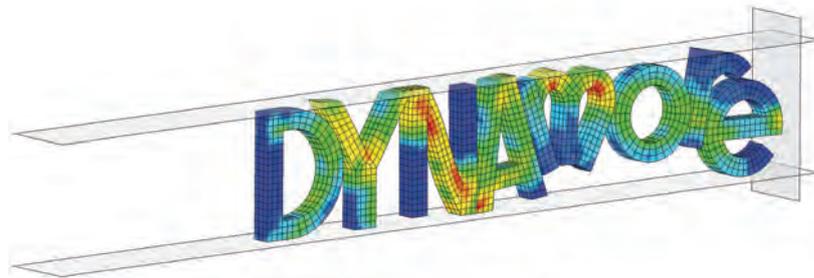
■ INFORMATION DAY: CLOUD SOLUTIONS FOR LS-DYNA

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Dates:
  27 March
  13 October

The idea of cloud technology is getting more and more popular in the IT world. Due to the efficient usage of available hardware resources, the IT investments can be reduced significantly. The efficient use of the soft- and hardware resources leads to a high cost saving potential for the whole IT budget in large as well as in small enterprises.

At the information event the possibilities of using cloud technology are presented. Furthermore requirements related to the usage of LS-DYNA and related products on such platforms will be discussed.

Content
■ Introduction to cloud technology
■ Services related to grid framework?
■ How to use LS-DYNA on a grid system?
■ How to achieve a good performance?
■ Data integrity

DYNA
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■ ELEMENT TYPES AND NONLINEAR ASPECTS IN LS-DYNA

This seminar is a collection of different topics on nonlinear aspects with respect to LS-DYNA. Emphasis is directed towards element technology and the various specific elements implemented in LS-DYNA. In particular, the theoretical background as well as the corresponding practical usage will be discussed. Additionally, adaptive schemes for nonlinear problems are presented. Since more and more implicit features are included in LS-DYNA, the seminar will also provide information on implicit solver technology for linear and nonlinear problems.

This class is intended for participants with pre-existing knowledge in finite element technology and LS-DYNA who would like to learn more about various aspects of nonlinearities and their implementation in LS-DYNA and who are also interested to obtain better insight into the theoretical background.

Content
- Element formulations implemented in LS-DYNA
- Application field and pros/cons of the different element types
- Theoretical background of various element formulations
- General aspects of nonlinear problems in finite element theory
- Solvers for implicit analyses with specific emphasis on LS-DYNA
- Various example problems using LS-DYNA
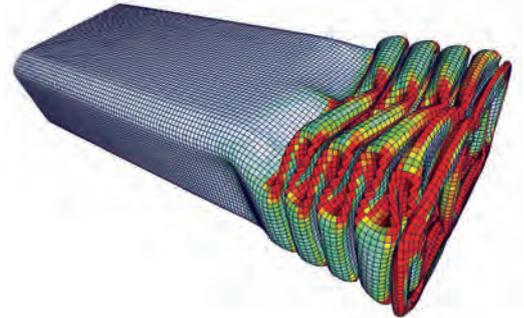
■ USER INTERFACES IN LS-DYNA

Beyond the possibility to implement custom material models in the program code, LS-DYNA provides the option to extend or modify the code in various areas by adding your own program routines. For example, user interfaces are available for element formulations, friction models, equation solvers, load application, and airbag sensors.

For this purpose, the user-developed routines are compiled and linked to the corresponding LS-DYNA object files. This seminar is designed for users in both industrial and academic research who intend to integrate their own routines in LS-DYNA and to share their implementation experience with a larger audience.

Content
- Overview of various user interfaces
- Download and overview of the LS-DYNA usermat package
- Explanation of the Makefile, compilation and Fortran files
- User interfaces: structure, subroutines, keyword input
- Discussion on various options and parameters
- Live demos

DYNAMORE
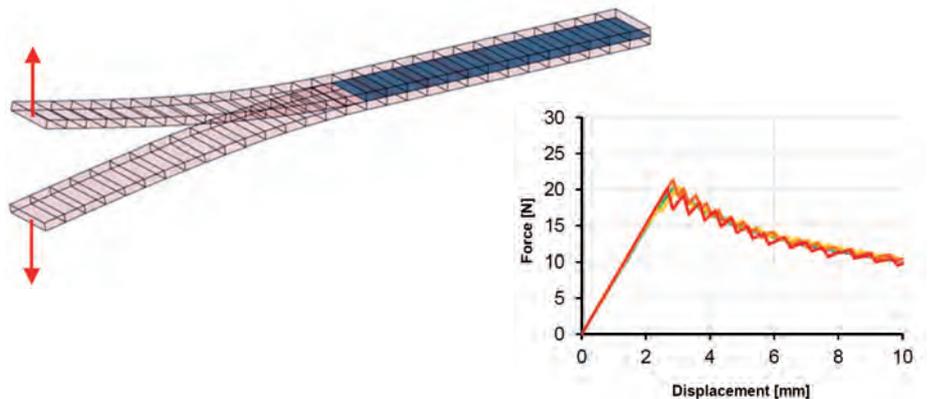
■ INFORMATION DAY: VERIFICATION AND VALIDATION

Increasing demands for improved prediction accuracy in FE calculations and, for example, reliable forecasts about structural and component failures, place much higher requirements on model quality than was generally the case in the past.

Not only approved and tested modeling techniques are of vital importance but also newer and more complex material models as well as assured process steps, such as the consideration of forming simulations in crash analysis. The evaluation of simulation results with regard to their significance and reliability is highly relevant to the quality of predictions.

When used in this context, the terms verification and validation are often synonymous with the additional effort required to achieve better predictive accuracy. Probability tests to estimate uncertainties in simulations are also becoming increasingly important.

The aim of the information day is to bring together different experts from the fields of testing, simulation and teaching to channel their knowledge in an interesting presentation program and to stimulate discussion and the exchange of experiences in this fascinating field.

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Date:
  17 July

Courtesy of F. Burbulla (Dr. Ing. h.c. F. Porsche AG),
A. Matzenmiller (Universität Kassel), LS-DYNA Forum 2013

Courtesy of LWF-Paderborn 2013

■ CRASHWORTHINESS SIMULATION WITH LS-DYNA

POPULAR

This is an advanced course and applies to engineers who have experience in the application of explicit programs or basic knowledge in the field of dynamic and nonlinear calculation with implicit programs. The aim of the course is to show how to perform a crashworthiness simulation in the automobile industry using LS-DYNA, whereby the presented methods are transferable to other kinds of crashworthiness simulations (rail vehicles, components of vehicles, airplanes, vans, etc.). Each crashworthiness simulation is a compromise between profitability and accuracy. At the moment there is no kind of a guideline for modeling and calculating crash. Therefore, the user has to be aware of advantages and disadvantages of different kinds of modeling procedures depending on the purpose of the simulation. In particular, the aim of the course is to show how to perform an accurate and reliable crashworthiness simulation by thorough modeling and further understanding of the procedure.

This course is designated for new employees from automotive development departments of car manufacturers and suppliers of the automobile industry as well as engineering companies and other users in related industrial sectors. The course instructor is an expert in crashworthiness simulation and is working for several car manufacturers using different FE-codes worldwide. He is also an excellent and popular teacher.

Content
- Introduction to crash simulation using LS-DYNA
  - Possibilities and technical limits
  - Accuracy and reliability problems
  - Current and future developments

- Modeling techniques for parts of car bodies
  - Timestep control
  - Mesh outlay, quality and convergence
  - Element quality
  - Flanges, weld spots, etc.
- Influence of the mass of components
- Contact definition for crash simulation
- Selection and description of suitable material models for steel materials
- Introduction to modeling techniques for foams and plastics
- Element formulation for shells and volume elements, hourglass stabilization
- Initialization of models, gravity and pre-tension
- Component models
- Quality control of FE models as well as analysis and evaluation of the results

Courtesy of Daimler AG

■ CONTACT DEFINITIONS IN LS-DYNA

LS-DYNA offers extensive possibilities to model contact. In total there are more than 30 different contact types available and each type supports numerous special settings. While this generous selection guarantees extreme flexibility for the contact definition, it also requires a great deal of knowledge on the user's part.
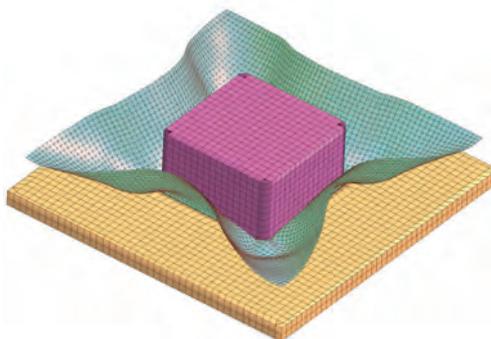
Courtesy of Benteler SGL GmbH & Co. KG

The objective of this seminar is to provide the user with a summary of the possibilities and limits of the various contact formulations. In particular, the discussion focuses on the selection of a suitable contact type for the application in question. Furthermore, the effects of the various contact options on the simulation results are explained with examples.

Prior attendance of the seminar "Introduction to LS-DYNA" is recommended.

Content
- Which contact types exist in LS-DYNA?
- When do I use which contact formulation?
- How do the various contact formulations differ – how can they be classified?
- Penalty vs. Constraint treatment
- Definition of a contact
- What is an "Automatic contact"?
- How does a single-surface contact work?
- What if a contact does not hold?
- Tied contacts
- Most recent contact options and current developments in LS-DYNA

DYNA MORE

■ JOINING TECHNIQUES FOR CRASH ANALYSIS WITH LS-DYNA

In this seminar you will gain insight into the possibilities to model and simulate component connections in LS-DYNA. The most frequently used connections, such as adhesive bonding, bolt fastening, welding, spot-weld adhesive bonding or riveting, each require a specific structural and material model for numerical simulation. For this reason, we will thoroughly discuss the load carrying action of the individual connections as well as their structural stability and demonstrate possible modeling approaches (in conjunction with flange models).

Currently used models will be discussed and the reliability of the obtained results is critically reviewed with particular emphasis on scenarios that include connection failure. Especially for welded and bolted connections, most recent LS-DYNA releases now include a large number of new features and improvements.

For example, the contact treatment of flanges has been expanded to enable a better assessment of the spot-weld forces at solid and beam elements. Further failure options have also been introduced. In addition, a new keyword is available to model bolted connections, which allows for a simplified definition of prestress. The seminar is designed for engineers with practical simulation experience who wish to broaden their knowledge in the field of connection simulations using LS-DYNA.

Content
- ■ Spot-welds/rivets
  - Options to model spot welds
  - Discussion of element types and formulations
  - Tied contacts, flange-flange contact
  - Material modeling of spot-welds
  - Definition of damage and failure
  - Analysis of spot-weld forces
- ■ Prestressed and non-prestressed bolted connections
  - Options to model bolted connections
  - Contact formulations for bolts
  - Analysis of bolt forces
  - KEYWORD: INITIAL_STRESS_SECTION for automated bolt prestressing
- ■ Adhesive bonds
  - Types of adhesive bonds: assembly adhesives, structural adhesives
  - Modeling the adhesive joint
  - Element formulation for continuum elements
  - Special hourglass control
  - Application and use of cohesive elements
  - Connection by tied contacts
  - Established and new material models
- ■ Spot-weld adhesive bonding
- ■ Verification and validation of connection technology models
- ■ Spot-weld adhesive bonding
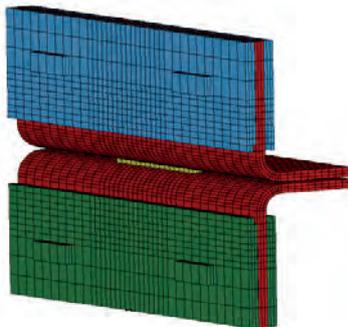
Courtesy of F. Burbulla (Dr. Ing. h.c. F. Porsche AG),
A. Matzenmiller (University Kassel)

Type:
  Seminar
Duration:
  2 days
Fee:
  950 Euro
Lecturers:
  Dr. Markus Feucht,
  Daimler AG;
  Dr. Tobias Graf,
  Dr. André Haufe,
  both DYNAmore
Dates:
  06-07 March
  04-05 April [G)]
  06-07 November
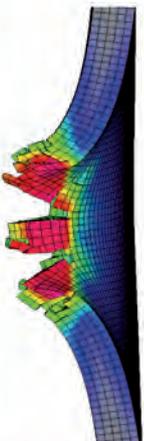 13-14 November [L)]

[L)] Linköping, Sweden
[G)] Göteborg, Sweden

POPULAR

■ FAILURE OF FIBER REINFORCED POLYMER COMPONENTS IN CRASH ANALYSIS

Type:
  Seminar
Duration:
  1 day
Fee:
  475,- Euro
Lecturers:
  e-Xstream staff
  member
Date:
  09 February

Using the software DIGIMAT, anisotropic nonlinear material formulations can be calibrated in dependence upon strain rates and temperature. The micromechanical basis of this concept enables failure indicators to be defined directly at fiber or matrix level of the material, or allows to derive the failure criteria of a material individually from its microstructure with a definition on component level.

Thus, the DIGIMAT material characterization bridges the injection molding simulation, which predicts the position of fibers in a component,

with the simulation of structures with LS-DYNA. By coupling LS-DYNA with DIGIMAT, much more accurate results are obtained when predicting the failure of injection-molded polymer components.

The seminar discusses in detail the coupling of LS-DYNA with DIGIMAT for crash simulations involving glass fiber reinforced polymer components. The user receives an overview of the strategy of the concept.

At the beginning of the course, the required experimental data, the basics of material models as well as their calibration are discussed and failure indicators are defined. Explanations are then given about how to map fiber orientations and link the models to LS-DYNA. To consolidate the learned lessons, the content of the seminar is directly applied to practical examples.

In collaboration with

Courtesy of Volvo Cars

■ INFORMATION DAY: SIMULATION OF DROP TESTS WITH LS-DYNA

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Date:
  26 June

Many of the product checks include the testing of impact loading. Typically, the resistance of consumer goods is examined due to an impact after a free fall out of heights that represent their respective usage. Examples for such consumer goods are laptops, cell phones, drilling machines or beverage cartons or cans. Furthermore, the package industry shows large interest to assure a good impact reliability during transport.

During this information day, the computational possibilities of LS-DYNA will be demonstrated in the context of impact and falling test simulations and application examples will be provided. Special attention will be drawn on the modeling possibilities of LS-DYNA with regard to plastics and foam materials. The approaches for the identification of the associated material parameters will be also be illustrated.

Content
- Introduction
- Physics for the propagation of stress waves during the drop test
- Characteristics of plastics materials at sudden impact
- Recommendations for the contact formulation for drop tests
- Liquid filled containers
  - Modeling of the liquid, the structure as well as the boundary conditions
  - Methods for fluid-structure coupling in LS-DYNA (ALE, ICFD, SPH, Lagrange elements)
  - Interpretation of the results
- Possible applications and limitation for the simulation of drop tests
- Validation with experimental results
- Examples
  - Analysis of drop tests of an electronic machine with and without packing
  - Impact of a liquid filled package
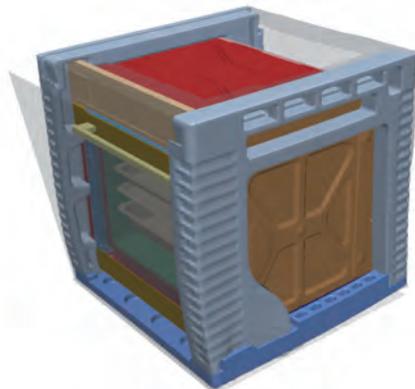
Courtesy of Electrolux Rothenburg GmbH

■ INTRODUCTION TO PASSIVE SAFETY SIMULATION WITH LS-DYNA

Particularly due to the growing amount of relevant legislation and consumer tests as well as new technological developments, the field of occupant safety in vehicle technology has become more important and also gained in complexity. The goal of this seminar is to present the most important features of LS-DYNA with respect to occupant safety simulations. Moreover, insights are provided on how to deal with the various components involved, such as airbags, seatbelts, crash-test dummies and seats. During this training, particular emphasis will be laid on modeling methods for practical application.

The seminar will provide the basic knowledge needed to setup an LS-DYNA occupant safety simulation, including the positioning of the dummy model and belt routing with PRIMER, the definition of recommended contacts between the safety systems and the principle set up of airbag models.

This seminar is mainly designed for beginners working in the field
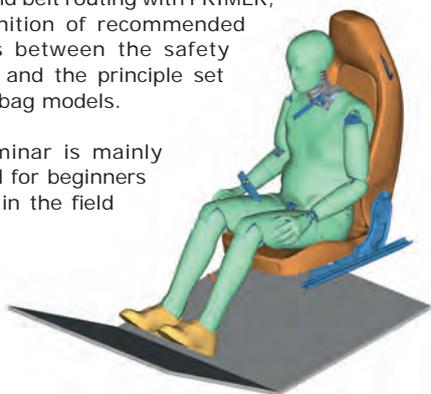
of occupant safety (especially dealing with side, frontal and rear impact). During the event, attendees will be given the opportunity to apply their acquired knowledge in practical exercises.

Content
- Overview of current impact load cases: side, frontal, rear crash
- Available dummy models in LS-DYNA and their validation methods
- Materials, elements and connections used for occupant safety simulations
- Overview of composition and usage of safety relevant vehicle components
- Focus on airbag models
  - Available model approaches in LS-DYNA
  - Airbag fabric material modelling
  - Dealing with existing airbag models
- Usage of dummies
  - Positioning inside the vehicle
  - Pre stresses in seat models
  - Extraction of dummy model signals
  - Overview injury criteria
- Usage of seat belts
  - Modeling seat belts, belt guides and pretensioner
  - Belt routing approaches
- Joining technics and contact definitions
- Composition of an occupant safety model

Type:
  Seminar
Duration:
  2 days
Fee:
  950 Euro
Lecturers:
  Sebastian
  Stahlschmidt,
  Alexander Gromer,
  both DYNAmore
Dates:
  09-10 March
  28-29 September

accelerating
crash & safety
simulation

β BETA
www.beta-cae.com

■ CPM FOR AIRBAG MODELING

Type:
　Seminar
Duration:
　1 day
Fee:
　475 Euro
Lecturers:
　Steffen Mattern,
　Sebastian
　Stahlschmidt,
　beide DYNAmore
Dates:
　17 March
　13 October

Airbags are one of the most important components for occupant safety in motor vehicles. Besides standard airbags for driver and passenger, more and more different and specified variants such as curtain airbags or knee airbags have been applied recently. Every airbag has to be optimized especially for its particular application. Precise representation of the airbag's behavior regarding deployment and performance are necessary in order to achieve a high quality model for the occupant restraint system.

The one day course presents the fundamentals to build up a model for the simulation of airbags in LS-DYNA. Starting with the less complex uniform pressure (UP) approach, theoretical background and implementation of the newer corpuscular method (CPM) is introduced. The method is based on a particle approach and has become state-of-the-art for all airbag applications due to its accuracy and numerical robustness and efficiency. In nowadays occupant simulations with LS-DYNA, every airbag is modelled using CPM.

Besides the description of *AIRBAG_PARTICLE as well as the related keywords regarding definition of the control volume, number of particles, definition of vents, gas properties, etc. further modeling aspects affecting the airbag's behavior are discussed.
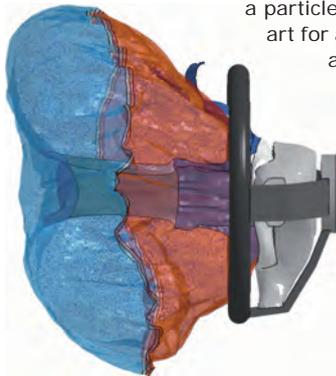
Courtesy of Daimler AG

State-of-the-art techniques as well as most recent implementations in LS-DYNA with their influence on the deployment behavior are presented.

Content
- Introduction to airbag modeling
  - Basics and modeling approaches
- The uniform pressure (UP) method
  - Theoretical background
  - Keywords related to different UP-models
  - Wang-Nefske approach and hybrid gas generators
  - Jetting definition for UP airbag models
  - Merits and limits of UP modeling
- Corpuscular Method (CPM)
  - Theoretical background
  - Keywords and application of CPM
  - Influence of different parameters on the behavior of the airbag
  - Merits and limits of CPM modeling
- Definition and influence of a reference geometry
- Material definition using *MAT_FABRIC (non-linearities, anisotropy, porosity and validation)
- Contact definition and folding simulation
- Model set-up
  - Modeling advices for CPM airbag models
  - Tank tests and airbag validation
  - Process chain for airbag modeling
  - Post processing of results
- Examples

■ LS-DYNA DUMMY AND PEDESTRIAN IMPACTOR MODELING

Type:
　Seminar
Duration:
　1 day
Fee:
　475 Euro
Lecturers:
　Sebastian
　Stahlschmidt,
　Alexander Gromer,
　both DYNAmore
Date:
　22 February

The aim of the seminar is to give participants an overview of how LS-DYNA crash test dummy models and pedestrian impactors can be implemented successfully in passive safety.

The course is recommended for engineers interested in analyzing side, front or rear impacts or pedestrian safety. Other related problems, such as the behavior of seats under a dynamic loading of the dummies, are also discussed. To measure the loads affecting a pedestrian from a collision, a range of impactors has been developed which can be shot/projected at the front of the vehicle in various test configurations. Moreover, an overview of the available impactors is also given.

All instructors have years of experience working on the development of FAT side impact dummy models, which are used throughout the world, and recently also on the FAT rear impact dummy model BioRID 2. These models have been developed in collaboration with the German automotive industry.

Content
- Dummy models available for LS-DYNA
- Differences between front impact dummy models from FTSS and LSTC
- When should which model be used?
- FAT side impact dummy models
- FAT rear impact dummy model BioRID 2
- Limits of modeling dummies
- Positioning dummies in vehicles
- Modeling seat belts, belt deflectors and belt pre-tensioners
- Putting the seat belt on the dummy
- Characterization of the impactor model: head, hip and leg impactors (construction and materials used)
- Comparison of impactor models from different software manufacturers
- How to avoid problems when modeling soft foams
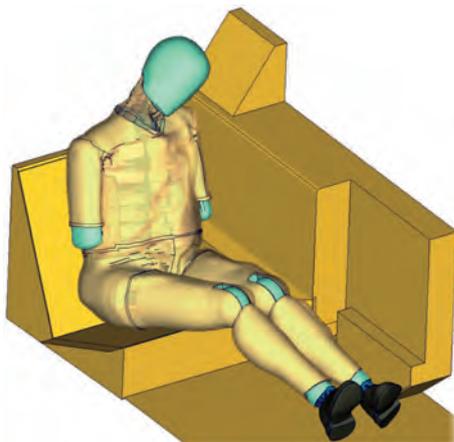
■ INFORMATION DAY:
DUMMY MODELS – OVERVIEW AND NEW DEVELOPMENTS

This information day gives a summary and future outlook on occupant simulation using LS-DYNA dummy models from Humanetics Innovative Solutions and DYNAmore. Front, side and rear crash dummy models are discussed.

Humanetics Innovative Solutions is the world's largest manufacturer of crash test dummies and also develops finite element models. The speakers from DYNAmore were involved in the development of the side impact dummy models and also the
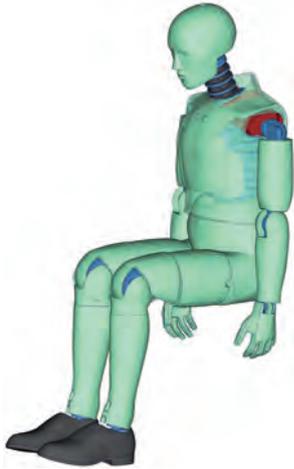
rear impact dummy model BioRID 2 from the Association for Research in Automotive Technology (FAT).

As well as giving an overview of existing models, a review of the latest developments in legislation and consumer protection organizations will also be presented. The focus will be on demands regarding the future development of models for simulations.

Content
- Which dummy models are available for LS-DYNA?
- Presentation of the models
  - Child models
  - Adult models for front and rear crash
  - WSID 50% model for side crash
  - AT models for side crash
- Free dummy models
- Where are the limits in dummy modeling?
- Future dummies
- On request, the FMVSS214 head model is also discussed

Type:
 Information day
Duration:
 1/2 day
Fee:
 Free of charge
Lecturers:
 Robert Kant,
 Humanetics Innova-
 tive Solutions;
 Uli Franz, Sebastian
 Stahlschmidt, both
 DYNAmore
Date:
 21 February

■ INFORMATION DAY:
HUMAN MODELS – OVERVIEW AND EXTENSION POSSIBILITIES

The aim of the information day is to give an overview of the possibilities to simulate a human body using LS-DYNA. Herein, the "Total Human Model for Safety" (THUMS) and its validation basis will be presented and explained with the aid of various applications.

The human model THUMS was developed by Toyota Central R&D Labs. Inc, Toyota System Research Inc., and Toyota Motor Company in collaboration with universities and is commercially

available via DYNAmore. The major objective of THUMS is the simulation of driver and pedestrian injuries. However, due to the accurately detailed geometric resolution of various organs, it can also be used in other applications, such as man-machine interaction.

In addition, brief discussions about other, more detailed models currently used in science are also planned. These will be especially concerned with the active control of the human model via internal muscle forces, which can be applied not only one-dimensionally in the modified Hill muscle but also three-dimensionally in the modeled muscle itself.

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

Type:
 Information day
Duration:
 1/2 day
Fee:
 Free of charge
Date:
 01 June

Courtesy of Daimler AG

■ METAL FORMING WITH LS-DYNA

Type:
 Seminar
Duration:
 3 days
Fee:
 1,425 Euro
 (475 Euro per day,
 can be booked
 separately)
Lecturers:
 Markus Künzel,
 Dr. Bernd
 Hochholdinger,
 Dr. André Haufe,
 Matthias Merten,
 Pierre Clay,
 all DYNAmore
Dates:
 29-31 May
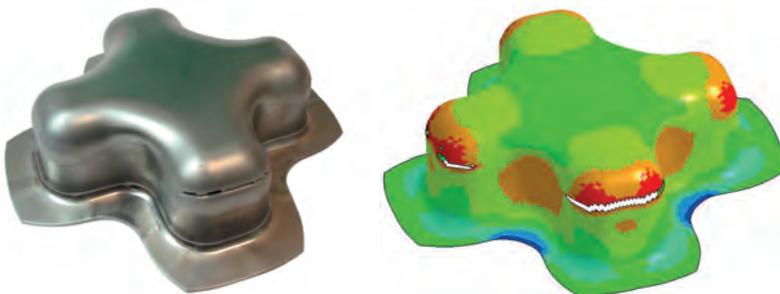 08-10 November

POPULAR

Basics (Days 1 and 2)

This seminar covers the basics for the simulation of sheet metal forming processes with LS-DYNA and provides tips for daily practical use. Herein, the forming-specific settings and features in LS-DYNA will be addressed.

The course begins with a brief introduction to LS-DYNA and a detailed description of the necessary keywords, respective settings and best practice for forming simulations. In particular, the typical forming process steps will be reviewed and the respective simulation setup will be presented in detail. Furthermore, an overview of commonly used material models for forming simulations will be given and the procedure for the creation of two material cards with anisotropic material behavior will be discussed for shell and solid elements. Another focus lies on the critical examination and verification of the simulation results as well as the available possibilities to overcome potential problems with alternative approaches and methods. Short workshop examples are repeatedly conducted during the seminar to consolidate the acquired knowledge through practical application directly at the computer. Herein, LS-PrePost will be used to setup the forming simulations.

The goal of the seminar is to enable the user to select the correct settings and parameters for successful simulations of sheet metal forming processes with LS-DYNA. The seminar aims at both beginners and experienced users in the field of metal forming, who want to learn how to use LS-DYNA in the context of sheet metal forming or who want to deepen their existing knowledge.

Content
- Introduction to LS-DYNA
- Forming-specific settings and features
  - Basic control cards
  - Special control cards
- Adaptive Mesh Refinement:
  - Minimization of discretization errors
  - Proper selection of the parameters
- Contact definitions for forming simulation
- Element types and their properties
- Overview of frequently used material models for sheet metal forming
- Description of material models MAT_036 and MAT_103
- Output Control in LS-DYNA

- Procedure for the simulation of multi-stage forming processes
- Basic control cards for LS-DYNA/Implicit
- Gravity simulation (implicit static or dynamic)
- Forming simulation
- Trimming simulation
- Springback simulation (implicit static)
- Simulation of post forming operations
- Analytical drawbeads

Courtesy of Ford Forschungszentrum Aachen GmbH

Advanced Forming Simulation (Day 3)

On the third day, typical procedures for the setup of complex forming simulations are discussed and the creation of the respective input decks is shown with the functionality of LS-PrePost. Moreover, further contact settings are shown which enable the definition of a direction-dependent coefficient of friction as a function of contact pressure, relative velocity and temperature.

The training concludes with recommendations for the simulation setup of the individual process steps with a focus on common mistakes in creating the respective stages and the corresponding troubleshooting procedures.

Content
- Possible procedure for the simulation setup
- Parameterization of input decks and automatic positioning
- Advanced control card settings
- Advanced contact settings
- Recommendations for the individual process stages
- Advanced troubleshooting procedures
- Workshop to create parameterized input decks

Courtesy of LKR - Leichtmetallkompetenzzentrum Ranshofen GmbH / AMAG Rolling GmbH

DYNA
MORE

■ APPLIED FORMING SIMULATION WITH ETA/DYNAFORM

This seminar provides an introduction to the simulation of sheet-metal and hydroforming processes with eta/DYNAFORM and LS-DYNA. All steps required to set up a LS-DYNA forming simulation are covered. The eta/DYNAFORM program is a special preprocessor for simulation of forming processes with LS-DYNA. Moreover, the program LS-PrePost is presented for postprocessing purposes.

The seminar is practice-oriented, with an emphasis on industrial applications. This seminar is suitable for users from the area of metal forming who wish to learn how to use eta/DYNAFORM and LS-DYNA to simulate sheet-metal forming processes or who wish to deepen existing knowledge.

Content
- Introduction to the simulation of sheet metal forming processes
- Introduction to the software eta/DYNAFORM
- Preprocessing with eta/DYNAFORM
  - Meshing of the tool geometry and the blank
  - Definition of the blank: Selection of the material model, choosing an element type, setting symmetry boundary conditions
  - Definition of the tools: Selection of the contact formulation, defining friction
  - Positioning of the tools
  - Applying force- and displacement-boundary conditions on the tools
  - Definition of draw beads
  - Definition of adaptive meshing
  - Determination of the sheared blanks
  - Trimming of the sheet with eta/DYNAFORM
- Starting simulations and job control of the LS-DYNA runs
- Multi-stage process definition: Gravity loading analysis, binder closing, drawing simulation
- Forming limit diagram
- Postprocessing with LS-PrePost (thickness distributions, plastic strains, ...)
- Application examples

Type:
  Seminar
Duration:
  2 days
Fee:
  950 Euro
Lecturers:
  Peter Vogel,
  Markus Künzel,
  both DYNAmore
Dates:
  26-27 January
  03-04 July
  06-07 November

Courtesy of Volkswagen AG

■ HOT FORMING WITH LS-DYNA

In this seminar, participants are taught the basics of thermal and thermomechanically coupled simulations using LS-DYNA. In addition, the definition and basic forms of heat transfer will be reviewed.

Due to its increasing relevance, special attention will be drawn on the application of thermal and coupled simulations of hot and cold forming processes. Among other things, the available material models will be described covering plasticity, viscoplasticity, anisotropy, and structural transformation of steel. Besides the modeling methods of the main physical effects, a focus is placed on illustrating efficient modeling techniques that are adapted to the calculation task at hand.

Content
- Basics of thermal computations
- Linear and nonlinear simulations
- Heat transfer during contact
- Thermomechanical coupling in LS-DYNA
- Material models for coupled calculations
- Temperature-dependent elasticity, viscoplasticity and anisotropy
- Thermomechanically coupled forming simulation
- Incorporate microstructural transformations during hot forming
- Calculation of the cooling or warming of hot forming tools
- Special applications in process simulation
  - Localized heat treatment of aluminum components
  - Heating by welding,
  - Induction heating, etc.

Type:
  Seminar
Duration:
  2 days
Fee:
  950 Euro
Lecturers:
  Dr. Bernd
  Hochholdinger,
  Markus Künzel,
  Dr. Thomas Klöppel,
  all DYNAmore
Dates:
  24-25 January
  06-07 July
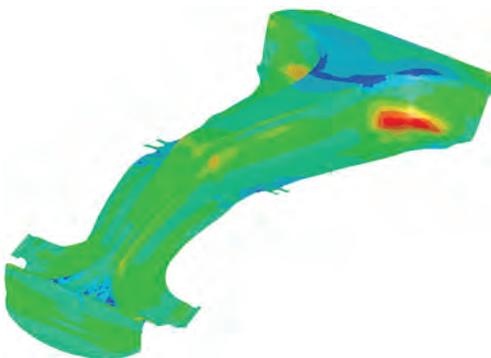
Courtesy of ThyssenKrupp Steel Europe AG

■ INTRODUCTION TO WELDING SIMULATION WITH LS-DYNA

Type:
  Seminar
Duration:
  1 day
Fee:
  475 Euro
Lecturers:
  Dr. Tobias Loose,
  DynaWeld GmbH &
  Co. KG;
  Dr. Thomas Klöppel,
  DYNAmore
Dates:
  23 June
  17 November

Due to recent developments in LS-DYNA, the complete welding process can be captured. In this regard, the numerical simulation can be performed in several stages where, for instance, the cooling process as well as the associated warping of the structural components can be computed after each welding stage. Moreover, the choice of a suitable material law also allows considering microstructural transformations in the welding zone itself or in the heat-affected zone. The resulting residual stress states and any remaining plastic strains can then be taken into account both in the next welding stage as well as in a subsequent usability simulation. With these features at hand, it is possible to virtually represent the entire process chain.

The aim of this seminar is to give the participants a brief introduction to the thermomechanical coupled simulation with LS-DYNA. Herein, the required forms of heat sources and heat transfer for a successful welding simulation will be discussed and their definition in LS-DYNA is shown.
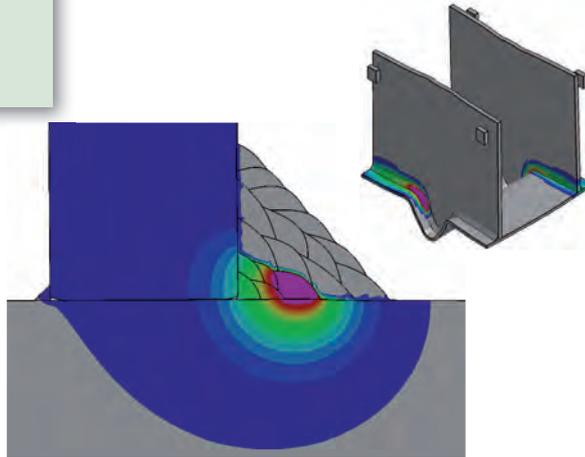
Content
- Introduction
- Material models for welding simulations (*MAT_270)
- Heat source computation with SimWeld
- Interface between SimWeld and LS-DYNA
- Modeling heat sources in LS-DYNA
- Implicit solver settings for welding simulations
- Time step size control
- Mechanical und thermal contact
- Structured organization of an input deck for several welding stages
- Post-processing

Courtesy of Ingenieurbüro Loose

In collaboration with

■ INTRODUCTION TO SHEET METAL FORMING WITH OPENFORM

Type:
  Seminar
Duration:
  1 day
Fee:
  475 Euro
Lecturer:
 GNS GmbH staff
  member
Date:
  05 July

OpenForm is a solver-independent graphical user interface (GUI) designed to aid the generation of input decks for numerical forming simulations as well as to evaluate the numerical results in an intuitive and simple fashion.

Based on an internal standardized metalanguage, the so-called "OpenForm Process Language" OFPL, the mechanical process to be simulated is described consistently regardless of the required solver-specific numerical parameters. Thus, the forming process described in OpenForm can be used simultaneously with different solvers.

The structure of the forming process is captured hierarchically using graphical templates and then translated and exported in the corresponding solver nomenclature using internal converters of OpenForm. The basic components of these process templates are formed by "items", which are in turn assembled in process "steps" to ultimately become "operations". For LS-DYNA, there already exist many such templates in OpenForm to deal with cold and hot forming of traditional form blanks as well as tailor rolled (TRB), welded (TWB) or sandwich blanks.

Content
- Concept of OpenForm
  - Preprocessing
  - Generation of a forming process
  - Description of the physical process
  - Creation/Modification of geometric entities
  - Selection of numerical parameters
- Postprocessing
  - Evaluation of the forming results
  - General visualization
  - Special evaluation
  - Comparison with measured data and other results
- Customization of the GUI in OpenForm
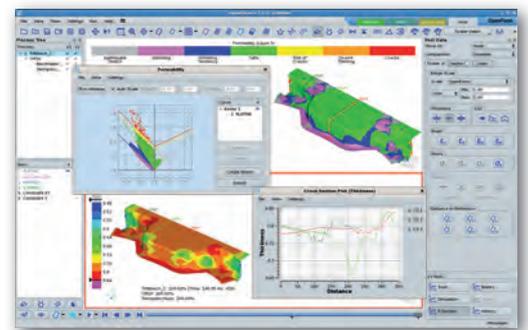
OpenForm is a commercial product of GNS.

In collaboration with **gns**

INFORMATION DAY: WELDING AND HEAT TREATMENT WITH LS-DYNA

Due to the increasing importance of simulations with welding processes and other heat treatments, numerous extensions have been implemented in LS-DYNA. It is now possible to calculate the complete process chain in several stages.

New material models *MAT_CWM and *MAT_GENERAL_PHASE_CHANGE are provided for welding and heat treatment in LS-DYNA which enable both an efficient warpage prediction and a detailed residual stress and structure calculation. LS-DYNA furthermore offers special heat source functions for shells and solids with energy input control and special welding contacts such that all welding processes can be captured.

The preprocessor DynaWeld is used to create complex material cards for LS-DYNA. Herein, the import of data from WeldWare, JMatPro or Sysweld is possible as well as a user-defined input.

This information day aims at simulation engineers who want to obtain an overview of the available tools in LS-DYNA, DynaWeld and SimWeld that can used for model building as well as simulation of welding and heat treatment processes.

Content
- Welding simulation and its inclusion in process simulations
- Simulation of special welding methods
  - Spot welding
  - Stud welding
  - Friction welding
  - Friction stir welding
  - Induction straightening
- Heat source computation for MSG welding (interface between SimWeld and LS-DYNA)
- Heat treatment and press hardening
- Further developments in LS-DYNA

In collaboration with dynaweld
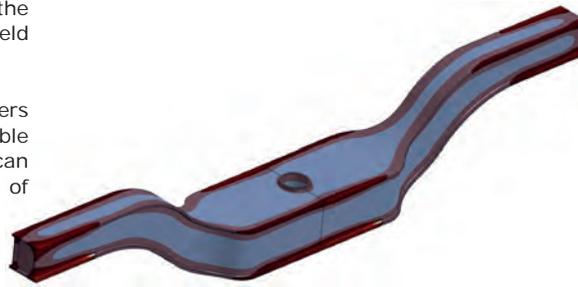
Courtesy of Ingenieurbüro Loose

POPULAR

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Dates:
  03 April
  22 May [Z]
  17 October [Ac]

[Ac] Aachen
[Z] Zürich, Switzerland

INFORMATION DAY: FORMING TRENDS IN LS-DYNA AND ETA/DYNAFORM

The software eta/DYNAFORM is an effective pre- and postprocessor that has been especially designed for forming simulations. Together with the solver LS-DYNA, it forms a complete package, which fully covers all forming simulation requirements.

Applications, such as determining preliminary sheet metal blanks, generating tool geometries and compensating for springback are covered by the main functions of the software package. Further functions allow defining a complete multistep forming processes based on blank positioning under the influence of gravity right up to simulating springback. Typical output of the simulation include sheet metal thickness distributions, forming forces, the amount and direction of springback or compensated tool geometries as well as the prediction of tear and fold formation.

The event addresses interested tool designers and method developers in the field of metal forming who wish to be kept up to date about the latest trends and developments in LS-DYNA and eta/DYNAFORM.

This information day presents the latest topics concerned with forming simulation using LS-DYNA and eta/DYNAFORM. Herein, new requirements, new developments and the current possibilities and limits of various concepts will be discussed.

For more information and event schedules sign up for our information mail or visit us on our website www.dynamore.de.

Content
- Integration of forming simulations into the development process
- Process characterization
- Add-ons and pre-simulation
- Trimming and cutting
- Analyzing calculations
- Calculating springback

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Dates:
  24 April
  30 October [A]

[A] Attendorn

Courtesy of BMW Group

■ MATERIAL MODELING FOR METALS

The aim of this class is to give practical guidelines about the application of the most commonly used material formulations. The focus will be especially on the underlying basic theory as well as on the assumptions made for the corresponding material formulations. Moreover, besides the practical information about particular input formats and the relevance of special settings, the algorithmic background of the various models will also be highlighted. Finally, diverse applications for the most commonly used metallic material models in LS-DYNA will be illustrated with the help of simple examples.

Content
- Review of rheological models
- Stress and strain measures
- Concepts of computational plasticity

- Presentation of the von Mises model
- Selection of LS-DYNA material models based on von Mises plasticity
- Description of *MAT_024
- Calibration of isotropic hardening curves
- Discussion on some metallic alloys
- Plasticity with isotropic damage (*MAT_081)
- A material model for transformation induced plasticity alloys (*MAT_113)
- Presentation of a Gurson-based material model in LS-DYNA (*MAT_120)
- A material model with tension-compression asymmetry (*MAT_124)
- A Generalized Yield Surface model for tension/compression/shear asymmetry (*MAT_224_GYS)
- Review of anisotropic concepts (e.g. R-Values)
- Barlat 1989 model in LS-DYNA (*MAT_036)
- Retrieving Tresca's yield criterion in LS-DYNA
- A Hill-based model for transverse anisotropy (*MAT_037)
- The _NLP_FAILURE option
- Barlat 2000 anisotropic model (*MAT_133)
- Aretz 2004 anisotropic model (*MAT_135)
- Short review of kinematic hardening
- A simple plasticity model with mixed hardening (*MAT_003)
- Extension of *MAT_024 to account for mixed hardening (*MAT_225)
- Overview of the mapping capabilities in LS-DYNA
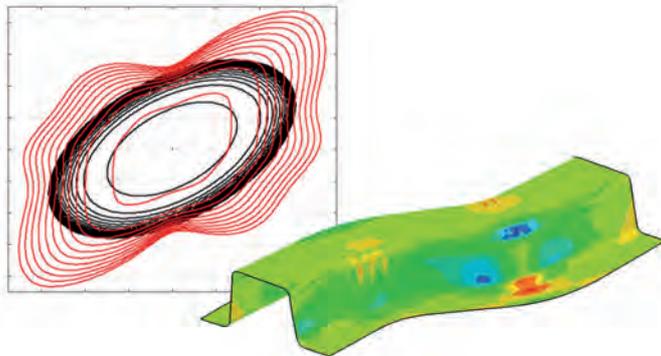
Prior attendance at the class "Introduction to LS-DYNA" is strongly recommended.

■ DAMAGE AND FAILURE MODELING

This two-day seminar will discuss and clarify issues related to the complex adjustment of material models considering damage and failure. Starting with the design process of the experimental layout, the seminar will embrace everything to the point of actually creating material cards using LS-DYNA, thereby reflecting the entire verification and validation process.

Herein, a detailed explanation of the conversion of experimental data into true Cauchy stresses and logarithmic strains will be given. Moreover, the dependency of deformations on anisotropy and triaxiality will be discussed under inclusion of the complex descriptions of failure. Of particular interest will be the influence of the model reduction with shell elements and their influence on failure models of, e.g., Wierzbicki, on the basis of Gurson, Johnson-Cook and extended Barlat models.

The influence of the element size dependency on the failure behavior will be presented in the context of strain and energy equivalence. The issues of material stability and softening will be discussed in detail using the Gurson material model. Exercise examples illustrate the theoretical findings.
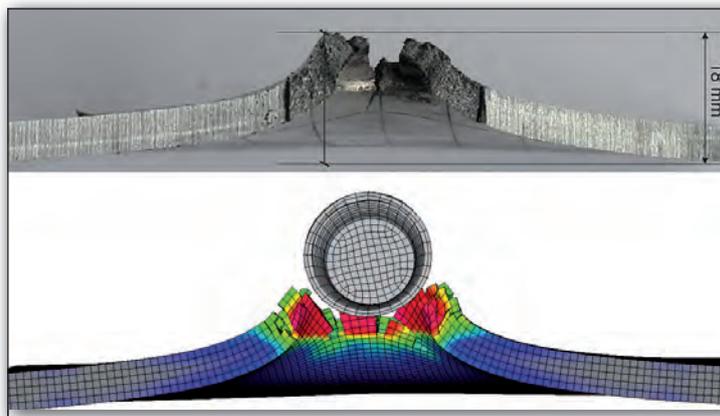
POPULAR

Courtesy of FVV (Forschungsvereinigung Verbrennungskraftmaschinen e.V.) and Inprosim GmbH

DYNA
MORE

■ PARAMETER IDENTIFICATION WITH LS-OPT

Type:
  Seminar
Duration:
  1 day
Fee:
  475 Euro
Lecturer:
  Katharina Witowski,
  DYNAmore
Dates:
  08 May [Sb]
  18 May [G]
 05 October [L]
  22 November

[L] Linköping, Sweden
[G] Göteborg, Sweden
[Sb] Salzburg, Austria

The use of new materials, such as plastics, composites, foams, fabrics or high-tensile steels, demands the application of highly complex material models. These material formulations are generally associated with numerous material parameters. The optimization program LS-OPT is ideally suited for identifying these parameters. In the identification process, an automatic comparison is carried out between the experimental results and the simulation results of LS-DYNA. Thereafter, the error between experiments and simulations is minimized.

In this seminar, a brief introduction in LS-OPT is given with a focus on the application of LS-OPT to determine material parameters. No prior knowledge about optimization or the application of LS-OPT is required.

Content
■ The optimization problem for the parameter identification
  - Objective function: minimization of deviations between simulations and experiments (least-squares principle)
  - Constraints
  - Optimization variables
  - Normalization and weighting
■ Brief introduction to LS-OPT
■ Graphical User Interface (GUI)
■ Simultaneous adaptation of several experiments (e.g. tensile, shear and biaxial tests)
■ Starting LS-DYNA simulations and job control in LS-OPT
■ Analysis and evaluation of optimization results
■ Execution of examples
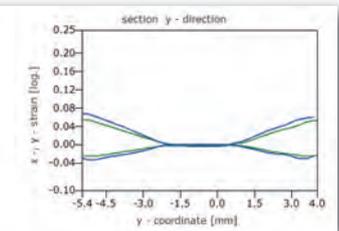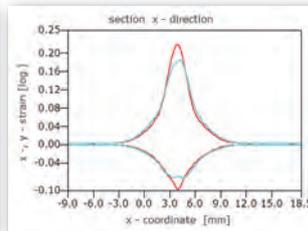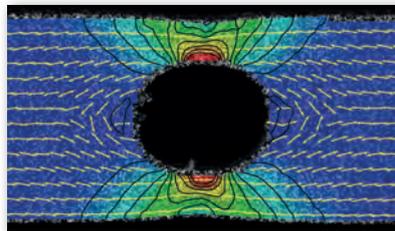
Parameter identification

for material models: Metals – Polymers – Composites

DYNA MORE

■ Isotropic, anisotropic and strain rate dependent materials
■ Failure characterization and GISSMO calibration
■ Digital Image Correlation of the strain field
■ Tension, compression and bending tests (quasi-static/dynamic)
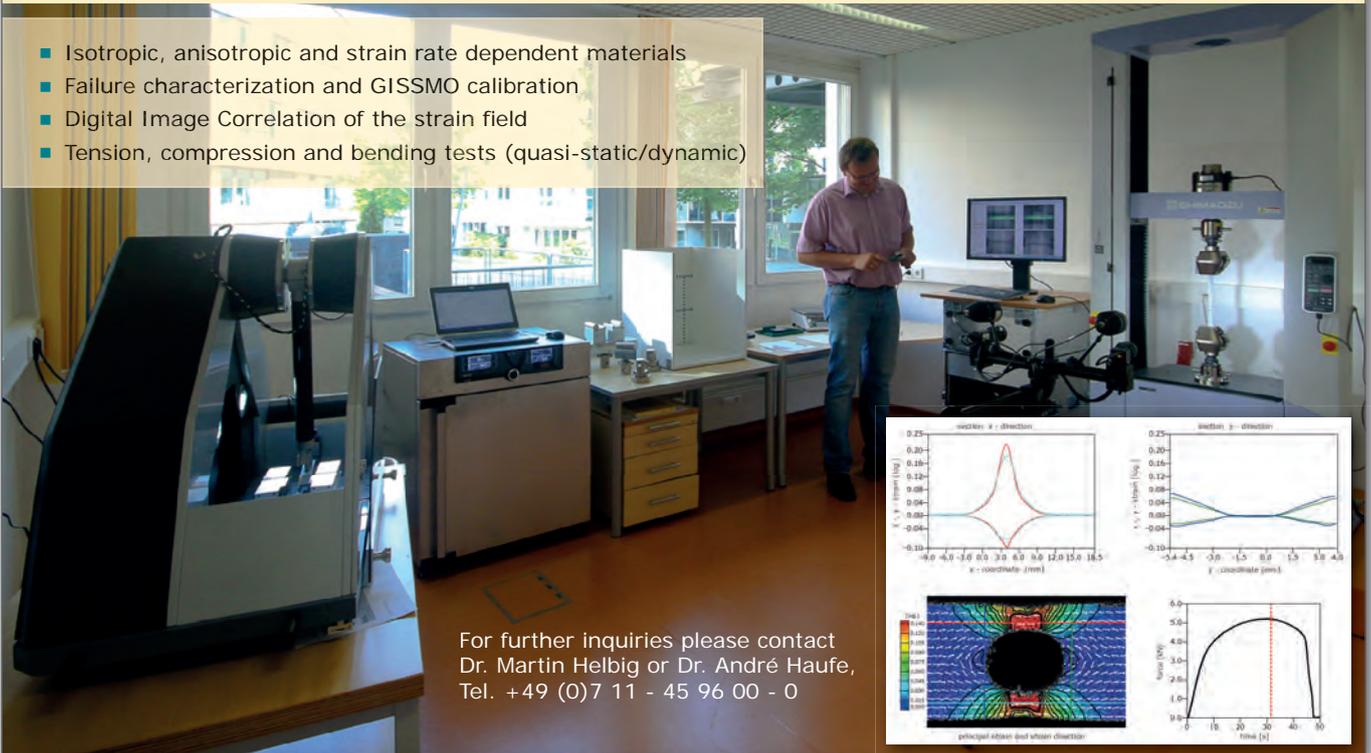
For further inquiries please contact
Dr. Martin Helbig or Dr. André Haufe,
Tel. +49 (0)7 11 - 45 96 00 - 0

■ MODELING POLYMERS AND ELASTOMERS IN LS-DYNA

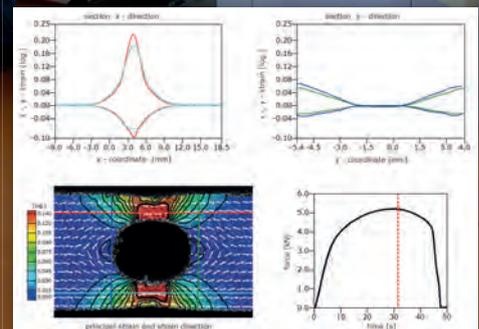For a variety of industrial applications, polymers (i.e. thermoplastics, foams and rubber materials) have become more and more important. Especially foams are widely used in the automotive industry because of their energy absorbing properties and their beneficial stiffness to density ratio.

Compared to other commonly used materials, as for example, steel or aluminum, the material behavior of foams is much more complex. Rubber and glue materials are in general nonlinear elastic. Especially for rubber materials, rate-dependency and damage have a great influence on the hysteresis formation. Thus, these properties need to be considered in the constitutive material formulation. Moreover, thermoplastics exhibit a very complex material behavior ranging from viscoelasticity to viscoplasticity with fundamental differences to the properties of metallic materials.

Following this, the reproduction of the material behavior of thermoplastics, foams, glue and rubber materials within a finite element analysis represents a challenging task for the simulation expert. The program LS-DYNA offers its users a wide range of material models that have been developed exclusively for the modeling of these materials. The choice and the application of such special material models require thorough knowledge of the theoretical as well as the numerical background.

The goal of this seminar is to provide an overview of the available material models for thermoplastics, foams, rubbers and glues in LS-DYNA and to give guidance to apply them properly. Additionally, their practical usage will be discussed and the theoretical background of these models will be presented. Also addressed will be the topics parameter identification, experimental set-up and evaluation of experimental results.

Small example problems will illustrate various application cases of the material models implemented in LS-DYNA.

Content
- Presentation of various applications
- Discussion of the material behavior of polymers
- Foams:
  reversible, crushable and semi-crushable foams; appropriate material models; preparation of test results
- Rubber materials:
  quasi-static and dynamic behavior; incompressibility; experimental set-up; data preparation; parameter identification
- Glue materials:
  structural glue, installation glue, screen glue; modeling of a glue lines; material behavior and material modeling of glue; experiments for the evaluation of material parameters
- Thermoplastics:
  material models for small and large deformations; experimental set-up, data preparation; validation and verification
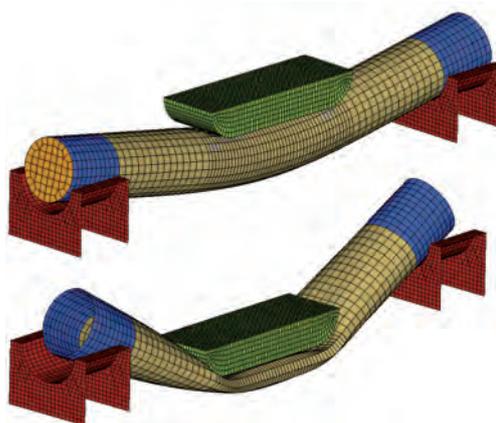
Courtesy of Dow Deutschland Anlagengesellschaft mbH

Type:
  Seminar
Duration:
  2 days
Fee:
  1,100 Euro
Lecturer:
  Prof. Dr. Stefan
  Kolling,
  TH Mittelhessen
Dates:
  27-28 March
  27-28 November

POPULAR

■ SIMULATION OF SHORT FIBER REINFORCED POLYMERS

Type:
  Seminar
Duration:
  1 day
Fee:
  475 Euro
Lecturers:
  Dr. Stefan Hartmann,
  Dr. Thomas Klöppel,
  Christian Liebold,
  all DYNAmore
Dates:
  29 March
  16 May [Tu)]
  29 November
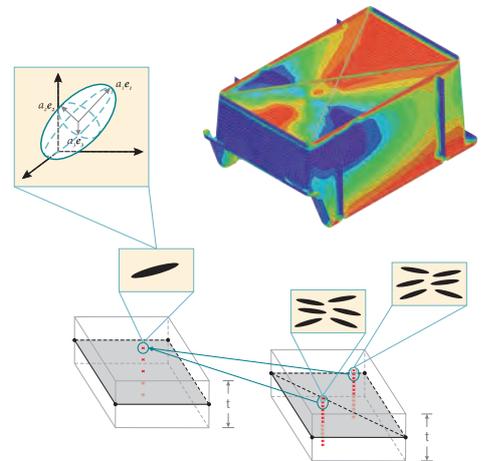
[Tu)] Turin, Italy

NEW

Besides standard plastic materials, more and more short and long fiber reinforced plastic materials are used to manufacture automotive components, aircraft parts, sports equipment and standard household appliances. Since the local properties of this group of materials are highly dependent on the production process, not only new material models are necessary, which allow to consider the complex load bearing capabilities and damage mechanisms of these materials properly, but also new modeling techniques allowing to close the simulation process chain for these materials.

Short fiber reinforced composite components are usually manufactured using an injection or compaction process. Thereby, carbon or glass fibers with a length of approximately 0.1 mm to 1.0 mm are brought into final shape together with a resin material. Strong local anisotropies in such material lead to complex structural mechanic effects which need to be captured within the simulation. In this course, material models available in LS-DYNA, are introduced and discussed.

As the consideration of the manufacturing process of such components plays an important role to be predictive in the structural analysis, different possibilities to consider results from other software tools used for the process simulation will be introduced. The simulation process chain is closed for this specific group of materials using the software tool ENVYO. Thereby, several homogenization strategies and the respective input parameters will be discussed and illustrated in application examples.

Contents
■ Introduction to composite materials
■ Anisotropy and definition of directions
■ Material modeling
  - Material models for short fiber reinforced composites in LS-DYNA
  - Failure criteria established by Tsai-Hill, Tsai-Wu and *MAT_GENERALIZED_DAMAGE
■ Evaluation of process simulation results, especially injection molding
■ Homogenization strategies
  - Mori-Tanaka, self-consistent method
  - Closure-Approximations
■ Introduction into ENVYO to close the simulation process chain for short fiber reinforced composites

■ SIMULATION OF CONTINUOUS FIBER REINFORCED POLYMERS

Type:
  Seminar
Duration:
  2 days
Fee:
  950 Euro
Lecturers:
  Dr. Stefan Hartmann,
  Dr. Thomas Klöppel,
  Christian Liebold,
  all DYNAmore
Dates:
  30-31 March
  17-18 May [Tu)]
  30 Nov. - 01 Dec.

[Tu)] Turin, Italy

POPULAR

Increasing requirements on resistance and durability in conjunction with weight reduction have advanced the development of composite materials very strongly within the last decades. Composites are no longer used for special applications or subordinate components, but increasingly for components in volume production. Hence, concepts are on demand to capture the complex mechanisms of load transfer and failure within numerical simulations.

A very important subgroup of "composites" consists of long fiber reinforced composite materials. They typically consist of high-strength carbon or glass fibers which are unidirectionally embedded in thin layers of an epoxy resin matrix.

This seminar gives an overview on potential modeling techniques of this subgroup. The strong anisotropy of these composite structures leads to a complex mechanical behavior which has to be captured in the simulation. Therefore, the available material models in LS-DYNA are introduced and discussed in-depth. Some of these models are implemented and co-developed with the support from DYNAmore employees. Furthermore, different possibilities to model the phenomena of delamination are shown. The applicability and limits are demonstrated by means of small numerical examples.

Content
■ Introduction to composite materials
■ Laminate theory
■ Structure modeling and model assumptions
■ Material modeling
  - Discussion of existing material models in LS-DYNA
  - Failure criteria of Chang-Chang, Tsai-Wu and Hashin
■ Modeling of delamination
  - Cohesive-elements and tiebreak contact
■ General effects by means of examples
■ Visualization of simulation results with LS-PrePost

DYNAMORE

■ CONCRETE AND GEOMATERIAL MODELING WITH LS-DYNA

Constitutive models for concrete and geomaterials (rock and soil) are typically based on the same mathematical plasticity theory framework used to model common metals. However, the constitutive behavior of concrete and geomaterials differs from that of metals in three important ways:
1. They are (relatively) highly compressible, i.e., pressure-volume response;
2. Their yield strengths depend on the mean stress (pressure), i.e. frictional response; and
3. Their tensile strengths are small compared to their compressive strengths.

These basic differences give rise to interesting aspects of constitutive modeling that may not be familiar to engineers trained in classical metal plasticity. The course starts from the common ground of introductory metal plasticity constitutive modeling and successively builds on this base adding the constitutive modeling features necessary to model concrete and geomaterials. The LS-DYNA constitutive models covered are adequate for modeling most types of rock, all concretes, and a large class of soils. The course is intended for those new to concrete & geomaterial constitutive modeling, but will also be useful to those seeking a more in-depth explanation of the LS-DYNA concrete and geomaterial constitutive models covered.
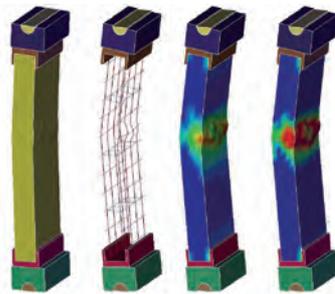
A significant portion of the course is devoted to understanding the types of laboratory tests and data that are available to characterize concrete and geomaterials. Unlike most metals, whose strength is characterized by a single value obtained from a simple uniaxial stress test, concrete and geomaterial characterization requires a matrix of laboratory tests. A knowledge of how these tests are performed, the form and format, of typical laboratory test data, and the interpretation of the data for use with a concrete or geomaterial constitutive model, is essential to becoming a successful concrete & geomaterial modeler.

The basic mathematics of the LS-DYNA concrete and geomaterials constitutive models are covered, with an emphasis on how the mathematics can aid the modeler in fitting constitutive models to the available laboratory data. The mechanics of the constitutive model are emphasized to provide the modeler with the insights necessary to easily separate cause and effect in these complicated constitutive models. Exercises in fitting the LS-DYNA concrete and geomaterial constitutive models to typical laboratory data are used to illustrate the data and the constitutive models.

Courtesy of Schwer Engineering

■ USER MATERIALS IN LS-DYNA

LS-DYNA offers the possibility to implement custom material models into the code of the program. In this regard, the user-developed material routines will be compiled and linked with the corresponding LS-DYNA object-files. The seminar aims at users from industrial as well as academic research facilities who would like to integrate their own material models in LS-DYNA and are interested in discussing their experience with the implementation in a wider circle of users.

Content
■ Demonstration of the development procedure
  - Recommended compiler and
    compiler options
  - Potential additionally required libraries
■ Access to data structures
■ Implementation of a custom material routine in LS-DYNA
■ On request, your custom models can be discussed and edited during the seminar
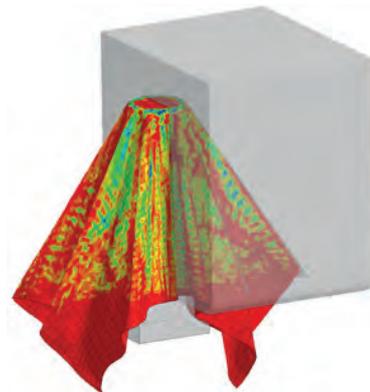
Courtesy of Institut für Verbundwerkstoffe GmbH

DYNAMORE

■ INFORMATION DAY: COMPOSITE ANALYSIS WITH LS-DYNA

Due to the increasing importance of lightweight construction, where the aim is not only to economize on weight but also to improve rigidity and strength, the use of composite materials has increased dramatically over recent years. If considerations are made regarding the use of such materials for crash-relevant components, the requirements of simulation tools increase enormously - especially in automotive construction. As a consequence, numerous enhancements have been implemented in LS-DYNA.

The aim of this information day is to inform participants about the state of the art in simulating composite materials. In particular, an overview of existing options in LS-DYNA for simulating composite materials is given and current developments will also be discussed. A further focus will be on the presentation of the software DIGIMAT, which

allows to analyze the microstructure of composite materials. The possibility of coupling DIGIMAT with LS-DYNA will also be addressed.

Content
- Overview of techniques to model composite materials in LS-DYNA
- Insight into the latest developments in LS-DYNA regarding composite materials (material formulations, elements, delamination mechanisms)
- Visualization of simulation results
- Overview of the application of DIGIMAT for composite materials
- Coupling DIGIMAT with LS-DYNA

In collaboration with

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Lecturers:
  DYNAmore and
  e-Xstream staff
  members
Language:
  German/English
Dates:
  13 March
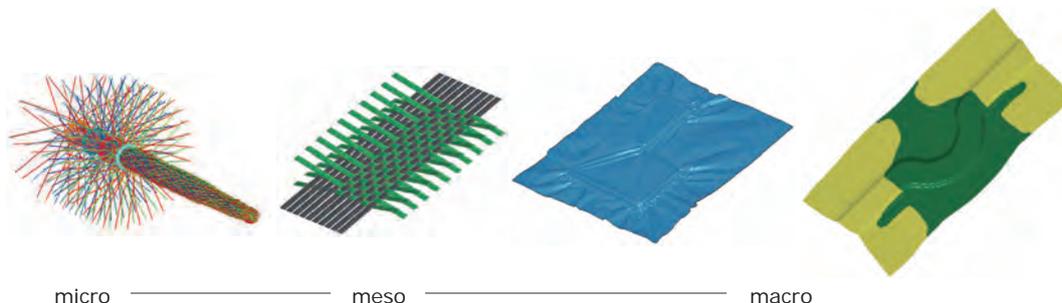 13 November

micro ———————— meso ———————— macro

■ INFORMATION DAY: ENVYO

Nowadays, the words "industry 4.0", "process chain" and "mapping" are often used in industrial research and development environments and point out the need to make use of simulation and experimental data for further numerical analysis.

Within the DYNAmore Company, this topic is being targeted within a number of industry and research projects and as a result, the software tool ENVYO was introduced to the public at last year's LS-DYNA User's meeting in Bamberg, GER. Thereby, a detailed introduction to the application possibilities of this tool to close the simulation process chain for components from metal forming applications, as well as short and continuous fiber reinforced composites was given.

ENVYO perfectly fits into the number of products accompanying LS-DYNA since it defines links between different tools for process simulations and the structural analysis with LS-DYNA and allows the user to process and homogenize those simulation data in many ways. In some cases, the tool can also be used to for the post-processing of a huge number of simulation data. ENVYO allows to consider a large number of material models and corresponding history variables along the simulation process chain and therefore helps to fully close it completely.

On this information day, experts from industry and research will report their experience from the various application possibilities with the software tool ENVYO to the public. Together with the

information exchange with the early adopters of this technology, attendees will have the chance to get information about the newest implementations within the ENVYO software and to directly discuss their needs with the developer of the tool. This will help to push the software solution to fully close the simulation process chain for a large number of applications.

Contents
- Overview on recent developments
- Possibilities of homogenization/data transfer with ENVYO
- Questions regarding homogenization and averaging of scalar and tensorial data
- Quality criteria for mapped and homogenized data
- Application examples

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Lecturers:
  DYNAmore staff
  members
Dates:
  13 March
  13 November

NEW
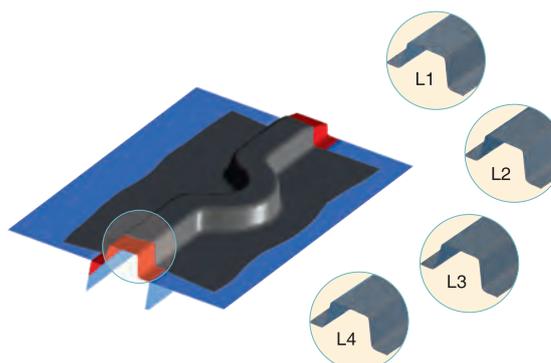
■ INFORMATION DAY: SIMULATION OF PLASTICS WITH LS-DYNA

Type:
Information day
Duration:
1/2 day (morning)
Fee:
Free of charge
Date:
27 September

Today, mechanically loaded plastic components are used in nearly all engineering environments. In recent years, their use has particularly increased in the automotive industry. Herein, extremely complex material models are needed to model such components realistically in a finite element simulation. Plastics are usually much more complicated in their material behavior than, for example, steel or aluminium. Frequently encountered properties of plastics are nonlinear elasticity, viscoelasticity, viscoplasticity, strain rate-dependent failure and anisotropic material behavior. Moreover, the usual von Mises flow criterion is normally insufficient for a description of elastoplasticity.

During this information day, experts will report on their experience with material modeling and the simulation of plastics. Part of the lectures will be different experiments for the identification of material parameters and classification of different plastic types.

Application examples from the calculation of relevant components will also be covered in the presentations. DYNAmore experts will provide information on current possibilities and the latest developments in LS-DYNA regarding material modeling of plastics. In a final discussion, participants will have an opportunity to ask questions and to exchange their experience with others.

Content
- What are the problems when modeling plastics?
- Discussion of elastic, visco-elastic and visco-plastic material models
- Failure/ localization / softening
- Classification of plastics
- Material models in LS-DYNA
- Experimental techniques:
  - Quasi-static, dynamic experiments
  - Local strain measurement
- Identification of material parameters
- How does the manufacturing process influence the mechanical behavior of plastics?
- User subroutines with custom material laws
- Examples of use

■ INFORMATION DAY: DYNAMIC MATERIAL CHARACTERIZATION WITH 4A-IMPETUS

Type:
Information day
Duration:
1/2 day (afternoon)
Fee:
Free of charge
Date:
27 September

A core aim of R&D is to reduce development times and cost. Due to higher requirements in a wide range of applications and especially in plastics technology, the number of different types of materials is constantly increasing. As a result, it is practically impossible to gain fast and flexible access to reliable material parameters which are essential for virtual simulation.

For the first time, 4a Impetus provides a closed pathway for generating validated material maps of manufacturing-aware test pieces under realistic loading conditions with the aid of numerical methods. Based on the available database, the input decks (material cards) are compiled automatically for numeric FE solvers such as LS-DYNA. With LS-OPT, an automatic comparison between the simulation and the test is carried out using the least-squares method. Material parameters are identified by minimizing errors between the test curves and the simulation curves.

The 4a Impetus pendulum test system is so compact that it can be placed on a desktop and directly set up in a development department. Using the double pendulum model, test velocities up to 10 m/s can be achieved, with the system working almost impulse-free towards the "outside".

With the aid of test specimen configurations, the system has been designed to investigate various materials such as elastomers, non reinforced and reinforced thermo-plastics, foams, thermoset plastics and fiber reinforced composites.

The information day gives you the opportunity to get familiar with the test system and also to discuss the subject of "dynamic material characterization" with experts and other participants. Tests will be performed on prepared samples during the course of the event and material cards for LS-DYNA will be identified on the basis of these tests.

Content
- Presentation of the test system (motivation, measuring technique, test execution, sample specimens)
- Methods applied (material parameter identification with LS-OPT, formation of substitute areas using neural networks and LS-OPT)
- Example Applications for
  - Foam materials
  - Compact thermoplastics
  - Elastomers

In collaboration with

31

■ IMPLICIT ANALYSIS WITH LS-DYNA

POPULAR

In recent years, the simulation possibilities in LS-DYNA using implicit time integration have been enhanced extensively. The main areas of application for implicit analyses include linear and nonlinear static computations, natural frequency analyses, springback, lengthy transient simulations, systems with preload, etc. The aim of the seminar is to give participants an overview of the possibilities and limits of implicit simulations using LS-DYNA. In particular, attention will be drawn on the required input cards for such simulations.

The seminar is recommended for engineers intending to use LS-DYNA to carry out implicit simulations. In addition, experienced "explicit users" learn about what to bear in mind when converting explicit into implicit input decks. Examples will be given during the seminar to illustrate the functionality of the implicit options.
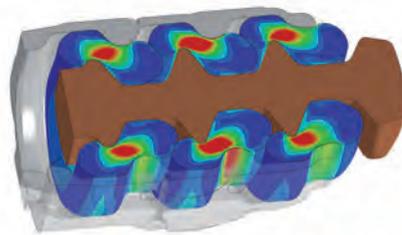
Courtesy of Dellner Couplers AB

Content
- Differences between explicit and implicit: theory, application, examples
- Input syntax for implicit control cards
- Linear static analysis: options, linear elements, boundary constraints, direct/iterative solvers, accuracy
- Dynamic analysis: Newmark method, input parameters, lumped/consistent mass matrix
- Nonlinear analysis: solution methods (Newton, BFGS, arclength), convergence, tolerances, output, automatic step size strategy
- Eigenvalue analysis: options, modeling aspects, intermittent output
- Modal analysis, linear buckling
- Frequency response function
- Switching: implicit/explicit, explicit/implicit
- Element types for implicit: linear and nonlinear elements
- Material models for implicit analyses
- Contact types for implicit: options, Mortar contact
- Troubleshooting convergence problems
- Summary with checklist of most important settings for implicit calculations

Basic knowledge of LS-DYNA or prior attendance at the seminar "Introduction to LS-DYNA" is recommended.

■ NVH, FREQUENCY DOMAIN ANALYSIS AND FATIGUE WITH LS-DYNA

The objective of the training course is to introduce the frequency domain vibration, fatigue and acoustic features of LS-DYNA to users, and give a detailed look at the application of these features in vehicle NVH simulation.

This course is recommended for engineers who want to run NVH or other frequency domain vibration, fatigue and acoustic simulation problems with LS-DYNA. This course is useful for engineers and researchers who are working in the area of vehicle NVH, aircraft/spacecraft vibro-acoustics, engine noise simulation, machine vibration testing and simulation, etc.

Content
- Introduction
  NVH theory and lab testing technology, overview of LS-DYNA frequency domain features and applications, frequency domain vs. time domain, Fourier transforms
- Frequency Response Function (FRF)
  Modal superposition method, damping, nodal force/resultant force FRF
- Steady State Dynamics (SSD) with harmonic loading
  Large mass method for enforced motion, Equivalent Radiated Power (ERP), mode expansion with LS-PrePost
- Random vibration with PSD loading
  Correlated and uncorrelated multiple PSD excitations, acoustic wave, pre-stress condition
- Acoustics
  Rayleigh method, Kirchhoff method, BEM, FEM, acoustic panel contribution analysis, vibro-acoustic problems, Muffler transmission loss analysis, ATV and MATV techniques, acoustic eigenvalue analysis, incident waves, half-space problem, weighted SPL, radiated sound power
- Response spectrum analysis
  Input earthquake spectrum, modal combination methods (SRSS, CQC, etc.), multi input spectra
- Fatigue
  Fatigue analysis in harmonic/random vibration environment, Miner's rule, S-N curves, Dirlik method
- Advanced topics
  SEA (Statistical Energy Analysis), brake squeal analysis; NVH based on IGA
- Workshop

DYNAMORE
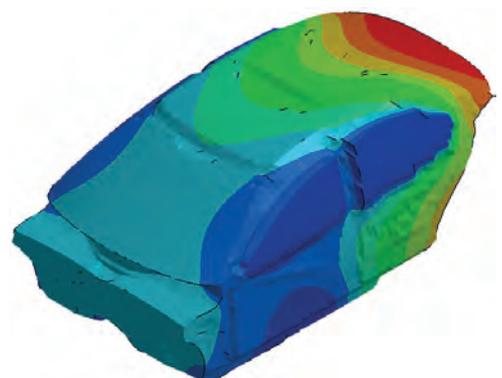
■ INFORMATION DAY: POSSIBILITIES WITH LS-DYNA/IMPLICIT

The goal of this information day is to present the current possibilities and recent developments of LS-DYNA/Implicit. Herein, various applications will be presented and the functionality of LS-DYNA/Implicit will be demonstrated with the aid of quasi-static as well as dynamic examples problems.

Courtesy of IMS Gear GmbH

Content
- Status quo of LS-DYNA/Implicit
- For which problems does it make sense to use LS-DYNA/Implicit?
- Application possibilities and limits
- Demonstration of different LS-DYNA/Implicit applications
- Troubleshooting convergence problems
- Planned future development
- Development status of the MPP parallelization

This Information day is not a substitute for the seminar "Implicit Analysis with LS-DYNA". It merely wants to demonstrate the possibilities of LS-DYNA/Implicit not focusing on the specific usage by the user.

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Dates:
  20 March
  18 September

■ INFORMATION DAY: FATIGUE, ACOUSTICS AND NVH ANALYSIS WITH FEM AND BEM

At this information day, the theoretical basics of predicting acoustic phenomena will be discussed. The methods are typically based on the boundary-element method (BEM) and the finite element method (FEM). Practical application examples will also be presented and the possibilities and limits of the methods with respect to industrial applications are discussed.

In LS-DYNA, acoustics simulations can be carried out using the BEM and FEM. For this reason, it is possible to investigate acoustic and vibro-acoustic problems in the time as well as in the frequency domain. Based on these computations, quantities such as the acoustic pressure (Pa) and the sound pressure level (dB) can be analyzed.

The aim of the event is to give general information about calculating problems in acoustics. The current state-of-the-art technology and typical industrial problems will be presented, and the possibilities and limits of simulating acoustics using LS-DYNA are discussed.

Content
- Possibilities and areas of application of acoustics simulations
- Basic theory
- Coupled simulations (FEM/BEM)
- Practical examples
- Acoustics simulation using LS-DYNA
  - Possibilities and current developments
  - Control cards, definition of the problem, model generation
  - Evaluation of the results

Courtesy of Technical University Hamburg-Harburg

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Date:
  25 October

■ SMOOTHED PARTICLE HYDRODYNAMICS (SPH) IN LS-DYNA

Type:
  Seminar
Duration:
  2 days
Fee:
  1,100 Euro
Lecturer:
  Prof. Mhamed Souli,
  University Lille
Language:
  English
Dates:
  12 May [Sb)]
  20-21 June [V)]
  21-22 September

[Sb)] Salzburg, Austria
[V)] Versailles, France

Attendees of this seminar will be introduced to the theoretical basics of the meshless method "Smoothed Particle Hydrodynamics" (SPH) and receive guidance for its practical application in LS-DYNA. The seminar will thoroughly illustrate the necessary configurations in the LS-DYNA input deck to realize a successful nonlinear SPH simulation and will furthermore clarify the differences to conventional FEM. Due to the true meshless nature of SPH, the method is perfectly suitable in situations with very large deformations. Typical applications of SPH in LS-DYNA include impact simulations of fluids or solids or other scenarios where it is essential to capture the momentum exchange accurately. Attendees will learn the application of the SPH with the aid of many workshop examples.

The course instructor Prof. Mhamed Soul of the University of Lille is a long-term software developer at LSTC and is frequently implementing new features for the methods ALE and SPH in LS-DYNA. This seminar aims at engineers who have already worked with LS-DYNA and would like to use SPH as a meshless method.

Content
- Introduction
- General possibilities/applications
- Development and classification of the method
- Principal idea of the SPH method
  - Particle approximation of field functions
  - Characteristic length scales
  - Renormalization
  - Tension instability and possible countermeasures
  - Available formulations
  - Comparison of SPH with FEM
- Symmetry boundary conditions
- Contact modeling
  - SPH to FEM
  - SPH to SPH
  - SPH to DEM
- Conversion of finite elements to SPH at failure
- Input parameters
  - Control settings
  - Output settings
- Pre- and postprocessing with LS-PrePost
- Sample applications

■ MESHFREE EFG, SPG AND ADVANCED FE METHODS FOR STRUCTURAL ANALYSES

Type:
  Seminar
Duration:
  2 days
Fee:
  1,100 Euro
Lecturer:
  Dr. Cheng-Tang Wu,
  Dr. Wei Hu,
  both LSTC
Language:
  English
Dates:
  08 May [Sb)]
  05-06 October

[Sb)] Salzburg, Austria

Attendees of this seminar will be introduced to the fundamental background of various Meshfree and advanced FEM methods. Particular attention is drawn on the application of the meshless method "Element-Free Galerkin" (EFG) as well as the newly developed method "Smoothed Particle Galerkin" (SPG). The seminar will thoroughly refer to the settings required in the LS-DYNA input deck to carry out a successful nonlinear meshfree or advanced FEM simulation. Herein, the difference between the conventional EFG and SPG formulations and the adaptive or discontinuous formulations will be explained.

Common applications of these methods are materials made of rubber or foam that undergo large deformations. The adaptive EFG formulation is the method of choice for the efficient simulation of cutting, bulk forming and forging processes. In particular, the new features of local mesh refinement in combination with the implicit time integration are the key enablers for these processes. Moreover, fracture simulations can be carried using the discontinuous EFG formulation.
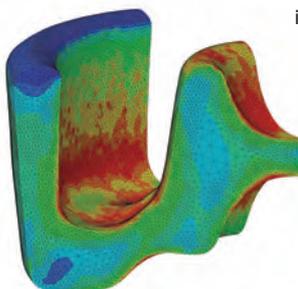
Content
- Introduction
  - Overview of current meshless and advanced FEM methods
  - Current research trends
  - Available formulations in LS-DYNA
  - Major industrial applications
- General Meshfree and advanced FEM in solid/shell formulations
  - Conventional EFG, stabilized EFG, EFG shells
  - Smoothed Particle Galerkin method (SPG) for severe deformation
  - Meshfree-enriched FEM (MEFEM) for rubber-like materials
  - Associated keywords
- Adaptive methods in FEM and meshfree solids (EFG)
  - Metal forming and manufacturing analysis
  - Conventional global and local adaptivity
  - Interactive adaptivity control
  - Boundary and contact conditions
  - Treatment of incompressibility
  - Implicit/explicit simulation
  - Thermal effects
- Continuum and discrete failure analysis in solid and shells
  - Cohesive EFG approach in brittle solids
  - Extended finite element method (XFEM) in 2D and shells
  - 3D SPG for brittle and ductile failure

DYNA
MORE

■ DISCRETE ELEMENT METHOD (DEM) IN LS-DYNA

The discrete element method (DEM) is usually applied to predict the behavior of different types of granular media during mixing processes, storage and discharge or transportation on belts. Herein, the interaction of the spherical particles with themselves as well as their surrounding deformable or rigid structures can be taken into account. Friction coefficients as well as spring and damper constants can be defined in normal and tangential direction. Wet particles can be estimated with the aid of a capillary force model and a certain roughness of the spherical particles can be achieved by introducing a rolling friction.

A continuum-mechanical description can be obtained with the introduction of "bonds" between the particles. Herein, the required mechanical behavior of the bonds is automatically computed by LS-DYNA using the parameters given in the material card. With the definition of a fracture energy release rate of the bonds, fracture mechanics of brittle materials can be studied.

Attendees of this seminar will obtain an overview of the involved material cards of a successful DEM simulation. For a better understanding of the involved parameters, simple examples will be presented addressing particle-particle as well as particle-structure interaction. Finally, the associa-

ted experiments will be discussed that are needed to determine the involved parameters.

Content
- Introduction to granular materials
- Involved keywords and their options
- Setting up DEM simulations with deformable/rigid structures
- Physical meaning of the parameters and their experimental determination
- Practice examples

Type:
  Seminar
Duration:
  1 days
Fee:
  475 Euro
Lecturer:
  Dr. Nils Karajan,
  DYNAmore
Date:
  27 September

WE DEVELOP **RESULTS**

GNS Systems
IT-Services for Engineering
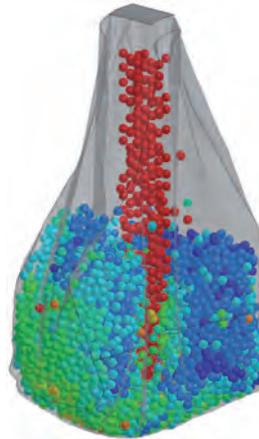
HIGH PERFORMANCE COMPUTING
Integration and operation of LS-DYNA and all other CAE applications on supercomputing systems

TECHNICAL DATA MANAGEMENT
Planning, integration, and operation of complete systems for structured management of analysis data, based, for example, on SimManager, SimData Manager, and LoCo

SOFTWARE DEVELOPMENT
Development of software for automation of pre and postprocessing methods, for example using ANSA and Animator4

GNS Systems GmbH | **Phone** +49 (0)531 - 1 23 87 0 | **Mail** info@gns-systems.de

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DYNAMORE

■ ALE AND FLUID-STRUCTURE INTERACTION IN LS-DYNA

Type:
Seminar
Duration:
2 days
Fee:
1,100 Euro
Lecturer:
Prof. Mhamed Souli,
Universität Lille
Language:
English
Dates:
21-22 March [v)]
15-16 May
19-20 September

[v)] Versailles, France

In this seminar, you receive comprehensive information about the latest developments in LS-DYNA to analyze fluids and, in particular, the fluid-structure interaction using its Arbitrary Lagrangean Eulerian (ALE) capabilities. Attendees will learn about the theoretical background how fluids are implemented in LS-DYNA using ALE and will gain a deep understanding of these concepts with the aid of many hands-on examples.

The seminar is directed towards advanced LS-DYNA users, who would like to solve problems in the fields of aquaplaning, tank sloshing, tank dropping (partially and completely filled), bird strike, viscous flow, ship collision, underwater explosion and acoustics in air and water. Prior knowledge of fluid dynamics is not required.

Courtesy of Hankook Tire Co.

The course instructor Prof. Mhamed Souli of the University of Lille is a longtime program developer at LSTC who implements new features for ALE/SPH in LS-DYNA.

Content
- Basic theoretical background
  - Navier-Stokes equation
  - Mass- and energy balance
- Selection of material models
- Selection of equations of state
- Discretization and numerical Solution
  - Lagrangean formulation
  - Eulerian formulation
  - ALE formulation
  - Moving Eulerian mesh
  - Operator-Split method
  - Advection schemes
  - Algorithms for mesh smoothing
- Multi-material ALE
  - Pressure relaxation based on volume fractions
  - Interface reconstruction
- Fluid-structure interaction
  - Constraint method
  - Penalty method
  - Leakage and methods to avoid it
- Vibro-Acoustic
- Explosions
- Practice examples

■ ICFD - INCOMPRESSIBLE FLUID SOLVER IN LS-DYNA

Type:
Seminar
Duration:
2 days
Fee:
1,100 Euro
(550 Euro per day,
can be booked
separately)
Lecturer:
Iñaki Çaldichoury,
LSTC
Language:
English
Dates:
17-18 May
17-18 October

POPULAR

This course provides an introduction to the incompressible fluid solver (ICFD) in LS-DYNA. It focuses on the solution of CFD problems, where the incompressibility constraint may be applied, e. g. ground vehicle, aerodynamics, hemodynamics, free-surface problems, ship hydrodynamics, etc. The solver may run as a stand-alone CFD solver, where only fluid dynamics effects are studied, or it can be coupled to the solid mechanics solver to study loosely or strongly coupled fluid-structure interaction (FSI) problems.

The first day of the course includes a presentation of the general principles and applications of the solver, a step by step guide to setting up a simple CFD problem, advanced feature introduction (FSI, conjugate heat transfer) and so forth. A brief review of basic fluid mechanics and CFD concepts are also offered such that no expert knowledge of fluids is required. The second day will deal with the newly implemented features and advanced applications.

Introduction to the ICFD solver in DYNA (Day 1)
- General principles and supported applications
- Step by step keyword description
- Setting up a pure CFD problem for aerodynamics
  - Setting boundary conditions
  - Fluid volume mesher
  - Mesh refinement tools
- Strong and loose FSI coupling
- Thermal coupling and conjugate heat transfer
- Computation of the heat transfer coefficient

Advanced topics and new features (Day 2)
- Advanced controlling and monitoring tools
- Turbulence modeling
  - New models and picking the right one
  - Law of the wall and boundary layer
- Non Newtonian flows
- Flow in porous media
- DEM coupling
- New postprocessing tools in LS-PrePost

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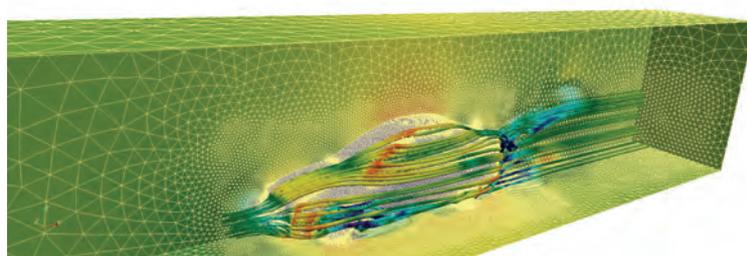
■ CESE – COMPRESSIBLE FLUID SOLVER IN LS-DYNA

Compressibility effects in fluid mechanics are typically considered significant if the Mach number of the flow exceeds 0.3 or if the fluid undergoes very large pressure changes. The most distinct phenomenon associated with high speed flows is the existence of shock waves or non-isentropic solutions.

The new compressible flow solver CESE in LS-DYNA is based on a novel numerical framework originally proposed by Dr. Chang of the NASA Glenn Research Center. The method exhibits many non-traditional features, including a unified treatment of space and time, the introduction of a conservation element (CE) and a solution element (SE), and a novel shock capturing strategy without using a Riemann solver, which is able to simultaneously capture both strong shocks and small disturbances. Moreover, the spatial gradients are treated as unknowns which allows for more accurate solutions of the shock waves than normal second order schemes.
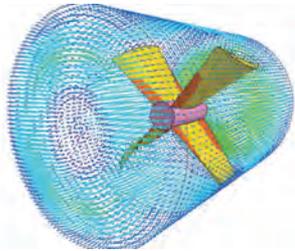
So far, this method has been used to solve many different types of flow problems, such as detonation waves, shock/acoustic wave interaction, cavitating flows, and chemical reaction flows. In LS-DYNA, it has been extended to also solve fluid-structure interaction (FSI) problems with the embedded (immersed) boundary approach or moving (fitted) mesh approach.

Content
- Introduction
- General Principles
- The CE/SE scheme
- Setting up a pure CFD/CESE problem
- Setting up an FSI/CESE problem
- Advanced capabilities
- Post treatment
- Documentation
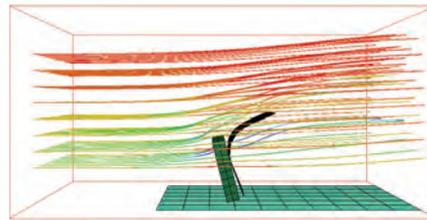
Type:
 Seminar
Duration:
 1 day
Fee:
 550 Euro
Lecturer:
 Iñaki Çaldichoury,
 LSTC
Language:
 English
Dates:
 19 May
 19 October

■ ELECTROMAGNETISM IN LS-DYNA

This course provides an introduction to the Electromagnetics (EM) solver in LS-DYNA. Herein, the Maxwell equations are solved in the Eddy-Current approximation, which is suitable for cases where the propagation of electromagnetic waves in air (or vacuum) can be considered as instantaneous. The solver is coupled with the solid mechanics and thermal solvers of LS-DYNA allowing the simulation and solution of applications such as magnetic metal forming, welding, bending, induced heating, resistive heating and so forth.

The course includes a presentation of the solver's general principles and applications, a complete keyword description for setting up an Eddy-Current problem, an introduction to the more advanced features (Inductive heating problems, exterior magnetic field, magnetic materials and so forth) as well as an advanced description of the available controlling tools to ensure a safe analysis. Key electromagnetic concepts are reviewed throughout the course and a general knowledge about electromagnetics is therefore appreciated but not mandatory.

Content
- Introduction and applications
- General principles
- Maxwell equations
- FEMSTER library
- FEM and BEM coupled system
- Setting up a EM problem step by step
- The EM timestep
- Circuits
- EM materials and equation of states
- Advanced functionalities
- Controlling and monitoring the analysis

Type:
 Seminar
Duration:
 1 day
Fee:
 550 Euro
Lecturer:
 Iñaki Çaldichoury,
 LSTC
Language:
 English
Dates:
 12 May [Sb)]
 20 October

[Sb)] Salzburg, Austria
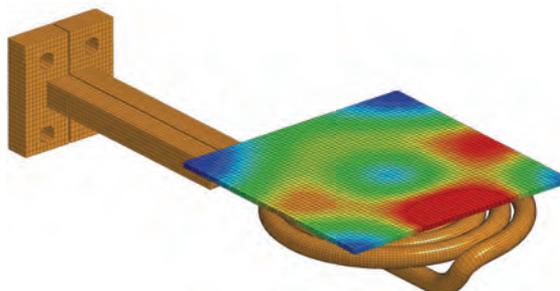
Courtesy of Institut für Verbundwerkstoffe GmbH

■ INFORMATION DAY: MULTIPHYSICS

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Date:
  16 October

The modern term "Multiphysics" can be understood as a synonym for the solution of generally coupled problems. Following this, multiphysical applications are often classified according to the nature of their coupling in terms of a weak or strong interaction of the involved processes, methods, materials, physical fields or scales as well as combinations thereof.

Moreover, the interacting quantities may result in either volume- or surface-coupled problems. Thus, the success of multiphysical simulations strongly depends on the coupling abilities of the underlying simulation platform. In the case of LS-DYNA, this is achieved in a unified simulation environment.

The goal of this information day is to enlarge upon the basic difficulties with the set-up of multiphysical simulations and to provide suitable solutions by embracing the available discretization schemes in space and time in LS-DYNA. In particular, a great variety of finite elements in a Lagrangean, Eulerian or Arbitrary-Lagrange-Eulerian formulation can be coupled with boundary elements, isogeometric elements or even meshfree methods like SPH, EFG or DEM. Moreover, implicit as well as explicit time integration schemes are provided and can be combined depending on the strength of the coupling.

On the basis of practical examples, an overview on the current coupling abilities in LS-DYNA is given. Herein, the attention is mainly on the mutual interaction of solids and fluids with thermal and electromagnetical fields.
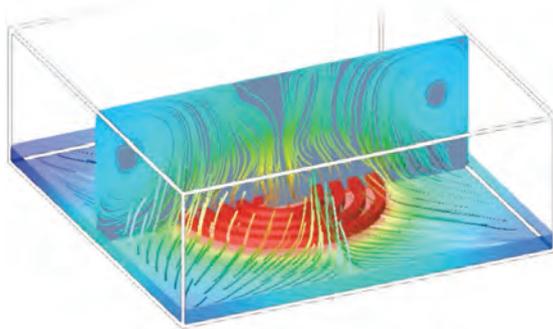
■ INFORMATION DAY: BIOMECHANICS

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Date:
  04 December

Regardless of whether you're working at a research institute or in industry, the topic of biomechanics is of growing interest. However, from a historical point of view, biomechanics is not a new subject at all because nature has been inspiring engineers for many years, as illustrated by the example of stress-driven structural optimization according to the paradigm of the trabecular structure in bones. Driven by an ever-increasing lifespan, the desire to better understand processes inside humans has emerged to allow engineering expertise to be used for medical purposes.

Combined with coupled multiphysical simulation methods, there are numerous application possibilities, such as modeling skeletal muscles and heart muscles which can be stimulated electrically, heart valves in circulating blood flows, the interaction between vessel-widening stents and arteries, among many other tasks. However, typical problems associated with the purely-mechanical design of implants under the effect of the constantly-changing system "man" continue to be of great interest.

The aim of the information day is to discuss modeling difficulties in biomechanics and also to demonstrate the various solutions offered by LS-DYNA.
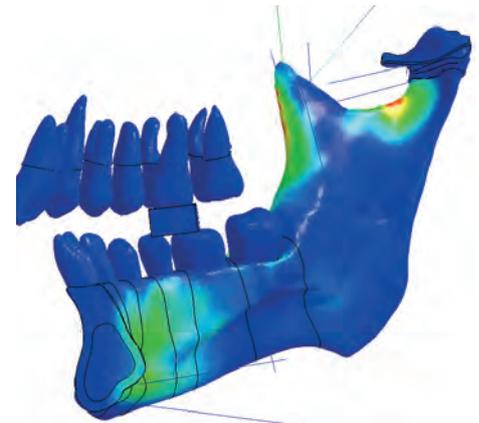
Courtesy of Karlsruhe Institute of Technology / University of Heidelberg

■ METHODS FOR SIMULATING SHORT DURATION EVENTS

Most applications of LS-DYNA are for complex, and often combined, physics where nonlinearities due to large deformations and material response, including failure, are the norm. Often the goal of such simulations is to provide predictions which will ultimately be used to guide product development and safety assessments.

Insights into modeling and simulation are illustrated through examples and numerous modeling 'tricks' and options are discussed. An emphasis is placed on modeling techniques, guidelines for which technique(s) to select, which techniques work well and when, and possible pitfalls in modeling choice selections. Simulation credibility is demonstrated through solution of multiple models, with associated multiple solvers, required checks of global and local energies, and mesh refinement strategies.

This two day class provides instruction on the selection and use of the LS-DYNA solvers used for analyzing blast and penetration 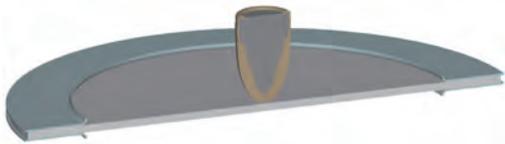related problems. It is intended for the LS-DYNA analysts possessing a comfortable command of the LS-DYNA keywords and options associated with typical Lagrange analyses. The training class will attempt to provide the analyst with the additional tools and knowledge required to make appropriate modeling decisions and convey the level of confidence in predictive results.

Content
Day 1
■ Introduction to modeling & simulation - verification & validation
■ Explicit & implicit - choosing an appropriate time integrator
■ 3d Multi-Material Arbitrary Lagrangian Eulerian (MM-ALE)
■ 1d and 2d-axisymmetric MM-ALE with mapping and adaptivity
Day 2
■ Contact – which type to use, when, and why
■ Fluid Structure Interaction
■ Smoothed Particle Hydrodynamics (SPH)
■ Stress initialization or preloads

Type:
  Seminar
Duration:
  2 days
Fee:
  1,100,- Euro
Lecturers:
  Paul Du Bois,
  Consultant;
  Dr. Len Schwer,
  Schwer Engineering
  & Consulting Services
Language:
  English
Date:
  16-17 October

■ BLAST MODELING WITH LS-DYNA

Blast events form a class of simulation environments well suited to the solution capabilities of LS-DYNA. LS-DYNA is unique in offering the analyst the choice of Lagrange, Eulerian (ALE) and Simple Engineering solvers, and combinations of these solvers, for simulating high energy events such as blast loading. In addition to air blast, the traditional focus of blast modeling, buried explosive charges have recently become important in the design of troop transportation.

This class focuses on the application of LS-DYNA for the simulation of high energy events. The analysis methods, and modeling, are illustrated through case studies. An emphasis is placed on modeling techniques: guidelines for which technique(s) to select, insights into which techniques work well and when, and possible pitfalls in modeling choice selections.

Sufficient mathematical theory is presented for each technique to provide the typical user with adequate knowledge to confidently apply the appropriate analysis technique. However, this training class is not a substitute for the in-depth treatments presented in the associated LS-DYNA training class, i.e. "ALE/Eulerian & Fluid Structure Interaction."

Mach Stem Formation
Courtesy of Schwer Engineering & Consulting Services

Type:
  Seminar
Duration:
  2 days
Fee:
  1,100,- Euro
Lecturers:
  Paul Du Bois,
  Consultant;
  Dr. Len Schwer,
  Schwer Engineering
  & Consulting Services
Language:
  English
Date:
  18-19 October
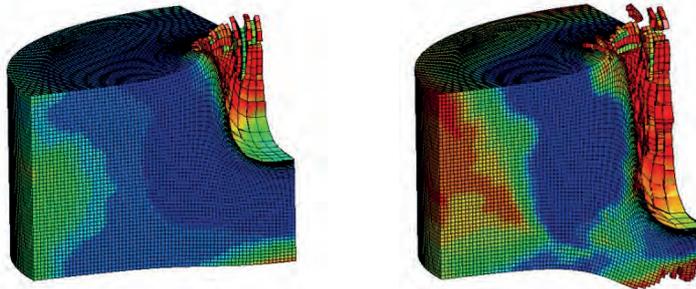
■ PENETRATION MODELING WITH LS-DYNA

Type:
  Seminar
Duration:
  2 days
Fee:
  1,100 Euro
Lecturers:
  Paul Du Bois,
  Consultant;
  Dr. Len Schwer,
  Schwer Engineering
  & Consulting Services
Language:
  English
Date:
  23-24 October

Penetration events form a class of simulation environments well suited to the solution capabilities of LS-DYNA. LS-DYNA is unique in offering the analyst the choice of Lagrange, Eulerian (ALE) and Meshfree Methods, and combinations of these methods, for simulating high energy events such as penetration and perforation. In addition to high energy, these events are typically associated with large deformations, damage, and failure both on the material and structural level. During the past decade successful modeling of such damage and failure has moved steadily from a "Black Art" to a widely accepted engineering practice.

This class focuses on the application of LS-DYNA for the simulation of high energy events. The analysis methods, and modeling, are illustrated through case studies. An emphasis is placed on modeling techniques: guidelines for which technique(s) to select, insights into which techniques work well and when, and possible pitfalls in modeling choice selections.

Sufficient mathematical theory is presented for each technique, especially Meshfree Methods, to provide the typical user with adequate knowledge to confidently apply the appropriate analysis technique. However, this training class is not a substitute for the in-depth treatments presented in the associated LS-DYNA training classes, i.e. "ALE/ Eulerian & Fluid Structure Interaction" and "Mesh-Free Methods (SPH-EFG)", respectively.

Courtesy of French-German Research Institute of Saint-Louis (ISL)

■ EXPLOSIVES MODELING FOR ENGINEERS

Type:
  Seminar
Duration:
  1 day
Fee:
  550 Euro
Lecturers:
  Paul Du Bois,
  Consultant;
  Dr. Len Schwer,
  Schwer Engineering
  & Consulting Services
Language:
  English
Date:
  20 October

This class focuses on the application of LS-DYNA to modeling explosives. LS-DYNA simulations involving explosives can be modeled on several engineering levels from simple application of equivalent pressure histories via *LOAD_ BLAST_ENHANCED, explicit inclusion of explosive charges using Equations-of-State and detonation via *INITIAL_DETONATION, and detonation of explosive due to impact using *EOS_IGNITION_ AND_GROWTH_OF_REACTION_IN_HE. The analyst selects the appropriate degree of model sophistication to satisfy the intended use of the model results.

The modeling methods are illustrated through case studies with sufficient mathematical theory to provide the user with adequate knowledge to then confidently apply the appropriate modeling method.

This training class is intended for the LS-DYNA analyst possessing a comfortable command of the LS-DYNA keywords and options associated with typical Lagrange and Multi-Material Arbitrary Lagrange Eulerian (MM-ALE) analyses.
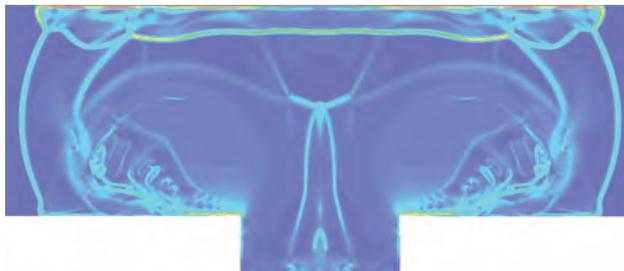
Courtesy of Rheinmetall Landsysteme GmbH

DYNA MORE

■ LS-OPT - OPTIMIZATION AND ROBUSTNESS

LS-OPT is an independent comprehensive, optimization program which is designed and developed by LSTC. It is ideal for solving strongly nonlinear optimization problems and is thus highly suitable for the usage in combination with LS-DYNA. However, LS-OPT can also be combined with any other solver, which offers the possibility to also solve multi-disciplinary problems.

LS-OPT is based on very effective response surface methods and offers also other genetic algorithms. Moreover, the program includes stochastic methods to assess the robustness of FE models and to illustrate dependencies between optimization variables and objective functions. The definition of the optimization problem is supported with the aid of a comfortable graphical user interface.

The aim of this course is to give participants a comprehensive overview of the practical application of stochastic methods and robustness analysis using LS-OPT. Additionally, basic knowledge of statistics and probabilistic will be given and the methods implemented in LS-OPT will be discussed.

Introduction and Optimization (2 days)	**Robust Design (1 day)**

The seminar gives an introduction to the program LS-OPT. General theoretical aspects of the Response Surface Method are presented and the possibilities of applying this method in LS-OPT are explained. In particular, the application of LS-OPT in combination with nonlinear FE solvers will be discussed in more detail. Seminar participants will be given the chance to implement their newly-gained knowledge with the aid of hands-on workshop examples.

Content
- Overview of optimization methods for strongly nonlinear problems
- Formulation of an optimization problem (objective function, constraints, design variables, etc.)
- DOE (Design of Experiments)
- Theory of the Response Surface Method (RSM)
- Interpretation of approximation errors of metamodels
- Multidisciplinary Optimization (MDO)
- Sensitivity analysis (ANOVA, Sobol)
- Parameter Identification
- Multi-objective Optimization (MOO, Pareot frontiers)
- LS-OPT graphical user interface
- Visualization of optimization results in LS-OPT
- Application examples

Methods for stochastic analysis to judge the robustness of FE models as well as influences of design variables on responses have been implemented in LS-OPT. These features allow answering questions such as:

- What is the probability of a specific failure limit being exceeded?
- Is my solution robust or does a minor variation of my input variables lead to a completely different result?
- Is the dependence between input variables and the response (solution) chaotic or predictable?
- Is there a correlation between variables and responses or between responses and responses?

To attend the module "Robust Design", prior attendance at the module "Introduction and Optimization" is recommended.

Type:
 Seminar
Duration:
 3 days
Fee:
 1,425 Euro
 (475 Euro per day, can be booked separately)
Lecturers:
 Katharina Witowski,
 Dr. David Aspenberg,
 both DYNAmore
Dates:
 22-24 March
 04-06 April [L]
 12-14 September [G]
 19-21 September [V]
 23-25 October
 28-30 November [Tu]

[L] Linköping, Sweden
[G] Göteborg, Sweden
[Tu] Turin, Italy
[V] Versailles, France

POPULAR
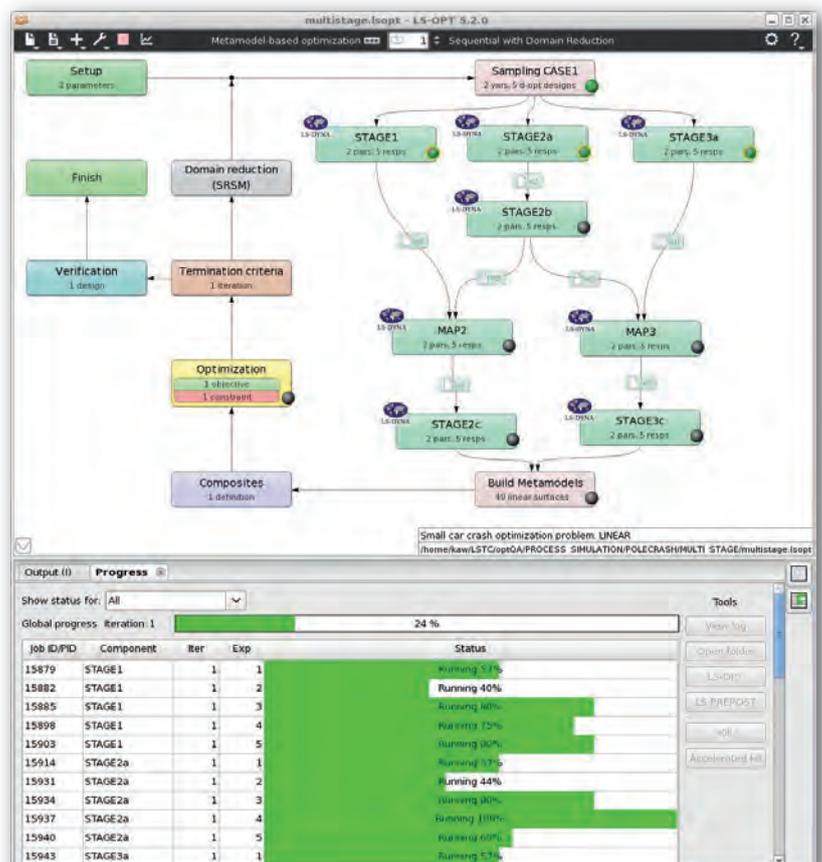
■ BASICS OF INDUSTRIAL STRUCTURAL OPTIMIZATION

Type:
  Seminar
Duration:
  1 day
Fee:
  550 Euro
Lecturer:
  Dr. Stefan Schwarz,
  Dr. Ing. h.c. F.
  Porsche AG
Date:
  21 March

The aim of this class is to provide interested users of optimization software with background information on optimization strategies and the associated algorithms. There exist many different terms for the available methods in the field of optimization, e. g. topology, topography and topometry optimization, which are often hard to categorize for the user. These methods are usually applied in combination with linear finite element analyses. For the optimization of nonlinear systems, special gradient-based methods (numerical/analytical), response surface methods, or genetic and stochastic search methods are frequently applied.

The aim of this class is to discuss the capabilities and limits of these methods such that the participants learn how to distinguish between the different structural optimization techniques. How the methods work as well as their practical application will be illustrated with examples particularly from the automotive industry.

Content
- Introduction to the basics of mathematical optimization
- Classification and explanation of different methods
- Selection of the right method based on the application
- Possibilities and limits of the different methods
- Effectivity analysis of the algorithms
- Pros and cons of the methods
- Correct definition of an optimization problem
- Interpretation of results

Courtesy of Hyundai Motor Company

■ STRUCTURAL OPTIMIZATION WITH GENESIS

Type:
  Seminar
Duration:
  2 days
Fee:
  950 Euro
Lecturers:
  VR&D and DYNAmore
  staff members
Date:
  18-19 July

GENESIS is an integrated FE analysis and optimization software program from Vanderplaats R&D. Among other things, GENESIS can be used to carry out comprehensive linear static structural analyses, perform time and frequency dynamic analyses, determine normal modes and natural oscillations as well as calculate heat transfer problems and composite structures. GENESIS enables conceptual designs of shape, form and material to be optimized providing the user with highly-efficient methods for topology, topometry, topography, sizing and shape optimization.

The implemented optimization strategies (DOT, BIGDOT) and the close interaction of FE analysis with the optimization algorithms allow the identification of an optimal design both efficiently and reliably. This is also the case for complex problems, generally requiring only a few FE analyses. The execution and analysis of an optimization is fully graphically supported by Design Studio for GENESIS.

The seminar gives an introduction to the GENESIS program and to the graphical user interface Design Studio for GENESIS. The various optimization concepts (topology, topometry, topography, sizing and form optimization) as well as areas of application are presented and discussed. Selected problems are also solved by participants using GENESIS during the seminar.

Content
- Introduction to topology, topometry, topography, sizing and form optimization
- Pre- and postprocessing with Design Studio for GENESIS
- Visualization of results using Design Studio for GENESIS
- Optimization, taking manufacturing constraints into account
- Optimization of natural structural oscillations/ vibrations (with mode tracking)
- Application examples

Corvette Daytona Prototype – Designed and built: Pratt & Miller
Courtesy of Vanderplaats Research and Development, Inc.

■ INFORMATION DAY: OPTIMIZATION/DOE/ROBUSTNESS

On this information day, several presentations will be given on examples of use as well as on solution strategies addressing optimization problems, sensitivity studies, design studies with meta-models or robustness and reliability investigations. Moreover, new developments in our software products LS-OPT and GENESIS will be illustrated as well as planned future developments are discussed.

With the aid of specific examples, new applications will be presented that demonstrate the practical usability of our software solutions. This stimulates participants to consider areas of application where LS-OPT or GENESIS can be effectively implemented as optimization software.

The optimization program LS-OPT
- is ideally suited for solving strongly nonlinear optimization problems and can thus be optimally combined with LS-DYNA,
- functions on the basis of the highly efficient Response Surface Method,
- contains stochastic methods for assessing the robustness of FE models and for determining dependencies between disturbance variables and system answers,
- enables significant and insignificant variables to be identified (variable screening, sensitivity analyses),
- can simultaneously combine several FE applications of different analysis types with different definitions of variables (multidisciplinary optimization (MDO)),
- is based on a clearly-arranged graphical user interface which enables optimization problems to be defined in a very simple way.

GENESIS of Vanderplaats R&D
- is a fully-integrated FE analysis and optimization software program,
- enables conceptual designs of shape, form and material to be optimized by providing the user with highly-efficient methods for topology, topometry, topography, sizing and shape optimization
- is ideally suited to optimize linear problems with a large number of design variables (>1 million),
- has an intuitively operated graphical user interface,
- is almost 100% compatible with Nastran.

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Dates:
  06 March
  30 March [v)]
  25 September

[v)] Versailles, France
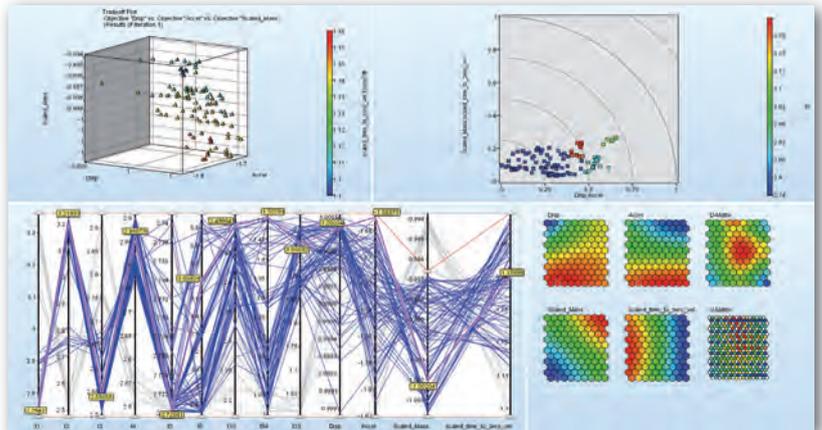
■ INFORMATION DAY: INTEGRATED OPTIMIZATION WITH ANSA, LS-OPT AND META

The current versions of LS-OPT and ANSA support simple coupling between ANSA and LS-OPT. For example, ANSA offers excellent possibilities to realize parameterized changes of FE meshes by means of morphing technologies. The control parameters for morphing are passed to LS-OPT, where they are controlled and modified. Thus, form optimizations or robustness analyses taking into account geometrical changes can be realized straightforward. Following this, any desired optimization variable can be defined in the FE input files in ANSA and can be passed to the optimization process in LS-OPT.

Moreover, the META postprocessor from BETA CAE Systems can be used to extract simulation results, which can then be automatically imported by LS-OPT as history or response quantities. This is of particular interest, if FE solvers other than LS-DYNA are to be used for optimization.

This information day shows how ANSA and META can be used in combination with LS-OPT to realize optimization and stochastic analyses. Examples from industrial practice will also be presented.

Content
- Short introduction to the morphing technologies of ANSA, Live demo with examples
- Application of the task manager in ANSA for the optimization
- Definition of design variables in ANSA
- Interface in LS-OPT for ANSA
- Use of META for simulation data extraction for LS-OPT
- Practical examples

In collaboration with LASSO

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Date:
  20 February
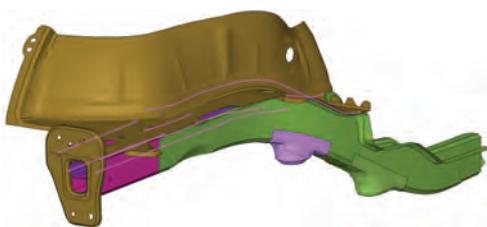
Courtesy of Audi AG

■ INFORMATION DAY: LS-DYNA FOR CIVIL ENGINEERING APPLICATIONS

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Date:
  20 July

With the increasing number of possibilities offered by LS-DYNA in implicit dynamics, engineering problems in long time dynamics can now also be examined and solved efficiently. Especially for challenging problems in civil engineering these functionalities are very interesting. Besides the classical tasks such as the vibration analysis of bridges and high-risers due to earthquakes, now serviceability problems, like the vibrations started by pedestrians or machine dynamics can be computed.

Furthermore LS-DYNA is said to be one of the world's leading software codes in the field of short time dynamics. Here typical civil engineering applications such as simulation based pendulum impact tests, vehicle impact on bridge structures, as well as - especially lately - civil defense or terror prevention problems can be solved. The excellent possibilities in LS-DYNA for the solution of fluid-structure-interaction problems can now be used to master the increasing challenges of facade-structures subjected to blast loads. Thus state-of-the-art simulation techniques can contribute to a more efficient dimensioning of cross sections.

The goal of this information event is to show experts in the field of civil engineering the various possibilities of LS-DYNA in the above mentioned areas. Particularly a more realistic estimation of loads for complex problems, thus leading to safer designs, as well as the potential of more economic dimensioning of structures will be the benefit.

Content
- Introduction of LS-DYNA
    - Explicit and implicit applications
    - Soil and concrete models
    - ALE for concrete, etc.
- Bridge design
    - Implicit vibration examination
    - Earthquake (beam models)
- Structural engineering
    - Glass models
    - Pendulum impact tests
    - Vehicle impact
- Civil defense (explicit):
    - Blast loads on facade surfaces
      and mountings
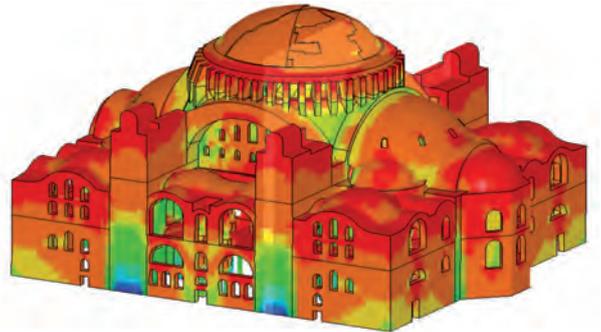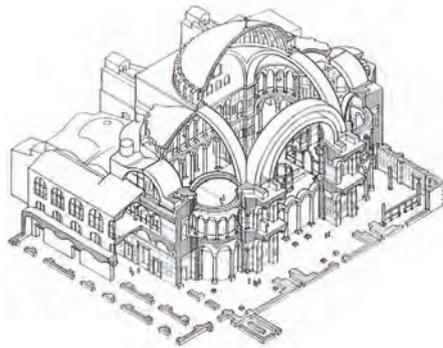
Earthquake hazard of the Hagia Sophia in Istanbul, numerical analysis models for dynamic loads, DFG-Project SCHW307-32-1
K. Schweizerhof, G. Blankenhorn (now LSTC), F. Wenzel, C. Duppel (Karlsruher Institut für Technologie, KIT, Germany)
Courtesy of Institut für Mechanik, Karlsruher Institut für Technologie KIT, Germany

INTRODUCTION TO PRIMER FOR LS-DYNA

The PRIMER preprocessor provided by our partner Arup is a high-performance solution to process and control LS-DYNA models. In addition to the range of features usually offered by a preprocessor, PRIMER can be used to adjust very specific LS-DYNA settings, such as all available contact options, special joints or highly complex material models.

PRIMER has been specially and exclusively designed for LS-DYNA as an FE solver. In many cases, PRIMER is also applied to check LS-DYNA models for errors or to remove redundant entries that may cause problems. In addition, the program offers a range of special properties to model occupant safety simulations, such as dummy positioning, seat adjustment, seatbelt fitting, or airbag folding.

Participants of this seminar will learn the practical use of PRIMER. All important functions are described and demonstrated with the aid of workshop examples such that everybody will enhance their capabilities in the safe operation for different areas of application.

In collaboration with ARUP

Courtesy of Arup

Type:
  Seminar
Duration:
  1 day
Fee:
  475 Euro
Lecturer:
  Daniel Keßler,
  DYNAmore
Language:
  German
Dates:
  06 April
  04 December

INFORMATION DAY: PRIMER AS PREPROCESSOR FOR LS-DYNA

The preprocessor PRIMER is developed by our partner Arup and offers a high performance solution to process and control LS-DYNA models. It is especially designed for LS-DYNA and supports almost 100% the available control cards and input options in LS-DYNA.

The program also offers a range of special properties to model occupant safety simulations, such as dummy positioning, seat adjustment, seatbelt fitting, or airbag folding.

This information day will provide attendees with an overview of the capabilities and limitations of the preprocessor PRIMER. This will be done with the aid of selected examples as well as live demonstrations.

In collaboration with ARUP

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Date:
  08 March

Arup PRIMER

The high-performance preprozessor for LS-DYNA

Because the program is specially and exclusively tailored to LS-DYNA as an FE (Finite Element) solver, PRIMER not only offers the standard scope of features of a preprocessor but also contains additional features:

- For implementing special settings, such as all available contact options, special joints, complex material models.
- For testing models, e. g. recognizing superfluous defined entries
- Special features for modeling occupant simulations, such as positioning dummies, adjusting seats, attaching seat belts or folding airbags.

Visit our information days and convince yourself about PRIMER, the preprocessor for LS-DYNA.

ARUP

www.dynamore.de

◼ ANSA AND METAPOST FOR LS-DYNA

The two-day seminar is suitable for engineers who are interested in using LS-DYNA in connection with the preprocessor ANSA and the postprocessor METApost.

Besides its excellent meshing capabilities, ANSA offers an extensive interface to LS-DYNA. Speakers from LASSO and DYNAmore will give participants an insight into the entire simulation process chain using ANSA – LS-DYNA – METApost.

Courtesy of BETA CAE Systems

Content 1st day: ANSA preprocessing
- Which problems can be solved with LS-DYNA?
- How is a LS-DYNA input deck generated with ANSA?
- Which element types are available in LS-DYNA, how are they defined in ANSA?
- How are different contact options adjusted in ANSA, what do these options mean?
- How can a material model be specified?

Content 2nd day: METApost postprocessing
- Introduction to the LS-DYNA interface of METApost:
  - 3-d result evaluation and x-y plots with METApost
  - Exercises
- Interpretation of results
- Important plausibility checks
- Result evaluation with practical crash-examples

Please note:
The seminars ANSA and METApost can be booked independently and will held on on request. Please contact us.

In collaboration with LASSO

◼ HYPERWORKS FOR LS-DYNA

The main application areas of LS-DYNA are crash worthiness simulation, metal forming, impact problems or other highly nonlinear problems. Furthermore, LS-DYNA can be used advantageously for solving highly nonlinear static problems, where implicit solution methods fail due to convergence problems.

The two-day introductive seminar is suited for engineers interested in computing nonlinear problems using LS-DYNA. The seminar provides a direct introduction into the application of LS-DYNA and into the LS-DYNA interface integrated in HyperMesh.

Content
- Which problems can be solved by LS-DYNA?
- Available element types and their definition in HyperMesh
- How to use the different contact options in HyperMesh?
- How to specify a chosen material model in HyperMesh?
- How to implement crash simulations and other dynamical computations and how to edit these models in HyperMesh?
- Treatment of quasi-static problems
- Evaluation of results using HyperMesh/yperView/HyperGraph
- Tutorials

Please note:
The seminar will held on on request. Please contact us regarding dates.

In collaboration with Altair

■ SUPPORT DAY: LS-DYNA

At the support days you are invited to come to our office in Stuttgart-Vaihingen bringing along the output of your LS-DYNA simulation as well as your input decks. It has been proven that a direct consultation with you at the screen is the easiest way to answer your questions. Together with you, our experienced employees of DYNAmore will

directly try to optimize your input decks or to solve problems in your simulation. Also very often, the questions are simply on how to model and solve a specific problem using LS-DYNA or what other modeling techniques and possibilities are offered by LS-DYNA.

Take advantage of this service, as we are certain that we can resolve many uncertainties or mis-understandings in the usage of LS-DYNA. You can simply bring along your CAD data or drawings to discuss your problem or you may also provide your data in advance. This would allow us to prepare even better for our conversation.

Please register ahead of time for the support days – ideally with a specification of the load case.

Courtesy of TAKATA-PETRI AG

Type:
  Support day
Duration:
  1/2 day
Fee:
  Free of charge
Dates:
  20 January
  17 February
  21 April
  19 May
  16 June
  15 September
  20 October
  17 November

■ SUPPORT DAY: OCCUPANT SAFETY

On the occasion of the occupant safety support days, you can bring your own LS-DYNA simulations or input decks to our headquarters in Stuttgart-Vaihingen. The support days will mainly focus on questions regarding the handling and analysis of dummy models. Experienced members of the DYNAmore staff will be available to discuss your specific needs and to find solutions to your problems. As a matter of course, questions will be dealt with on a confidential basis without any other customers being present.

Exemplary questions
- How can I position a model?
- How accurate are the results?
- Do I require any prestress in the model?
- Is the model for the seat or door sufficiently refined?
- What do I have to pay attention to during postprocessing?

- Have I developed a sufficiently exact model for my restraint system?

Please register ahead of time for these support days – ideally with a specification of the load case, such that we are able to prepare for your visit.

Courtesy of
Autoliv & Volvo Cars

Type:
  Support day
Duration:
  1/2 day
Fee:
  Free of charge
Dates:
  17 March
  21 July
  15 December

■ WEBINARS – STRAIGHTFORWARD INFORMATION ON LS-DYNA

During the webinars, already established as well as new developments in LS-DYNA will be presented and their usage will be explained. On the on hand, the goal is to inform LS-DYNA users about new features and on the other hand, to provide an overview of the capabilities of LS-DYNA to interested users, who already have experience with other finite element solvers.
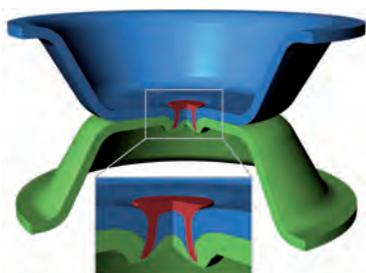
Particular focus will be drawn on new software versions, thereby outlining the resulting new application possibilities. Moreover, background information will be given on future developments and trends. Following this, the selection of topics for the webinars is dynamically adapted to current demands and will be announced on short notice in our newsletter as well as on our website www.dynamore.de.

Topics
- Nonlinear implicit FE analysis in LS-DYNA
- LS-OPT
- DYNAstart
Exemplary further topics
- Presentation of new LS-DYNA releases
- Hardware: MPI, Hybrid, MPP/SMP, GPU,...
- Joining techniques
- Material modeling
- New element formulations:
  ALE, CPM, EFG, SPH, DEM, isogeometry
- CFD and FSI
- DYNAtools

Type:
  Webinar
Duration:
  Approx. 60 - 90 min.
Fee:
  Free of charge
Dates:
  Dates will be
  announced in
  short term

empowering
CAE processes

SCALE
IT-Solutions for CAE

+ PRODUCTS

- **CadMe**
  Support meshing processes and data provision for CAD/CAE

- **LoCo**
  Comprehensive simulation data management solution for CAE processes

- **CAViT**
  Integrated post data management for tests and simulation

- **Status.E**
  Monitoring of requirements and project status in product development

+ IT-SERVICES

+ CONSULTING

DYNA
MORE

■ INTRODUCTION TO SIMULATION DATA AND PROCESS MANAGEMENT WITH LOCO

The software system LoCo is a work environment for managing simulation data and processes. In particular, the distributed development through simulation, across locations within a company or with external development partners, is greatly supported by LoCo.

Simulation models are managed in LoCo and provided to users via a graphical user interface in a structured manner. Due to the integrated version management, any changes made by the user to the simulation models can be tracked. So-called "History Trees" show all changes during the development process. In addition, LoCo provides an environment for the integration of arbitrary, user-specific specialized CAE processes like model/load case construction, quality control, parameter studies, linked simulations, etc.

On the first day, the seminar provides participants the basic knowledge of how to use LoCo. In-depth knowledge in the application of LoCo is dealt with on the optional second day. The usage of the software and the realization of workflows for the daily work as a design engineer will be presented in detail.

Day 1 (base)
- ■ Introduction to LoCo, overview
- ■ Use of the graphical user interface
  - Browser
  - Grid
  - Property view
  - Notification console
  - History trees
  - Inbox
  - Job status
  - Menus
- ■ Tutorials, workshop
  - Setup Wizard
  - Adding and editing Includes
  - Definition of parameters / attributes
  - Construction of runs
  - Working with the history graph

Day 2 (construction)
- ■ Modeling recommendations
- ■ Merge and Compare
- ■ Management of attributes
- ■ Creating and configuring new projects
- ■ Error analysis (Notification console)
- ■ Parameter (DOE) studies, Optimization and robustness with LoCo and LS-OPT
- ■ Python interface
- ■ Representing individual processes of departments and disciplines in LoCo (depending on the group of participants)

Type:
  Seminar
Duration:
  2 days
Fee:
  950 Euro
  (475 Euro per day, can be booked separately)
Lecturer:
  SCALE GmbH staff member
Date:
  01-02 June

SCALE
IT-Solutions for CAE
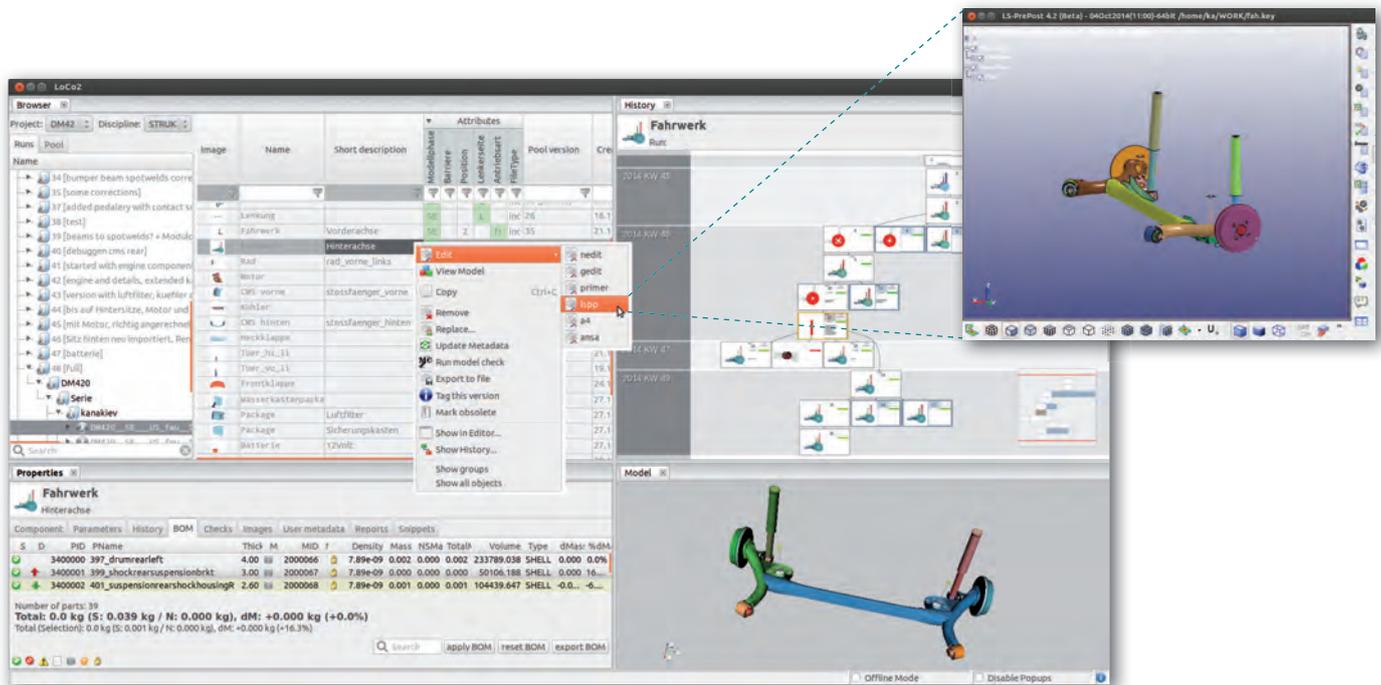
LoCo graphical user interface – model processing using the example of LS-PrePost

■ INFORMATION DAY: PROCESS AUTOMATION AND SIMULATION DATA MANAGEMENT (SDM)

Type:
  Information day
Duration:
  1/2 day
Fee:
  Free of charge
Date:
  09 October

SCALE
IT-Solutions for CAE

Today, simulation data management (SDM) is a highly relevant topic in computer-aided engineering (CAE) of vehicles. While a few years ago, the input of a vehicle model to analyze its crashworthiness consisted of only one large file. Today, such models are constructed using modules which consist of numerous separate components. Following this, the overall input file for the finite-element solver is assembled on the basis of such model components, e.g. airbags, doors, dummies, etc. Moreover, the number of load cases that need to be investigated by simulation engineers is also constantly increasing.

Courtesy of Audi AG

Among others, the administration of these model components in a multi-user environment as well as the automated simultaneous preparation of several load cases for simulation are demanding challenges for an SDM system. The automated data flow from CAD to CAE, i.e. from the geometrical representation to meshed components, is another important subject. This also includes the demand for consistent and transparent metadata relating to the process chain CAD - Pre-SDM - assembly - simulation - post processing.

Simulation data/process management can basically be divided into three sections:

- Linking CAD-CAE, i.e. batch processing to meshing/discretization of component geometries (Pre-SDM)
- Load case compilation and input (includes) data management (assembly)
- Management of simulation results (Post-SDM)

The event will be held in collaboration with partner companies. The above-mentioned topics from process automation and simulation data management will be jointly discussed.

DYNAMORE
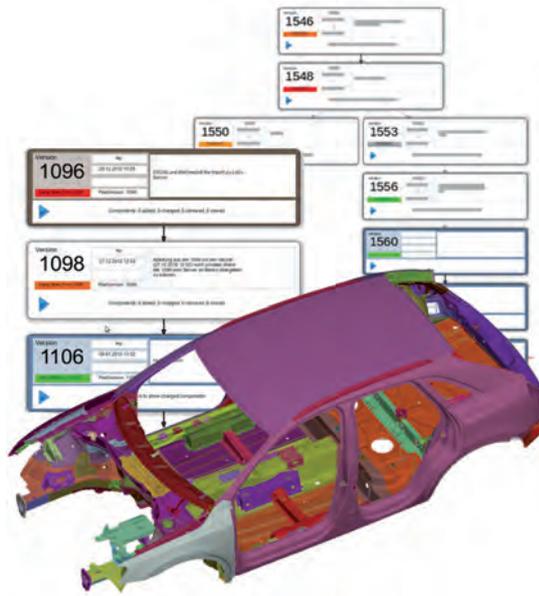
VOCATIONAL TRAININGS FOR LS-DYNA SIMULATION ENGINEERS IN VARIOUS APPLICATION AREAS

This offer gives you the chance to receive complete comprehensive instruction in your field of application. This includes training packages for certified simulation engineers in the fields of nonlinear structural mechanics (crash), occupant safety and metal forming. We would be happy to provide conceptual advice regarding comprehensive solutions for vocational trainings to become a simulation engineer using LS-DYNA. Please get in touch with us.

■ LS-DYNA FOR NONLINEAR STRUCTURAL MECHANICS (CRASH)

Professional education to become a certified simulation engineer in nonlinear structural mechanics using LS-DYNA

This package offers you an efficient option to receive comprehensive training as a nonlinear structural simulation engineer using LS-DYNA. After taking part in these seminars, you will have the necessary know-how to meet industrial requirements as a simulation engineer. On completion of all seminars within the package, you will receive a certificate declaring you a qualified LS-DYNA simulation engineer in nonlinear structural mechanics.
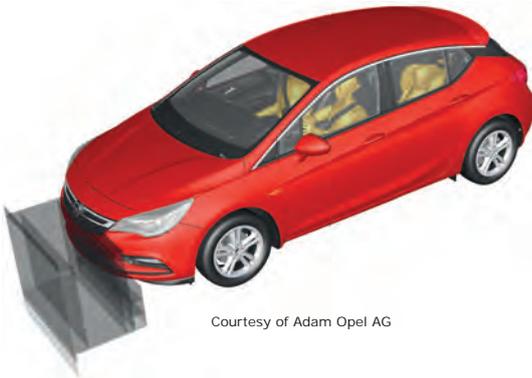
Courtesy of Adam Opel AG

Seminars
- ■ Introduction to LS-DYNA: Basics - 2 days
- ■ Introduction to LS-DYNA: Advanced Topics - 1 day
- ■ Contact Definitions in LS-DYNA - 1 day
- ■ Joining Techniques for Crash Analysis with LS-DYNA - 2 days
- ■ Modeling Metallic Materials - 2 days

Package price: 3,540 Euro

■ LS-DYNA FOR OCCUPANT SAFETY SIMULATIONS

Professional training to become a certified simulation engineer in occupant safety simulation using LS-DYNA

With this package, you receive comprehensive training for the computational design of occupant safety systems. After attending these seminars you will have the necessary know-how to meet industrial requirements as a simulation engineer in occupant safety. On completion of all courses within the package, you will receive a certificate declaring you a qualified LS-DYNA simulation engineer in occupant safety simulation.

Seminars
- ■ Introduction to LS-DYNA: Basics - 2 days
- ■ Contact Definitions in LS-DYNA - 1 day
- ■ Introduction to Passive Safety Simulation with LS-DYNA - 2 days
- ■ LS-DYNA Dummy and Pedestrian Impactor Modeling - 1 day
- ■ CPM for Airbag Modeling - 1 day

Package price: 3,100 Euro

Courtesy of Daimler AG

### ■ LS-DYNA FOR METAL FORMING

Professional training to qualify for a certified simulation engineer in metal forming using LS-DYNA and eta/DYNAFORM

After taking part in these seminars you will be able to carry out forming simulations in an industrial environment as a simulation engineer. On completion of all seminars within the package, you receive a certificate declaring you a qualified LS-DYNA simulation engineer in forming processes.
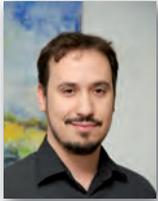
Seminars
- ■ Introduction to LS-DYNA: Basics - 2 days
- ■ Introduction to LS-DYNA: Advanced Topics - 1 day
- ■ Contact Definitions in LS-DYNA - 1 day
- ■ Applied Forming Simulation with eta/DYNAFORM - 2 days
- ■ Metal Forming with LS-DYNA - 2 days

Package price: 3,540 Euro
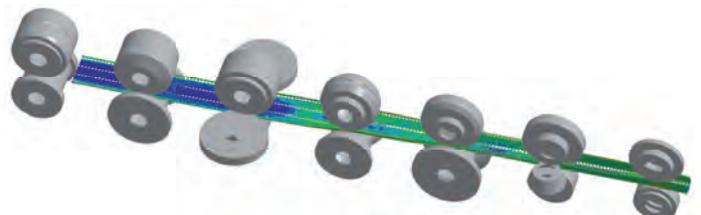
Courtesy of Ubeco GmbH

■ DYNAMORE LECTURERS

Dr. Filipe Andrade
Areas of expertise:
Material modeling, FE theory
Academic studies:
Mechanical engineering

Dipl.-Ing. Alexander Gromer
Areas of expertise:
Occupant safety, dummy models
Academic studies:
Mechanical engineering

Dr.-Ing. Tobias Erhart
Software developer LS-DYNA
Areas of expertise:
FE theory, material modeling
Academic studies:
Civil engineering

Dr.-Ing. Stefan Hartmann
Software developer LS-DYNA
Areas of expertise:
Composites, FE theory
Academic studies:
Civil engineering

Dipl.-Math., Dipl.-Ing. (BA) Uli Franz
Managing director
Areas of expertise:
Occupant safety, dummy models
Academic studies:
Mechanical engineering, mathematics

Dr.-Ing. Andre Haufe
Manager process simulation
Areas of expertise:
Material modeling, forming simulations,
joining techniques
Academic studies:
Civil engineering

Dr.-Ing. Dirk Freßmann
Development and support THUMS
Areas of expertise:
Human models, FSI
Academic studies:
Civil engineering

Dr. Bernd Hochholdinger
CEO DYNAmore Swiss GmbH
Area of expertise:
Thermal forming processes
Academic studies:
Civil engineering

Diplôme d'Ingénieur Pierre Gley
Areas of expertise:
Forming and process simulations
Academic studies:
Mechanical engineering

Dr.-Ing. Nils Karajan
Manager trainings
Areas of expertise:
Multiphysics, biomechanics
Academic studies:
Civil engineering

Dr.-Ing. Tobias Graf
Areas of expertise:
Joining techniques, material modeling
Academic studies:
Civil engineering

Dipl.-Ing. (FH) Daniel Kessler
Support PRIMER
Areas of expertise:
Crash, occupant safety, seats
Academic studies:
Civil engineering

Prof. Dr. rer. nat. Ulrich Göhner
Manager software solutions
Area of expertise:
Computational fluid dynamics (CFD)
Academic studies:
Mathematics

Dr.-Ing. Thomas Klöppel
Software developer LS-DYNA
Areas of expertise:
Composites, FE theory
Academic studies:
Mathematics

Dipl.-Ing. Markus Künzel
Support eta/DYNAFORM
Area of expertise:
Forming and process simulations
Academic studies:
Mechanical engineering/automotive

Prof. Dr.-Ing. Karl Schweizerhof
Technical director
Area of expertise:
FE theory
Academic studies:
Civil engineering

Dipl.-Ing. Christian Liebold
Area of expertise:
Composites
Academic studies:
Aerospace engineering

Dipl.-Ing. Sebastian Stahlschmidt
Manager occupant simulation
Areas of expertise:
Occupant safety, dummy models
Academic studies:
Civil engineering

Dipl.-Ing. Silvia Mandel
Area of expertise:
Occupant safety, pre-/postprocessing
Academic studies:
Mechanical engineering

Dipl.-Ing. (FH) Peter Vogel
Manager deep drawing simulations
Area of expertise:
Forming simulations
Academic studies:
Mechanical engineering

Dr.-Ing. Steffen Mattern
Area of expertise:
Crash
Academic studies:
Civil engineering

Dipl.-Math. Katharina Witowski
Software developer LS-OPT
Area of expertise:
Optimization
Academic studies:
Mathematics

Dipl-Ing. Mathias Merten
Area of expertise:
Forming and process simulations
Academic studies:
Mechanical engineering

Dr.-Ing. Heiner Müllerschön
CEO SCALE GmbH
Areas of expertise:
Optimization, processes, SDM
Academic studies:
Civil engineering

Dr. Thomas Münz
Managing director
Areas of expertise:
Material modeling
Academic studies:
Techno-mathematics
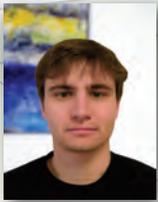
■ EXTERNAL LECTURERS

Dipl.-Ing. Paul Du Bois
Consultant
Lecturer of the seminars:
- Crashworthiness Simulation with LS-DYNA
- Methods for Simulating Short Duration Events
- Blast Modeling with LS-DYNA
- Penetration Modeling with LS-DYNA
- Explosives Modeling for Engineers

Dr.-Ing. Tobias Loose
Ingenieurbüro Tobias Loose
Lecturer of the seminar:
- Introduction to Welding Simulation
  with LS-DYNA

Iñaki Çaldichoury
Livermore Software Technology Corporation
(LSTC) – software developer LS-DYNA
Lecturer of the seminars:
- Electromagnetism in LS-DYNA
- ICFD – Incompressible Fluid Solver
- CESE – Compressible Fluid Solver

Dr.-Ing. Stefan Schwarz
Dr. Ing. h.c. F. Porsche AG
Lecturer of the seminar:
- Basics of Industrial Structure
  Optimization

Dr.-Ing. Markus Feucht
Daimler AG
Lecturer of the seminars:
- Joining Techniques for Crash Analysis
  with LS-DYNA
- Damage and Failure Modeling

Dr. Len Schwer
Schwer Engineering & Consulting Services
Lecturer of the seminars:
- Crashworthiness Simulation with LS-DYNA
- Methods for Simulating Short Duration Events
- Blast Modeling with LS-DYNA
- Penetration Modeling with LS-DYNA
- Explosives Modeling for Engineers

Dr. Wei Hu
Livermore Software Technology Corporation
(LSTC) – software developer LS-DYNA
Lecturer of the seminar:
- Meshfree EFG, SPG and Advanced
  FE Methods for Structural Analyses

Prof. Mhamed Souli
University of Lille
Lecturer of the seminars:
- ALE und FSI in LS-DYNA
- Smoothed Particle Hydrodynamics
  (SPH) in LS-DYNA

Dr. Yun Huang
Livermore Software Technology Corporation
(LSTC) – software developer LS-DYNA
Lecturer of the seminar:
- NVH, Frequency Domain Analysis and
  Fatigue with LS-DYNA

Dr. Cheng-Tang Wu
Livermore Software Technology Corporation
(LSTC) – Software-Entwickler LS-DYNA
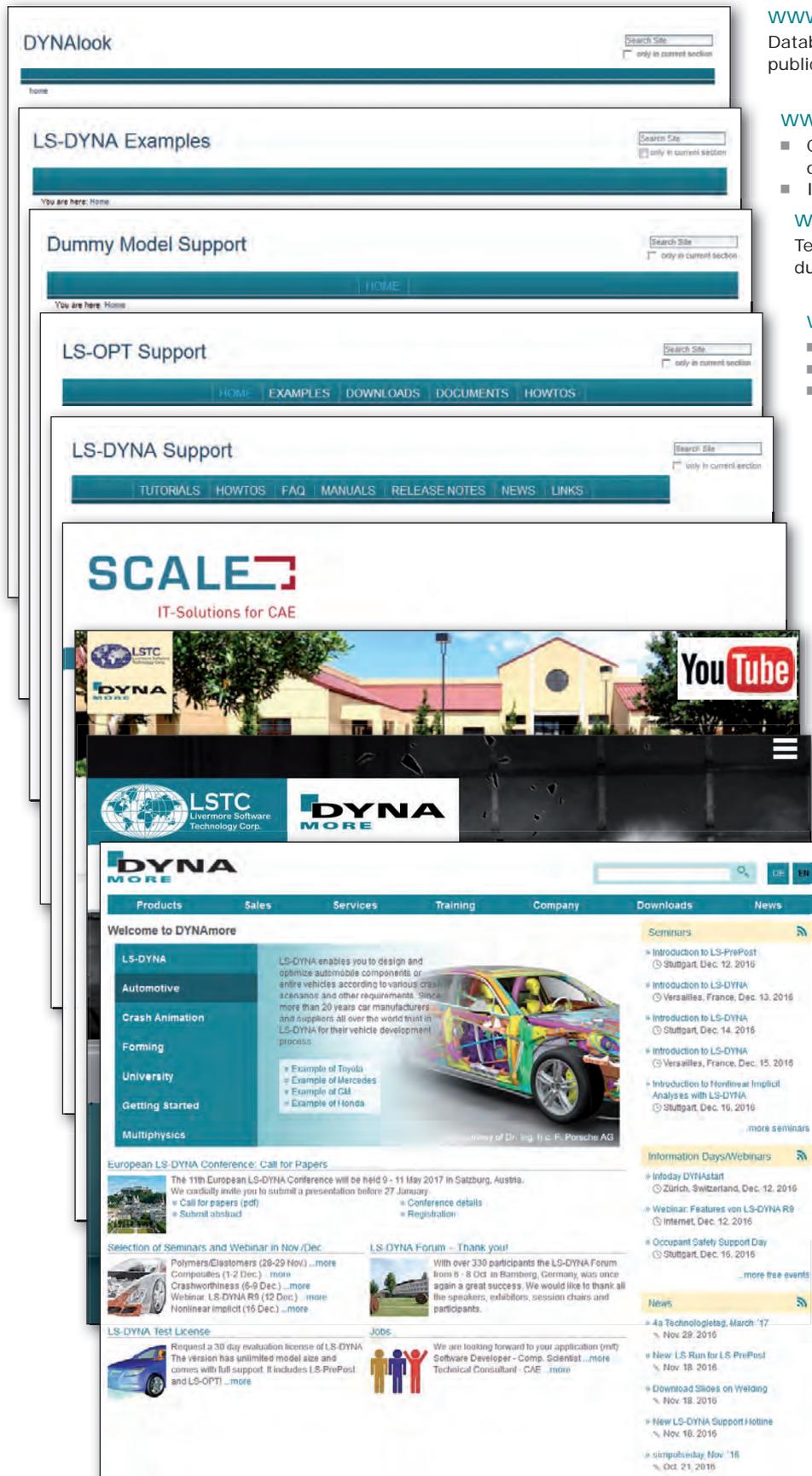Lecturer of the seminar:
- Meshfree EFG, SPG and Advanced
  FE Methods for Structural Analyses

Prof. Dr.-Ing. Stefan Kolling
Technische Hochschule Mittelhessen
Lecturer of the seminar:
- Modeling of polymers and elastomers
  in LS-DYNA

USE OUR E-SERVICES ON THE WEB

www.dynalook.com
Database for downloading numerous publications on LS-DYNA applications.

www.dynaexamples.com
- Comprehensive collection of examples of various LS-DYNA training seminars
- Images, animations, LS-DYNA input decks

www.dummymodels.com
Technical information about LS-DYNA dummy models.

www.lsoptsupport.com
- LS-OPT support site
- Examples, documents
- FAQs, HowTo´s

www.dynasupport.com
- LS-DYNA support site
- Tutorials, release notes
- FAQs, HowTo´s

www.scale.eu
- CAE data management (SDM)
- Process integration/automation
- Optimization

www.dynamore.de/youtube
YouTube channel with numerous tutorials and animations of LS-DYNA, LS-PrePost, LS-OPT and LS-TaSC.

www.ls-dynacloud.com
Simulation platform to utilize LS-DYNA on a high performance computing platforms in the cloud.

www.dynamore.de
- Description of software products and FE models
- Download area for software and documentation
- Current information and offers
- Seminar dates, booking and descriptions
- Contact addresses
- Conference information
- FE and IT services

ABOUT DYNAMORE

DYNAmore GmbH – Gesellschaft für FEM-Ingenieurdienstleistungen – is your contact partner for consulting, training, support and sales services concerning the finite element software LS-DYNA. The product portfolio consists of LS-DYNA, LS-OPT, LS-PrePost, GENESIS, additional complementary programs as well as numerous FE models for crash simulations (dummies, barriers, pedestrians, human models, etc.).

Our range of services is completed by secured and qualified support for all application fields, various seminars as well as FEM calculation services and general consulting on the subject of structural dynamics. We are one of the top addresses for pilot and development projects concerned with the simulation of nonlinear dynamic problems. The services provided by DYNAmore GmbH also include software development for finite element solver technology and simulation data management as well as consulting and support for modern, massively parallel computer systems.

LS-DYNA – one solution for many nonlinear problems

LS-DYNA is one of the world's leading finite elements software systems for the numerical simulation of highly-complex, nonlinear dynamic processes, such as

- Crash
- Occupant safety
- Metal forming
- Impact and drop tests
- Snap-though buckling
- Penetration problems
- Fluid structure interaction
- Thermo-mechanical coupling
- Explosion

The program is intensively used in the automotive, aircraft and aerospace industries. Further areas of application include bio-mechanics, shipbuilding, locomotive construction, civil engineering, defense industry and consumer goods industry. A wide range of problems can be solved by LS-DYNA simply using standard PC.

LS-PrePost – definition and evaluation of simulations

LS-PrePost is a pre- and postprocessor which can be used to modify input decks and to visualize results computed by LS-DYNA. An intuitive graphical user interface simplifies its use. Options for handling and visualizing LS-DYNA input decks are available to help you prepare input data.

LS-OPT – optimization / robustness analysis of nonlinear systems

LS-OPT combines optimization algorithms with an optimization environment which automatically generates and analyzes variants and visualizes the obtained results. The program is designed for nonlinear problems and can include LS-DYNA as well as other solvers to enable multidisciplinary optimization. LS-OPT is not only used for optimization purposes but also for robustness analyses.

FEMZIP

This software allows to drastically reduce the storage size of simulation results, thus enabling the results to be viewed, sent and archived faster.

GENESIS – optimization software for large linear systems

GENESIS is a software system for optimizing topologies and designs. As a distributor, we provide the complete product portfolio of the manufacturer Vanderplaats R&D for customers in Europe. This is a supplement to the optimization solution LS-OPT for linear systems.

Validated FE models for standard load cases

FE models

In vehicle assessment, tests are carried out under comparable conditions. To successfully achieve this, accurately specified barriers and dummies are used for testing. DYNAmore develops and distributes FE models for such test pieces.

Dummy models

To compute occupant values, DYNAmore develops the following models for the automotive industry (PDB): ES-2, ES-2re, BioRID-2 and WorldSID. The portfolio is completed by models developed by the hardware dummy manufacturer Humanetics and by LSTC.

DYNA MORE

Pedestrian safety models

We supply impactor models from various manufacturers for assessing pedestrian safety during vehicle collisions.

Barrier models

The impact on the structure of a vehicle is often due to a barrier. We supply finite element models for all standard barriers, which are developed by our partners Arup and LSTC or within the scope of a working group by Daimler, Dr. Ing. h.c. F. Porsche, Lasso and Peng.

Human models

Besides the dummy models, there is also the option of using human models to investigate vehicle safety. The models distributed by DYNAmore are developed in Japan by Toyota.

Simulating forming processes

Metal forming in LS-DYNA

With LS-DYNA, DYNAmore provides a solution to meet high accuracy requirements in the computation of sheet metal and pipe forming. Quite a few automotive and supplier companies investigate the manufacturability and springback of a component using LS-DYNA before constructing a tool. Main applications include deepdrawing, stretch-forming, pipe bending, hydroforming and thermal deep drawing.

eta/DYNAFORM

An integrated pre- and postprocessor system for forming processes is combined in eta/DYNAFORM. In a user environment, eta/DYNAFORM combines mesh generation, the computation of binder forces, binder closing, deep drawing simulation, trimming processes, the computation of springback and multistep processes.

Simulation services

The staff at DYNAmore has a wealth of experience in computing nonlinear problems. We see ourselves as a suitable contact partner for:

- Nonlinear statics and dynamics
- Crash analysis
- Developing dummy models
- Component tests
- Passive safety, pedestrian safety
- Metal forming
- Implicit analyses using LS-DYNA
- Optimization, robustness analyses
- Flow simulation
- Fluid-structure interaction
- ...

Software development

SDM and Process Integration

With our subsidiary SCALE we develop software for CAE IT infrastructure. For example, our Software LoCo offers you a good platform for collaborative engineering. Furthermore, we develop on behalf of clients, predominantly from the automotive industry, custom software solutions in the fields of simulation data management (SDM), process integration, process automation and optimization.

Development in LS-DYNA

DYNAmore is an experienced contact partner regarding the development of new features in LS-DYNA. Together with our customers, we integrate failure models into material laws, develop interfaces, create material models for foams and integrate new element technologies.

Development of DYNAtools and additional software

DYNAmore supplies a wide range of additional tools which facilitate working with LS-DYNA and LS-OPT. The tools are developed in close cooperation with the automotive manufacturers Audi, Daimler, Dr. Ing. h.c. F. Porsche and Adam Opel.

Portfolio

- Software solutions
- Method development
- Support and consulting
- Calculation services
- IT solutions for CAx process and data management
- Training courses and information events
- Conferences

Facts

- 130 employees at DYNAmore and subsidiary companies in Germany, Sweden, Italy, France and Switzerland.
- Our customers include over 500 industrial companies and more than 300 universities and research organizations in Germany, Austria, Switzerland, Italy, Spain, Portugal, Benelux, Turkey, Czech Republic, Slovenia, Poland and Rumania, who all together use over 120,000 LS-DYNA licenses. We also take care of numerous companies outside Europe, e.g. USA, Japan, China, India, Brazil, Korea, Australia and Malaysia, which primarily use our dummy models.
- Our headquarters are in Stuttgart/Vaihingen in Germany. We have other offices near Wolfsburg, in Ingolstadt, in Dresden, in Berlin as well as on five customer premises.
- The founders of DYNAmore have been working in the field of the nonlinear finite element method since the beginning of the Eighties. DYNAmore has gained experience from numerous car crash and development projects and possesses expertise acknowledged both by industry and universities. The staff at DYNAmore is also actively involved in the further development of the programs LS-DYNA and LS-OPT.
- A distinguishing feature of the company is our good, long-term customer relationships. Our references range from large-scale companies to engineering offices.

Support – Consulting – Sales – Training Courses

Products

All products mentioned are used and further developed by DYNAmore in day-to-day project work. This enables us to provide highly practice-related advice on your tasks. According to your requirements, you receive a tailormade package comprising anything from software licensing right up to the handover of component responsibility by DYNAmore.

Support

The software you obtain from us is supported by highly experienced members of staff. You can contact each individual expert directly on the phone anytime. We also provide in-house support on request.

Test license

You can test any of our products free of charge. You then decide to rent the software, buy it or use it via a web portal. All standard platforms are supported.

Training courses

Besides offering numerous seminars on the various areas of application of LS-DYNA and LS-OPT, DYNAmore also holds other seminars concerned with pre- and postprocessing topics. All seminars can be aligned individually to company requirements and can also be held at your company premises if required.

Events

In order to promote the exchange of information, DYNAmore regularly organizes events such as user meetings, information days and webinars on a range of different subjects.

ORGANIZATION

Seminar locations

Unless otherwise stated, events are held in our headquarters in Stuttgart, Germany:

- Industriestr. 2, D-70565 Stuttgart, Germany
  Tel: +49 (0)711 - 45 96 00 - 0

Other seminar locations:

- Office Dresden
  Pohlandstraße 19, D-01309 Dresden
  Tel: +49 (0)351 - 31 20 02 - 0
- Office Ingolstadt
  Friedrichshofener Str. 20, D-85049 Ingolstadt
  Tel.: +49 (0)841 - 1 29 43 24
- Office Berlin
  Stralauer Platz 34, D-10243 Berlin
  Tel: +49 (0)30 - 20 68 79 10
- DYNAmore Swiss GmbH
  Technoparkstrasse 1, CH-8005 Zurich, Switzerland
  Tel.: +41 (0)44 - 5 15 78 90
- DYNAmore Nordic AB
  Brigadgatan 5, S-587 58 Linköping, Sweden
  Tel.: +46 (0)13 - 23 66 80
- DYNAmore Nordic AB
  Office Göteborg
  Lindholmspiren 3, S-417 56 Göteborg, Sweden
  Tel.: +46 (0)31 - 3 01 23 80
- DYNAmore Italia S.r.l.
  Piazza Castello 139, I-10122 Turin, Italy
  Tel.: +39 335 157 05 24
- DYNAmore France SAS
  2 Place de Touraine, F-78000 Versailles
  Tel.: +33 (0)1 70 29 08 18
- 4a engineering GmbH (partner in Austria)
  Industriepark, A-8772 Traboch, Austria
  Tel.: +43 (0)38 42 - 4 51 06 - 6 00

Seminars on request / in-house seminars

All courses can be individually compiled. We would be also happy to consider your special requirements. For example, the contents of seminars can be adapted to your company's specific needs, or alternatively the course can be held parallel to a project selected by you. We are also pleased to give seminars on your premises. Please get in touch with us.

Seminar fees

See seminar description. All seminar fees quoted are per participant and seminar and do not include statutory value-added tax. Seminar fees are due on application and include seminar documents, drinks during breaks and lunch.

Reductions

We give a 50 % reduction to members of universities and public research institutions. Students may attend the seminars free of charge if there are vacancies (please show your enrolment certificate).

Course times

Seminars: 9:00 - 17:00 (unless otherwise indicated).
Information days: usually 13:30 - approx. 17:00.

Speakers

Seminars are only given by experienced experts.

Language

Unless otherwise stated, all seminars will be given either in German or English language on an on-demand basis at short notice. Please indicate your preferred language during registration.

Cancellation of a seminar by a participant

Up to one week before the start of the seminar: no charge
Up to two days before the start of the seminar: 50 %
Non-attendance: complete seminar fee
Substitute participants will be accepted.

Cancellation of a seminar by the organizer

If less than four applications without reduction were received, we reserve the right to cancel a seminar. In such a case, all participants who have applied for the course will be notified at the latest one week before commencement of the seminar.

Registration

Please apply either using the registration form on page 61 or register online under www.dynamore.de or just send us an email to seminars@dynamore.de. You will be sent a registration confirmation as well as information regarding directions and hotels. Please note, that all seminars and the seminar language will be confirmed separately.

Data protection and competition law declaration of consent

With your registration you allow us the use and the processing of your data for the seminar organization and for promotional purposes. You may at any time revoke these commitments. For this, please contact DYNAmore GmbH by fax, telephone or in writing.

Further information

Seminars on the Internet
You will find current information and new developments concerning LS-DYNA on our website www.dynamore.de. There, you may also find up-to-date details about our seminars, information days and webinars as well as additional or modifications to dates and further information events.

Newsletter
If you would like to be informed by email about current events and new developments in the LS-DYNA world, we would be happy to send you our "DYNAmore News". To register, please send us an email to infomail@dynamore.de.

Contact partner

Organization
Carina Sieber
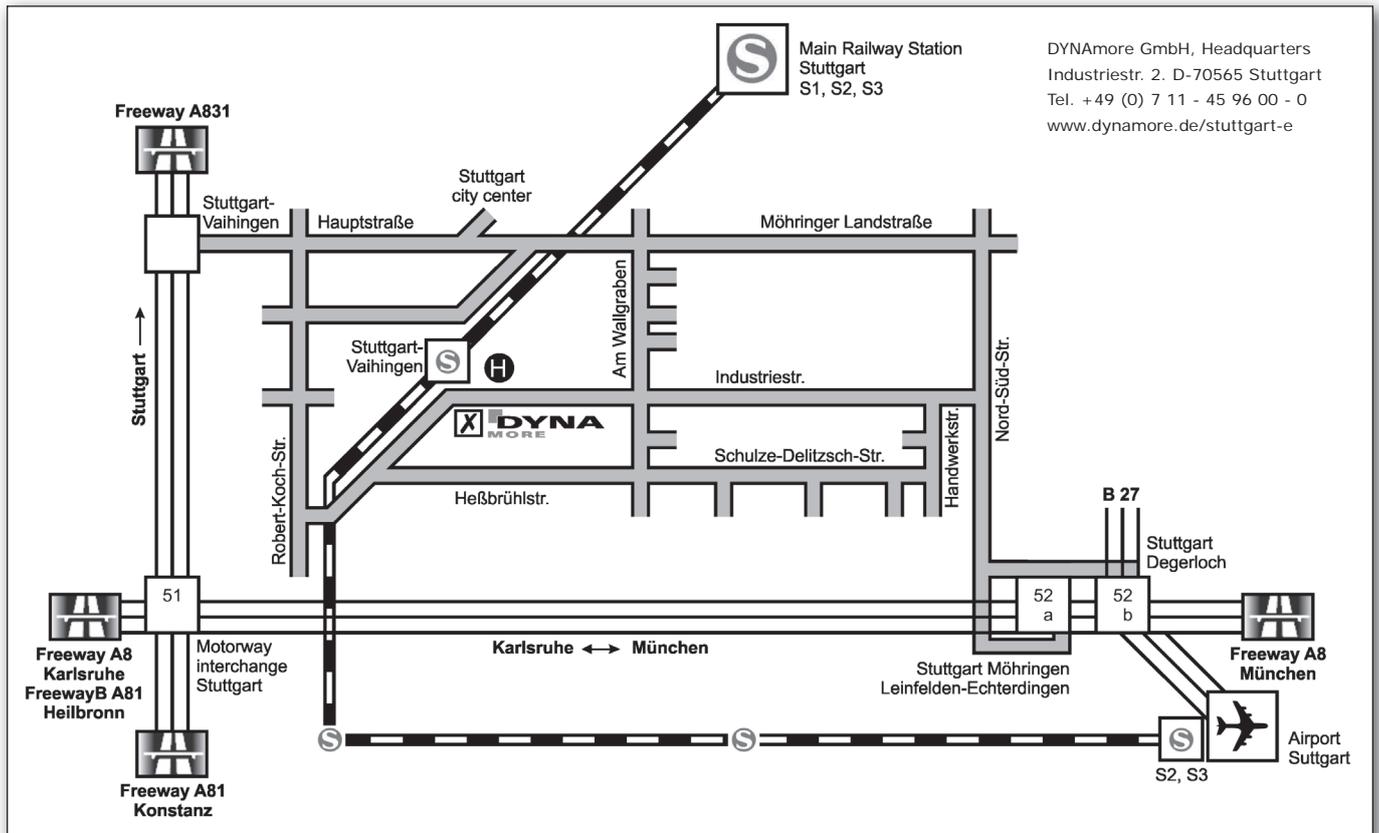Tel.: +49 (0)711 - 45 96 00 - 0
seminar@dynamore.de

Course Advisor
Dr. Nils Karajan
Tel.: +49 (0)711 - 45 96 00 - 22
nik@dynamore.de

DYNAmore HEADQUARTERS

DYNAmore GmbH, Headquarters
Industriestr. 2. D-70565 Stuttgart
Tel. +49 (0) 7 11 - 45 96 00 - 0
www.dynamore.de/stuttgart-e

Arriving by car

From the direction of Munich
Take the freeway A8 to Stuttgart, exiting at Möhringen/Degerloch/LE-Leinfelden. Follow signposts marked Möhringen/LE-Echterdingen, Industriegebiet Vaihingen/Möhringen. The DYNAmore headquarters are located opposite the train (S-Bahn) station.

From the direction of Frankfurt/Karlsruhe/Heilbronn/Singen
Take the freeway A8 towards Munich (München), exit at Möhringen/Vaihingen/LE-Leinfelden. Follow signposts marked Industriegebiet Vaihingen/Möhringen. The DYNAmore headquarters are located opposite the tram station.

Arriving by public transport

Stuttgart Airport
Take the train (S-Bahn) "S2" in the direction of Schorndorf or the S-Bahn "S3" in the direction of Backnang and alight in either case at the stop marked Stuttgart-Vaihingen. The DYNAmore headquarters are located opposite the train station.

Stuttgart Main Railway Station
Take the train (S-Bahn) "S1" in the direction of Herrenberg or the S-Bahn "S2" or "S3" in the direction of the airport and alight at the stop marked Stuttgart-Vaihingen. The DYNAmore headquarters are located opposite the train station.

More information about the S-Bahn timetable can be found under: www.vvs.de

DYNAmore Headquarters

Printed on paper made from 60% FSC-certified recycling fibers and 40% FSC-certified cellulose.

Come and write your

DIPLOMA OR MASTER THESES …

at DYNAmore in collaboration with the following companies:
Adam Opel AG, Audi AG, Daimler AG, Dr. Ing. h.c. F. Porsche AG, …

We would be pleased to offer you a range of exciting topics for your diploma or master thesis related to current developments in the latest FE technologies using LS-DYNA. Especially in the field of crashworthiness simulations, LS-DYNA is one of the world's leading FE programs and used for this purpose by many leading automotive manufacturers. As a result of the close collaboration between DYNAmore GmbH and Adam Opel AG, Audi AG, Daimler AG and Dr. Ing. h.c. F. Porsche AG, challenging tasks are constantly arising. Exemplary topics could address:

- Material modeling of composites, foams, plastics, layers of adhesive
- Modeling of joining techniques
- Simulation of welding processes
- Simulation of sheet metal and bulk forming processes
- Hot forming taking into account phase transitions
- Extensions for human models
- 3d skeletal muscle modeling in biomechanics
- Modeling of coupled multiphysic problems
- Fluid-structure interaction
- Particle mechanics
- Comparison of new simulation methods
- Optimization and robustness analysis with LS-OPT (optimization software)
- Software development for process integration
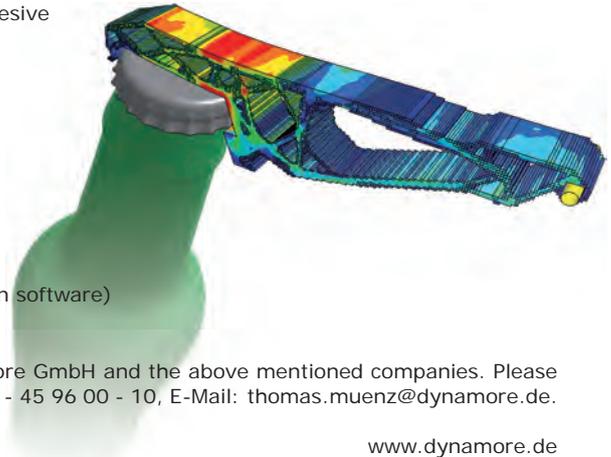
The preparation of the thesis will be in collaboration with DYNAmore GmbH and the above mentioned companies. Please get in touch with Dr. Thomas Münz (DYNAmore), Tel: +49 (0) 7 11 - 45 96 00 - 10, E-Mail: thomas.muenz@dynamore.de.

www.dynamore.de

NEW PHONE NUMBER
OF THE LS-DYNA SUPPORT HOTLINE

The phone number of the LS-DYNA support hotline has changed. Starting now, the hotline can be reached at:

+49 (0)711 459 600 11

Further contact possibilities for LS-DYNA support
via E-Mail: support@dynamore.de
File-upload: http://incoming.dynamore.de

PLEASE COMPLETE AND FAX TO FAX-NO. +49 (0)711 - 45 96 00 - 29

Address for window envelope

DYNAmore GmbH
Industriestr. 2
D-70565 Stuttgart
Germany

I hereby register for the following seminar/information day/support day:

Introduction
- ❏ Introduction LS-DYNA
  Optional: ❏ only 1st and 2nd day (basics)
  ❏ only 3rd day (further topics)
- ❏ Introduction LS-PrePost
- ❏ Introduction Nonlinear Implicit Analyses
- ❏ Information day: New LS-DYNA Features
- ❏ Information day: Cloud Solutions

Basics/Theory
- ❏ Element Types and Nonlinear Aspects
- ❏ User Interfaces in LS-DYNA
- ❏ Information day: Verification/Validation

Crash/Short-Term Dynamics
- ❏ Crashworthiness Simulation
- ❏ Contact Definitions
- ❏ Joining Techniques for Crash Analysis
- ❏ Failure of Fiber Reinforced Polymer
- ❏ Information day: Drop Tests

Passive Safety
- ❏ Introduction to Passive Safety Simulation
- ❏ CPM for Airbag Modeling
- ❏ Dummy/Pedestrian Impactor Modeling
- ❏ Information day: Dummy Models
- ❏ Information day: Human Models

Metal Forming/Process Simulation
- ❏ Metal Forming with LS-DYNA
  Optional: ❏ only 1st and 2nd day
  ❏ only 3rd day
- ❏ Forming Simulation with eta/DYNAFORM
- ❏ Hot Forming with LS-DYNA

- ❏ Welding Simulation with LS-DYNA
- ❏ Sheet Metal Forming with OpenForm
- ❏ Information day: Welding/Heat Treatment
- ❏ Information day: Forming Trends

Materials
- ❏ Material Modeling for Metals
- ❏ Damage and Failure Modeling
- ❏ Parameter Identification with LS-OPT
- ❏ Modeling Polymers and Elastomers
- ❏ Short Fiber Reinforced Polymers
- ❏ Continuous Fiber Reinforced Polymers
- ❏ Concrete and Geomaterial Modeling
- ❏ User Materials
- ❏ Information day: Composite Analysis
- ❏ Information day: ENVYO
- ❏ Information day: Simulation of Plastics
- ❏ Information day: Material Characterization

Implicit
- ❏ Implicit Analysis
- ❏ NVH, Frequency Domain Analysis and Fatigue
- ❏ Information day: LS-DYNA/Implicit
- ❏ Information day: Fatigue/Acoustics/NVH

Particle Methods
- ❏ Smoothed Particle Hydrodynamics (SPH)
- ❏ Meshfree EFG, SPG, Advanced FE
- ❏ Discrete Element Method (DEM)

Multiphysics/Biomechanics
- ❏ ALE and Fluid-Structure Interaction
- ❏ ICFD - Incompressible Fluid Solver
  Optional: ❏ only 1st day ❏ only 2nd day
- ❏ CESE - Compressible Fluid Solver

- ❏ Electromagnetism
- ❏ Information day: Multiphysics
- ❏ Information day: Biomechanics

High Energy Events
- ❏ Short Duration Events
- ❏ Blast Modeling
- ❏ Penetration Modeling
- ❏ Explosives Modeling for Engineers

Optimization
- ❏ LS-OPT - Optimization/Robustness
  Optional: ❏ only 1st and 2nd day
  ❏ only 3rd day
- ❏ Basics of Structure Optimization
- ❏ Structural Optimization with GENESIS
- ❏ Information day: Optimization
- ❏ Information day: ANSA, LS-OPT, META

Civil Engineering
- ❏ Information day: Applications

Pre- and Postprocessing
- ❏ Introduction to PRIMER for LS-DYNA
- ❏ Information day: PRIMER for LS-DYNA
- ❏ Pre- and Postprocessing with
  ❏ ANSA ❏ METApost ❏ HyperWorks

Support
- ❏ Support day: LS-DYNA
- ❏ Support day: Occupant Safety

CAE Processes/SDM/IT
- ❏ SDM and Process Management LoCo
  Optional: ❏ only 1st day ❏ only 2nd day
- ❏ Information day: Process Autom./SDM

Date (please specify): _____

❏ I will cancel my registration if the course will be held in German language.

Sender

Company / University: _____

Dept. / Institute: _____

Title, first/last name: _____

Street: _____

ZIP code, town/city: _____

Tel.: _____

E-Mail: _____

Date, Signature: _____

PLEASE COMPLETE AND FAX TO FAX-NO. +49 (0)711 - 45 96 00 - 29

Address for window envelope

DYNAmore GmbH
Industriestr. 2
D-70565 Stuttgart
Germany

I hereby place an order for the following LS-DYNA version:

❏ DYNAstart Professional (industry)

DYNAstart Professional is the LS-DYNA introductory package from DYNAmore. It comprises the following features:

- First license for LS-DYNA
  including LS-PrePost, LS-OPT, LS-TaSC

- Unlimited version with full functionality
  (including implicit, particle methodes and multiphysics)

- Access to latest software versions

- The program can be run under Windows/Linux

- Full technical support

  Annual rental fee: 6,900 Euro *

❏ DYNAlab (research, teaching)

- Licence for LS-DYNA (any number of processors),
  LS-PrePost, LS-OPT, LS-TaSC

- Unlimited version with full functionality
  (including implicit, particle methodes and multiphysics)

- Rent per institute / faculty

- Full technical support

  Annual rental fee: 1,150 Euro *

❏ DYNAstart Personal (private)

- One license for LS-DYNA, LS-PrePost, LS-OPT, LS-TaSC

- Limited to 10,000 elements

- No composites, no MPP functionalities

- 1st month: telephone support

- 11 further months: e-mail support

  Annual rental fee: 90 Euro *

Sender

Company / University: _____

Dept. / Institute: _____

Title, first/last name: _____

Street: _____

ZIP code, town/city: _____

Tel.: _____

E-Mail: _____

Date, Signature: _____

* Prices do not include statutory value-added tax. Subject to exchange rate fluctuations USD/Euro.

11th EUROPEAN LS-DYNA CONFERENCE

9 - 11 May 2017 – Salzburg, Austria

We kindly invite all users of LS-DYNA, LS-OPT, and LS-TaSC to take advantage of this fantastic opportunity to showcase their work. The Conference is your chance to talk with industry experts, catch up with colleagues and enjoy time exploring new ideas. In addition, attendees can meet with exhibitors to learn about the latest hardware and software trends as well as additional services relating to the finite element solver LS-DYNA, the optimization codes LS-OPT and LS-TaSC, and the pre- and postprocessor LS-PrePost.

Make sure that you will be part of the conference as presenter or participant.

Important dates
Abstract submission deadline:	17 February (extended)
Author notification:	27 February
Full paper submission:	27 March

Abstract submission
Please submit your micro abstract (max. length 2,500 characters) by E-Mail to conference@dynamore.de or online at www.dynamore.de/conf2017.

Participant fees
Industry speaker:	400 Euro
Academic speaker:	340 Euro
Industry:	590 Euro* / 640 Euro
Academic:	440 Euro* / 490 Euro

* Registration before 1 April.
All prices plus VAT

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Exhibition
We encourage hardware and software suppliers, consultancies and those offering LS-DYNA related services to exhibit or sponsor the conference.

Accompanying seminars
Training courses will take place the day before and after the conference.

Confernce venue
Salzburg Congress
www.salzburgcongress.at

Conference website:
www.dynamore.de/conf2017

Registration:
www.dynamore.de/conf2017-reg

Call for Papers (pdf):
www.dynamore.de/conf2017-c4p

Abstract online submission:
www.dynamore.de/conf2017-submit

The conference will be organized by

DYNAMORE

LSTC
Livermore Software
Technology Corp.

In association with

ARUP

DYNAMORE FRANCE

DYNAMORE NORDIC

DynaS+

We will provide further details about the event in our "DYNAmore News" and on our conference website www.dynamore.de/conf2017.

Copyright Tourismus Salzburg GmbH

DYNAmore Gesellschaft für FEM Ingenieurdienstleistungen mbH

Germany

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Fax: +49 (0)711 - 45 96 00 - 29
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