DYNA MORE

NEW:
All seminars are available in English language on demand.

# 2013

Seminars

Information Days

Webinars

Workshops

Support Days

Courtesy of Daimler AG

# CONTENTS



## SEMINAR DESCRIPTIONS

| Seminars | Information days Webinars | Workshops | Support Service | On site Individual |
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| Introductions | Crash | Passive Safety | Forming/ Processes | Materials |
| Basics | Implicit | Multiphysics | Biomechanics | Optimization |
| Theory | CAE/IT | Defence | Civil Engineering | Pre-/Post-processing |

Dear Reader,

This year again, we are pleased to be able to offer you a wide range of seminars, information events, workshops, webinars and support days. As usual, the contents thereof have been adapted to current technical developments and innovations.

Due to the continued interest shown in the simulation of composites and fiber-reinforced plastics, we are now able to offer two dates for the successful information day, which attracted more than 70 participants last time. We have also registered an increasing interest in the solution strategies provided by LS-DYNA to simulate coupled multiphysical problems. We aim to meet this demand with our new information days, which focus on the multiphysical capabilities of LS-DYNA as well as the simulation of electromagnetically and thermomechanically coupled problems. In this context, we would also like to mention the seminars on computational fluid dynamics, strongly- and weakly-coupled fluid-structure interaction and electromagnetic field calculation. Moreover, we have introduced a new information day on biomechanics, as the far-reaching coupling options in LS-DYNA are perfectly suited to enable simulations in this field. To plan your potential use of LS-DYNA, we now provide information about its various simulation possibilities on a monthly basis – also at our new offices in Berlin and Zurich. Additionally, we have extended our successful introductory course to three days which can be booked on a modular basis.

A detailed description of all seminars, workshops and information days can be found on the subsequent pages of this seminar catalog. The seminars are directed at engineers wanting to learn how to handle and specifically utilize LS-DYNA and other software solutions. Information days are events, where new applications and new possibilities of our software products are presented. In the workshops, participants are given an introduction to specific topics via joint practical exercise. Support days give you personal assistance with your technical problems and are held every third Friday of the month.

On top of the events listed in the seminar catalog, we are pleased to meet your individual requirements by arranging special on-site training courses on your company premises. Following this, you have the option of combining the contents of our various courses to adapt them to your own custom requirements.

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

We hope that we have aroused your interest and are looking forward to welcoming you to one of our events.

Kind regards,

Dr.-Ing. Nils Karajan

Your contact partner for any questions

Organization

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Course Advisor

Dr.-Ing. Nils Karajan

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| Seminar title | Jan. | Feb. | March | April | May | June | July | Aug. |
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[1] = English course
[2] = Date and delegate fee on request
[3] = Euro per delegate plus VAT if applicable
[I] = Ingolstadt
[D] = Dresden
[B] = Berlin
[A] = Attendorn

| Sept. | Oct. | Nov. | Dec. | Sem | WS | Info | S/W | Fee[3] | Page | Seminar title |
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| | | 19 | | ■ | | | | 550 | 34 | Theoretical Aspects of Structural Optimization |
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[Z] = Zurich, Switzerland
[L] = Linkoping, Sweden
[T] = Traboch, Austria

Sem = Seminar
Info = Infoday
WS = Workshop
S/W = Supportday/Webinar

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Registration information: Page 52

## INTRODUCTION TO LS-DYNA

*Type:*
Seminar
*Duration:*
3 days
*Seminar fee:*
1,425 Euro
(475 Euro per day, can be booked seperately)
*Lecturers:*
Dr. Tobias Graf,
Dr. Filipe Andrade,
Dr. Nils Karajan
all DYNAmore
*Dates:*
04-06 February
18-20 March
24-26 April T)
06-08 May
14-16 May Z)
19-21 June
16-18 July
08-20 September
07-09 October
29-31 October T)
12-14 November Z)
03-05 December

Z) Zurich, Switzerland
T) Traboch, Austria

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 an FE 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.

*Contents*

- Which problems can be solved using LS-DYNA?
- What is the difference between implicit and explicit time integration and how are both methods carried out 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 almost-static problems be handled?
- What input/ output data is there and what does it contain?
- How can results be analyzed and compared?

We strongly recommend LS-DYNA novices to attend this seminar.

Advanced 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 joins such as spot-welds and bolt connections are shown to demonstrate how they can be represented in an FE model using LS-DYNA.

*Contents*

- 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 "Advanced Topics", we recommend prior attendance at the module "Basics".

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

## 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 analysis that was 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.

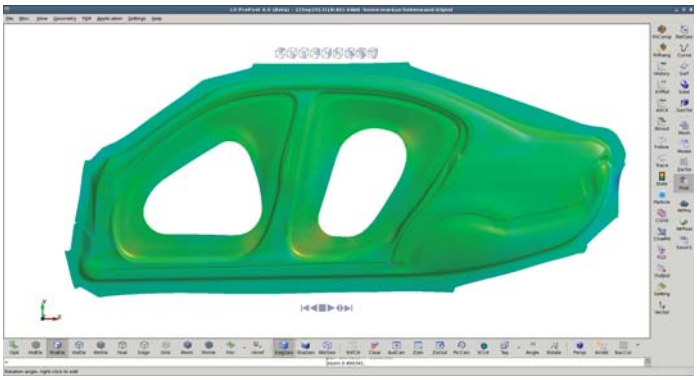
Basic knowledge of LS-DYNA is desirable.

*Contents*

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

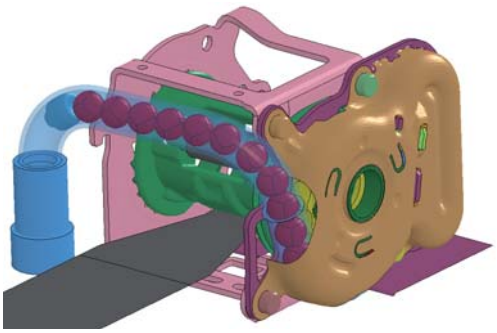
Postprocessing
- Handling different LS-DYNA output files
- Plot and modification of curves (summation, scaling, filtering)
- Printing and preparing results for presentations
- Color plots of physical quantities on the model (fringe plots)
- Vector plots, cross sections of the model, …

*Type:*
Seminar
*Duration:*
1 day
*Seminar fee:*
475 Euro
*Lecturer:*
Markus Künzel, DYNAmore
*Dates:*
07 February
21 March
19 July
10 October
06 December



## INFORMATION DAY: DYNAstart – GETTING STARTED WITH LS-DYNA

The objective of this information day is to walk through the first steps in LS-DYNA along with you. The functionality of LS-DYNA is explained and the fundamental configuration of an LS-DYNA input deck is shown using simple examples. Once the sample input files have been loaded into LS-DYNA and the simulation is finished, the visualization and evaluation of results is demonstrated.



Courtesy of TAKATA-PETRI AG

Moreover, you will be given an overview of the many different areas of application of LS-DYNA by means of selected sample demonstrations. Some of these applications are certainly also of interest to you. We will be happy to consult with you regarding your special requirements.

The offered software packages "DYNAstart Personal" and "DYNAstart Professional" are intended to facilitate the introduction to nonlinear dynamic calculation with LS-DYNA for private and professional use, respectively.

Note that this information day is not a substitute for the seminar "Introduction to LS-DYNA".

*Type:*
Information day
*Duration:*
1/2 day
*Fee:*
Free of charge
*Dates:*
23 January
21 February [B)]
15 March [D)]
23 April [T)]
18 June
01 July [B)]
15 July
10 September [T)]
28 October [I)]
11 November [Z)]

[B)] Berlin
[D)] Dresden
[I)] Ingolstadt
[Z)] Zurich, Switzerland
[T)] Traboch, Austria

## INFORMATION DAY: VERIFICATION AND VALIDATION OF SIMULATIONS

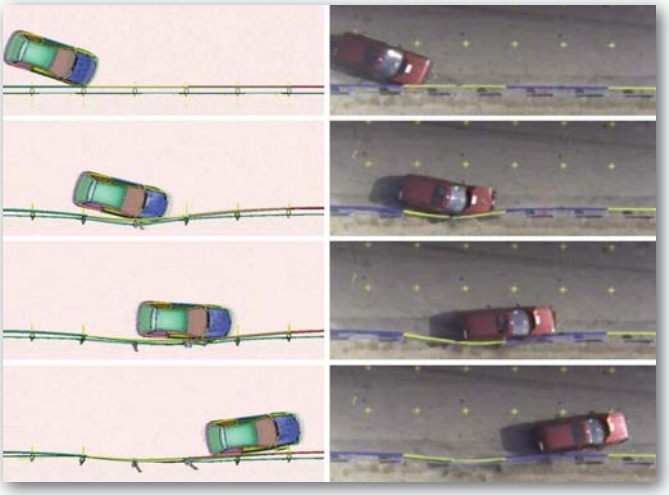
*Type:*
Information day
*Duration:*
1/2 day
*Fee:*
Free of charge
*Date:*
11 July

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 calculations. 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 channelize their knowledge in an interesting presentation program and to stimulate discussion and the exchange of experiences in this fascinating field.



Courtesy of University of Maribor, Slovenia

## ELEMENT TYPES AND NONLINEAR ASPECTS IN LS-DYNA

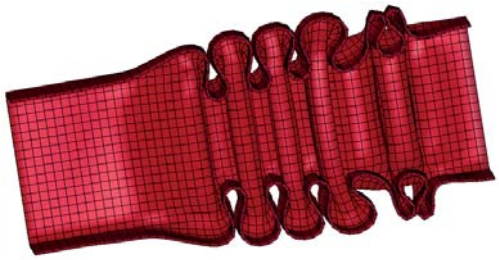
This seminar is a collection of different topics on nonlinear aspects with respect to LS-DYNA. Emphasis is directed towards element technology and the various specific elements implemented in LS-DYNA. In particular, the theoretical background as well as the corresponding practical usage will be discussed. 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.

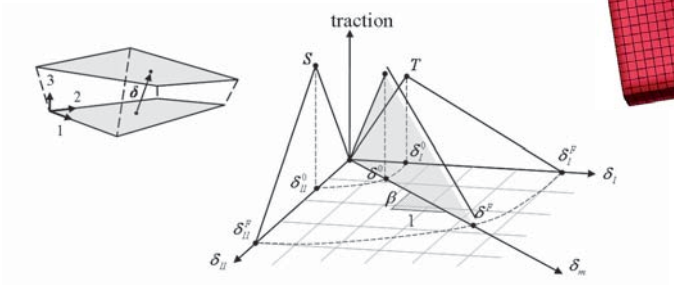
This class is intended for participants with pre-existing knowledge in finite element technology and LS-DYNA who would like to learn more about various aspects of nonlinearities and their implementation in LS-DYNA and who are also interested to obtain better insight into the theoretical background.

*Contents*

- Element formulations implemented in LS-DYNA
- Theoretical background of various element formulations
- Application field and benefits/drawbacks of the different element types
- 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

*Type:*
Seminar
*Duration:*
1 day
*Seminar fee:*
475 Euro
*Lecturers:*
Dr. André Haufe, DYNAmore;
Prof. Dr. Karl Switzerlanderhof, DYNAmore / KIT
*Date:*
10 July






## WORKSHOP: 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 workshop 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.

*Contents*

- Overview of various user interfaces
- Presentation of the coupling approach for your own code
- Recommended compilers and compiler options
- Additional libraries that may be required
- Access to data structures
- Examplary implementation of a custom routine in LS-DYNA
- If required, discussion of your own routines developed prior to the workshop

*Type:*
Workshop
*Duration:*
1 day
*Workshop fee:*
475 Euro
*Moderator:*
Dr. Tobias Erhart, DYNAmore
*Date:*
11 November

```
      include 'nlqparm'
      dimension bmtrx(nlq,3,3,48),gmtrx(nlq,3,3),gjac(nlq)
c
c     Compute b and g matrix for user defined shell 101
c
      do i=lft,llt
        bmtrx(i,1,1,1) =dn1dxi
      enddo
c
      return
      end
```

## CRASHWORTHINESS SIMULATION USING LS-DYNA

*Type:*
Seminar
*Duration:*
4 days
*Seminar fee:*
1,800 Euro
*Lecturer:*
Paul Du Bois,
Beratender Ingenieur
*Dates:*
23-26 April
05-08 November [L)]
17-20 December

[L)] Linkoping, Sweden

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.

Courtesy of Adam Opel AG

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.

*Contents*

- 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

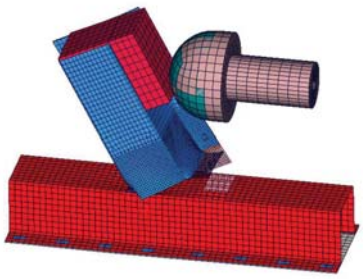
## JOINING TECHNIQUES CONNECTIONS IN LS-DYNA

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
950 Euro
*Lecturers:*
Dr. Markus Feucht,
Daimler AG;
Dr. Tobias Graf,
Dr. André Haufe,
DYNAmore
*Dates:*
18-19 February
16-17 September

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 are 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.

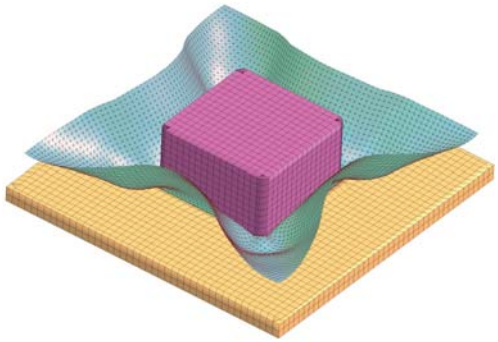


*Contents*

- 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

## 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.

*Contents*

- 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

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

*Type:*
Seminar
*Duration:*
1 day
*Seminar fee:*
475 Euro
*Lecturer:*
DYNAmore staff members
*Dates:*
22 March
11 October

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

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

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 high 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 with regard to plastics and foam materials. The approaches for the identification of the associated material parameters will be also be illustrated.

Courtesy of Hilti Entwicklungsgesellschaft mbH

*Contents*

- 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

## FAILURE OF FIBER-REINFORCED POLYMER COMPONENTS IN CRASH SIMULATION

*Type:*
Seminar
*Duration:*
1 day
*Seminar fee:*
475 Euro
*Lecturer:*
e-Xstream staff members
*Date:*
28 June

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.

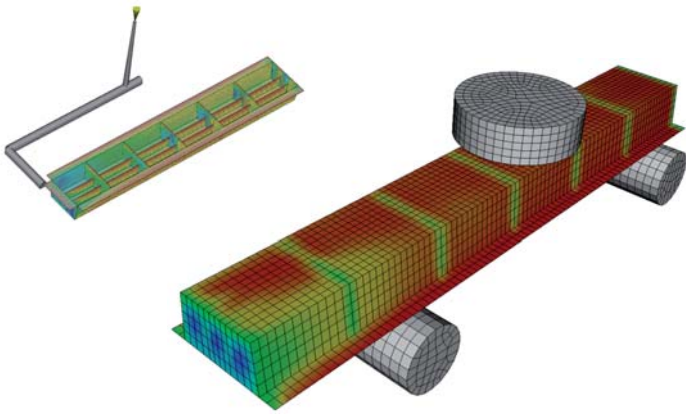
Thus, the DIGIMAT material characterization bridges the injection molding simulation, which predicts the position of fibers in a component, with the simulation of structures with LS-DYNA.

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. The contents of the seminar are directly practised with an application to practical examples.

In cooperation with e-Xstream engineering, MSC Software Company



Courtesy of e-Xstream engineering / Rhodia

## EXPLOSIVES MODELING FOR ENGINEERS WITH LS-DYNA

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. The training class will attempt to provide the analyst with the additional tools and knowledge required to model explosives for a range of applications. The theory and illustrations portions of the class will benefit LS-DYNA users and non-LS-DYNA users alike.

*Type:*
Seminar
*Duration:*
1 day
*Seminar fee:*
550 Euro
*Lecturers:*
Paul Du Bois, Consultant;
Dr. Len Schwer, Schwer Engineering & Consulting Services
*Language:*
English
*Date:*
09 December

## 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
*Seminar fee:*
1,100 Euro
*Lecturers:*
Paul Du Bois, Consultant;
Dr. Len Schwer, Schwer Engineering & Consulting Services
*Language:*
English
*Date:*
10-11 December

## PENETRATION MODELING WITH LS-DYNA

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.

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
1,100 Euro
*Lecturers:*
Paul Du Bois, Consultant;
Dr. Len Schwer, Schwer Engineering & Consulting Services
*Language:*
English
*Date:*
12-13 December

### Applications to protective structures, vehicles and homeland security threats

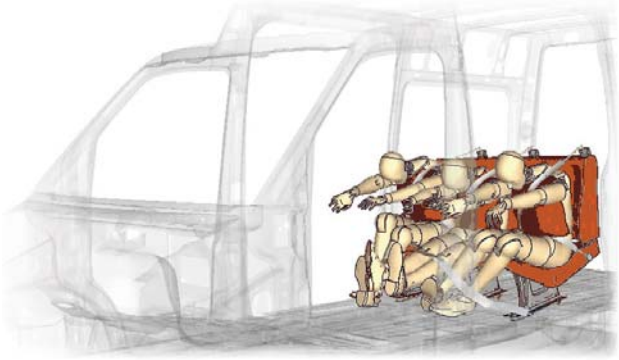
These training classes are intended for the LS-DYNA analyst possessing a comfortable command of the LS-DYNA keywords and options associated with typical Lagrange analyses. The training classes will attempt to provide the analyst with the additional tools and knowledge required to model the above described class of high energy events. The typical attendee is likely to have a background in defense applications, to include protective structures and vehicle vulnerability, Homeland Defense topics, and terrorist threat mitigation techniques. Because the class uses example problems to illustrate concepts and techniques, numerous modeling 'tricks' and options are discussed, and this knowledge would benefit any LS-DYNA user.

## INTRODUCTION TO PASSIVE SAFETY SIMULATIONS USING LS-DYNA

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
950 Euro
*Lecturers:*
Sebastian Stahlschmidt, Alexander Gromer, both DYNAmore
*Dates:*
29-30 April
12-13 November

Particularly due to the growing amount of relevant legislation and consumer tests , 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 included in LS-DYNA in relation 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 and the practical application of the features.

The seminar will describe the fundamentals regarding the composition of an LS-DYNA occupant safety simulation, including the positioning and fitting of seatbelts to the dummy, the definition of recommended contacts between the safety systems, and the design of uniform-pressure 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 use the knowledge acquired in sample exercises.



Courtesy of Daimler AG

*Contents*

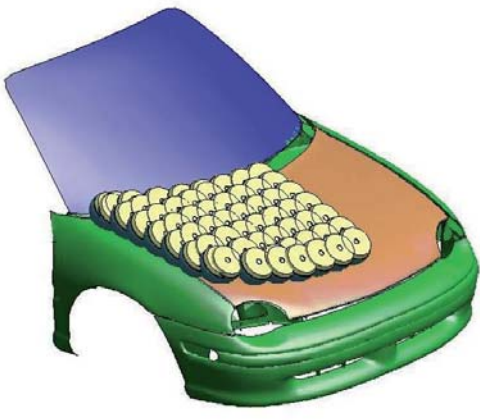
- Overview of current impact load cases (side, frontal, rear)
- Barrier models available in LS-DYNA
- Dummy models available in LS-DYNA, and their validation methods
- Materials, elements and links used for occupant safety simulations
- Use and positioning of dummies
  - How to position the dummy in the vehicle?
  - How to prestress the seat foam?
  - How to analyse signals of interest at a dummy?
  - What are the injury criteria?
- Definition and fastening of seatbelts
  - How to model seatbelt, belt deflector/ tensioner?
  - How to fit the seatbelt to the dummy?
- Airbag technology
  - How does an airbag system work?
  - Tank test
  - Control volume approach
  - Wang-Nefske formulation
  - Possibilities and limits
  - Syntax and fundamental terms of airbag simulations with LS-DYNA
  - Specific options to define materials
  - Surrogate models for airbag restraints, fire proofing
  - Surrogate models for outlet openings
  - Jetting
  - Composition of an LS-DYNA simulation model

## LS-DYNA DUMMY AND PEDESTRIAN IMPACTOR MODELING

*Type:*
Seminar
*Duration:*
1 day
*Seminar fee:*
475 Euro
*Lecturers:*
Sebastian Stahlschmidt, Alexander Gromer, both DYNAmore
*Date:*
7 June

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.



Courtesy of Arup

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.

*Contents*

- 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 pretensioners
- 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).

*Contents*

- 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
  - FAT models for side crash
- Free dummy models
- Where are the limits in dummy modeling?
- If desired, the FMVSS214 head model will also be discussed
- Future dummies

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.

*Type:*
Information day
*Duration:*
1/2 day
*Fee:*
Free of charge
*Lecturers:*
Uli Franz, Sebastian Stahlschmidt, both DYNAmore; Robert Kant, Humanetics Innovative Solutions
*Date:*
6 May

Courtesy of Rheinmetall Landsysteme GmbH

## INFORMATION DAY: HUMAN MODELS

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

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.

Courtesy of Daimler AG

## INTRODUCTION TO AIRBAG MODELING WITH LS-DYNA

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
950 Euro
*Lecturers:*
Sebastian Stahlschmidt,
Dr. André Haufe,
both DYNAmore
*Date:*
05-06 June

Today, airbags are one of the most important components of a motor vehicle's occupant protection system. In addition to the standard airbags for the driver and front passenger, an increasing number of specialized airbag variants, such as curtain airbags, kneebags, etc., are used. Each airbag must be specifically designed and optimized for its intended purpose . A sensible and comprehensive simulation that captures the behavior of airbags as part of a simulation of the entire restraint system is essential.

This course illustrates the basics that are required to set up an airbag simulation in LS-DYNA. In addition to the deployment technology per se, which can in principle be based on the uniform pressure approach or the more recent corpuscular method, this also includes the selection of the inflow method (Wang-Nefske or hybrid approach, etc.) as well as the verification and validation of the associated inflow data. Moreover, the deployment behavior is also determined by the correct adjustment of contact, discharge opening and porosity parameters. Regarding the latter, particularly the gas loss in seams needs to be included, which will also be discussed in the course. In the past it has been shown that the material behavior has a significant influence on the deployment kinematics, such that the manifold possibilities and more recent implementations in LS-DYNA to define material behavior will need to be discussed in detail.

Courtesy of Autoliv B.V. & Co. KG

*Contents*

- Introduction to the topic
- Airbag technology
  - Design of an airbag system
  - Discussion of tank tests and generator characteristics
- Fundamentals
  - Basic principles of airbag simulations
  - Uniform pressure methods with Wang-Nefske formulation and hybrid inflators
  - Possibilities and limits of UP deployment calculations
  - Corpuscular method
- Model composition
  - Syntax of model structure
  - Folding of airbags
  - Generation of a reference mesh (initial metric or reference geometry)
  - Possibilities of material definition (nonlinearities, orthotropy, porosity) and validation
  - Surrogate models for tether straps, heat shield, tear seams
  - Surrogate models for discharge openings
  - Jetting definition for UP airbag models
  - Discussion of an LS-DYNA airbag model (UP and corpuscular method)
  - Presentation of the process chain for model configuration
- Airbag validation and evaluation of results
- Exercises

The course is intended for beginners in airbag simulation. Participants can directly apply their gained knowledge during the seminar via hands-on exercise.

## CORPUSCULAR METHOD – SIMULATE AIRBAG UNFOLDING WITH LS-DYNA

In addition to the ALE method, which has been used for the simulation of out-of-position (OoP) load cases for a number of years, LSTC developed the corpuscular method (CPM) to simulate airbag deployment processes based on a particle approach. This method is distinguished by extremely simple handling and reduced computing times compared to the highly variable and widely applicable ALE method.

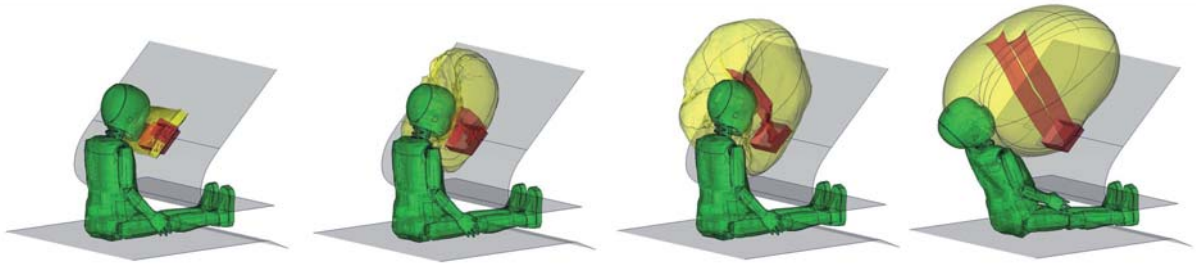
Based on this molecular particle approach, it is now possible to set up simulations for OoP load cases in an extremely simple manner with just a few changes to the input files that utilize the uniform pressure method. The experience gained with the application of the CPM has been excellent so far. The accuracy and efficiency of the method in particular are persuasive. It permits realistic calculations of many new load cases – to supplement the established ALE method.

The one day class presents the basics of the new corpuscular method and gives a brief introduction on the ALE method. Emphasis is placed on the steps from a uniform pressure input file to a simulation also considering the gas flow.

*Contents*

- Overview
- Basic theoretical aspects
- Application of the method in LS-DYNA
- Merits and limits of the methodology
- Comparison to the uniform pressure approach
- OoP examples
- Exercises

*Type:*
Seminar
*Duration:*
1 day
*Seminar fee:*
475 Euro
*Lecturer:*
Reuben D'Souza
*Language:*
German/English
*Date:*
27 November



## SUPPORTDAY: OCCUPANT SAFETY

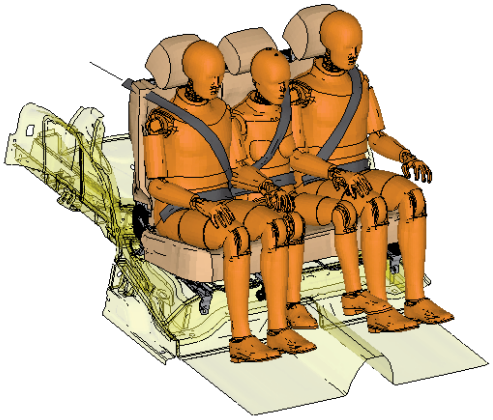
On the occasion of the occupant safety support days, you can bring your own LS-DYNA simulations or input decks to our headquarters in Stuttgart-Vaihingen. The support days will mainly focus on questions regarding the handling and analysis of dummy models.
Experienced members of the DYNAmore staff will 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.

*Examplary 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 post-processing?
- 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.

*Type:*
Supportday
*Duration:*
1/2 day
*Fee:*
Free of charge
*Dates:*
15 March
19 July
20 December



Courtesy of Faurecia Autositze GmbH

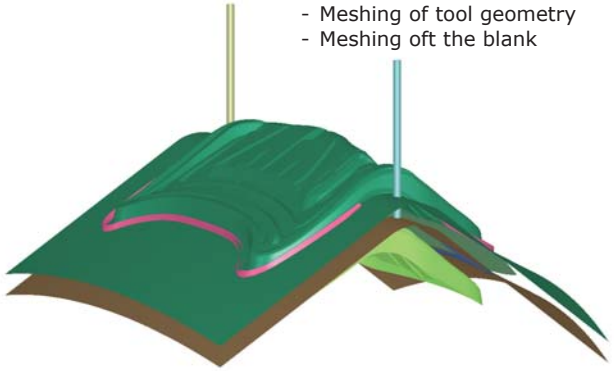
## METAL FORMING SIMULATIONS WITH ETA/DYNAFORM AND LS-DYNA

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
950 Euro
*Lecturer:*
Peter Vogel,
DYNAmore
*Dates:*
29-30 January
24-25 June
21-22 October

This course 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. The LS-PrePost program is presented for use in postprocessing.

*Contents*

- Introduction in the simulation of sheet metal forming processes
- Introduction in the software eta/DYNAFORM
- Preprocessing in eta/DYNAFORM
  - Meshing of tool geometry
  - Meshing oft the blank
  - Definition of the blank (Selection of the material model, setting of the symmetry boundary conditions)
  - Definition of the tools (Selection of the contact formulation, setting of the friction, positioning of the tools, applying force- and displacement- boundary conditions on the tools)
  - Positioning of the tools
  - Boundary conditions
  - Definition of draw beads
  - Definition of adaptive meshing
  - DeDateation of the sheared blanks
  - Trimming of the sheet with eta/DYNAFORM
- Calculation (explicit, static or dynamic implicit)
- Multi-sdays process definition with AutoSetup
  - gravity loading analysis
  - binder closing
  - drawing simulation
- Postprocessing with LS-PrePost
- Application examples with eta/DYNAFORM, LS-DYNA and LS-PrePost



Courtesy of BMW Group

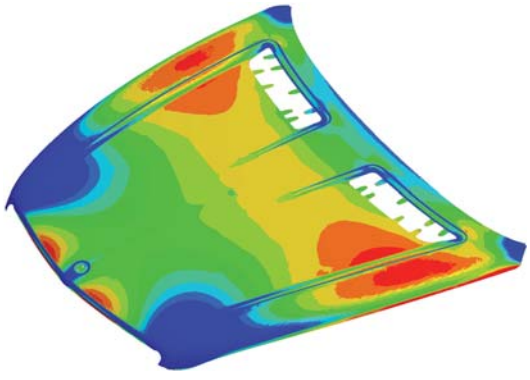
The course is practice-oriented, with an emphasis on industrial applications. This seminar is suitable for users from the area of metal forming who wish to learn how to use eta/DYNAFORM and LS-DYNA to simulate sheet-metal forming processes or who wish to deepen existing knowledge.

## SIMULATION OF SHEET METAL FORMING PROCESSES WITH LS-DYNA

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
950 Euro
*Lecturer:*
Dr. André Haufe,
DYNAmore
*Date:*
23-24 October

The two-day course communicates the fundamentals of the simulation of sheet-metal forming processes with the LS-DYNA program and provides notes and hints for everyday practical application. Particular attention will be given to the forming-specific settings and features in LS-DYNA.

The focus of the first day is primarily on introductory remarks about forming simulation in LS-DYNA. Required input decks, settings, interrelationships and procedures will be explained in detail. Another focus will be the critical consideration and examination of the simulation results and possibilities to overcome problems by means of alternative approaches and methods. The goal of the seminar is to enable the user to independently select the correct settings and parameters for a specific task. On the second day, the understanding of the fundamental theory imparted will be deepened, and its limits will be discussed.



Courtesy of Daimler AG

This seminar is suitable for users from the area of metal forming who wish to learn how to use LS-DYNA for simulation of sheet-metal forming processes or who wish to deepen existing knowledge.

*Contents*

- Discussion of specific settings and features for the forming process in LS-DYNA
  - Contact settings
  - Material models (isotropic/anisotropic plasticity)
  - Shell element types
  - Definition of displacement and force boundary conditions regarding global and local coordinate systems
  - Adaptive mesh refinement: minimization of the discretisation error and correct choice of parameters
  - Analytical draw bead model
  - Trimming with LS-DYNA (trimming operations)
- Procedure to simulation of multisdays forming processes
  - Gravity simulation (explicit or dynamic implicit)
  - Forming simulation
  - Springback simulation (statisch implizit)
  - Simulation of postforming operations
- Model checking and post-processing with LS-PrePost
- Plasticity-theoretical foundations and modeling assumptions
- Characteristic of available material models
  - isotropic/anisotropic plasticity
  - kinematic/isotropic hardening
  - Discussion of the different models and their suitability for certain materials
- Possibilities for parameter identification

## INFORMATION DAY: TRENDS AND DEVELOPMENTS IN LS-DYNA AND ETA/DYNAFORM CONCERNING FORMING PROCESSES

The program eta/DYNAFORM is an effective pre- and post processor that has been specially 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 deDateing preliminary sheet metal blanks, generating tool geometries and compensating for springback are covered by the main functions of the software package. Further functions allow to define 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.

On this information day, the latest topics concerned with forming simulation using LS-DYNA and eta/DYNAFORM will be handled. New requirements, new developments and the current possibilities and limits of various concepts will be presented and discussed.

*Contents*

- Integrating forming simulation into the development process
- Process characterization
- Add-ons and pre-simulation
- Trimming and cutting
- Analyzing calculations
- Calculating springback

For more information and advance details of programs of events, sign up for our information mail or visit us on our internet site www.dynamore.de.

*Type:*
Information day
*Duration:*
1/2 day
*Fee:*
Free of charge
*Dates:*
28 January
18 June [D)]
1 October [A)]

[D)] Dresden
[A)] Attendorn

Courtesy of Volkswagen AG

## INFORMATION DAY: ELECTROMAGNETICAL/THERMOMECHANICAL FORMING WITH LS-DYNA

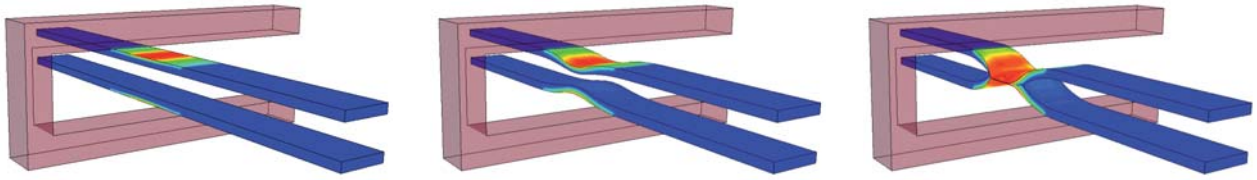
*Type:*
Information day
*Duration:*
1/2 day
*Fee:*
Free of charge
*Date:*
26 June

This information day is directed at interested LS-DYNA users who would like to be informed about the thermomechanically and electromagnetically coupled process simulation with LS-DYNA.

With the aid of simulation examples, a variety of coupled problems and their solution will be discussed. In particular, besides the already-established application of a thermomechanical coupling in hot forming processes, concepts to account for the microstructure in material models for metal plasticity will also be illustrated.

Moreover, the simulation of electromagnetic high-speed forming processes using LS-DYNA is also presented. In such simulations, one proceeds from multiple couplings of the actual mechanical problem with the calculation of temperature as well as electrical currents and the magnetic field.

Contents
- Thermomechanical coupling
- Phase transition in steel materials
- Consideration of the microstructure in material models
- Electromagnetic coupling
- High-speed forming

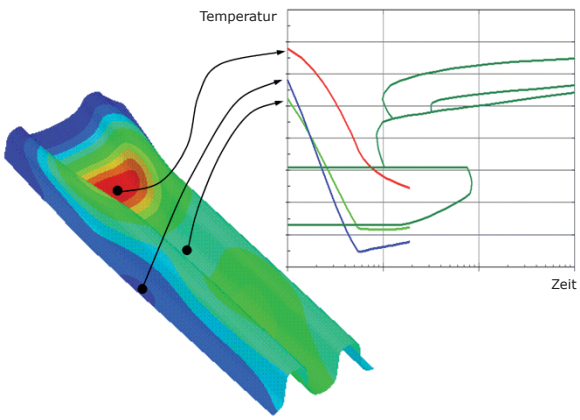


## THERMOMECHANICALLY COUPLED FORMING SIMULATIONS USING LS-DYNA

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
950 Euro
*Lecturer:*
David Lorenz, DYNAmore
*Date:*
31 Jan. - 1 Feb.

In this course, participants are taught the basics of thermal and thermo-mechanically 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 an efficient modeling techniques that are adapted to the calculation task at hand.

*Contents*
- 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.

## BASICS OF MODELING METALLIC MATERIALS

In LS-DYNA today there are dozens of material models which can be selected to depict steels. A sound understanding of the material models used is needed in order to obtain meaningful and reliable FE simulation results.

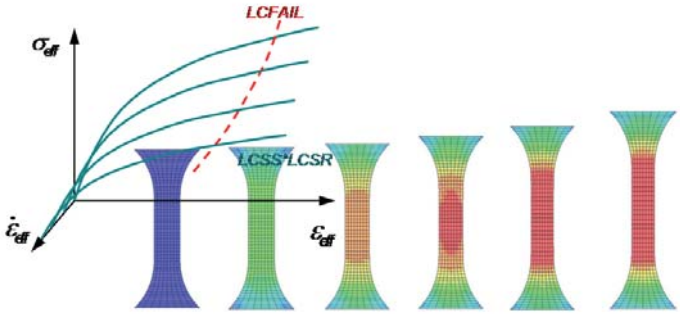
The aim of this seminar is to give practical guidelines about the application of the most commonly-used material formulations. The focus will be especially on basic theory and assumptions concerned with corresponding material formulations. As well as giving practical information about particular input formats and the relevance of special settings, the algorithmic background of the various model assumptions will also be explained. Smaller examples will illustrate diverse applications for the most-commonly used metallic material models in LS-DYNA.

*Contents*

- Theoretical aspects of modeling materials
  - Stress and strain measures
  - Rheological models
  - Isotropy and anisotropy
- Classification and differentiation between material models in LS-DYNA
- Research-oriented remarks on modeling materials in LS-DYNA
- Introduction
  - Linear elastic, elastoplastic models and projection algorithms
  - Viscoelastic and viscoplastic models
  - Anisotropic material models for 2-d and 3-d discretizations
  - Identifying parameters to take the effects of strain rates into account
  - Damage and failure models in cases where they are theoretically linked to the basic models (e.g. Gurson)
- Differentiation between various metallic materials with corresponding discussion
- Examples to be worked through by course participants

To attend this seminar, prior attendance at the seminar "Introduction to LS-DYNA" is recommended.

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
950 Euro
*Lecturers:*
Dr. André Haufe,
Dr. Thomas Münz,
both DYNAmore
*Dates:*
08-09 April
14-15 October

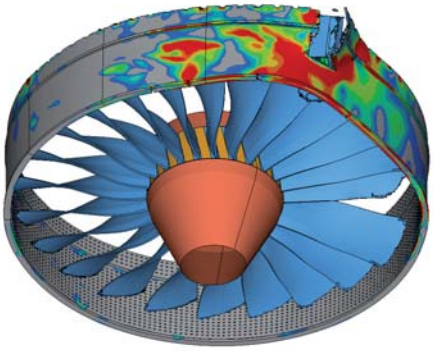



## MATERIAL AND FAILURE MODELS (MESH DEPENDENCE /TRI-AXIAL CONDITION)

This one-day seminar will discuss issues related to the adjustment of material models considering the failure, which can sometimes be relatively complex. The seminar intends to look at the complete picture, reaching from the approach to test design to the actual creation of a material card using LS-DYNA, thus reflecting the entire verification and validation process.

In more detail, the conversion of test data to real stress and expansion values will be explained, as well as the dependencies of deformation patterns on anisotropy and tri-axial condition, including complex descriptions of failure. In addition, the seminar intends to explain, in particular, the influence of model reduction in shell elements, using descriptions of failure. e.g. according to Wierzbicki, on the basis of Gurson, Johnson-Cook and extended Barlat models. The influence of the dependency on element size will be discussed in the context of expansion and energy equivalence. The issues of material stability and strength loss will be discussed in detail using the Gurson material model. Exercise examples illustrate the theoretical findings.

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
950 Euro
*Lecturers:*
Dr. Markus Feucht,
Daimler AG;
Dr. André Haufe,
DYNAmore
*Dates:*
10-11 April
16-17 October



Courtesy of Inprosim GmbH

## MODELING OF POLYMERS AND ELASTOMERS IN LS-DYNA

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
1,100 Euro
*Lecturer:*
Prof. Dr. Stefan Kolling, TH Mittelhessen
*Dates:*
15-16 April
04-05 November

In recent years foam-, rubber- and glue-materials have become more and more important for a large variety of industrial applications. Especially foams are widely used in the automotive industry because of their energy absorbing properties and the advandaysous 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. The modeling of foams for a finite element simulation therefore represents a challenging task for the simulation expert. Rubber- and Glue-Materials are in general non-linear elastic. Especially rubber materials show a very strong rate-dependent behavior, which has to be considered in the constitutive material formulation.

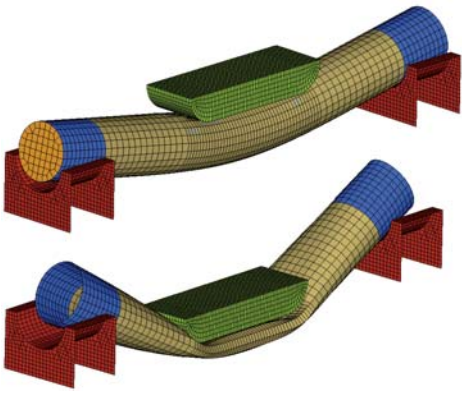
The program LS-DYNA offers its users a wide range of material models that have been developed exclusively for the modeling of foams and rubbers. The choice and the application of such special material models require a good basic knowledge of the theoretical as well as the numerical background.

It is the objective of this seminar to give an overview of the available material models for foams, rubbers and glues in LS-DYNA and on how to apply them properly. In addition to that the theoretical background of these models will be presented.

Furthermore the topics parameter identification, experimental set-up and evaluation of experimental results will be discussed. Small example problems will illustrate various application cases of the material models implemented in LS-DYNA.

*Contents*

- Presentation of various applications
- Discussion of the material behavior of polymers
- Foams
  - Reversible, crushable and semi-crushable foams
  - Appropriate material models for LS-DYNA
  - Preparation of test results and assumption in LS-DYNA
- Rubber Materials
  - Quasi-static and dynamic behavior
  - Incompressibility
  - Experimental set-up, data preparation
  - Parameter Identification
- Glue Materials
  - Structural glue, installation glue, pane glue
  - Modeling of a glue line
  - Material behavior and material modeling of glue
  - Tests for the evaluation of material parameters
- Thermoplastics
  - Material models for small deformations
  - Material models for large deformations
  - Experimental set-up, data preparation
  - Validation and verification



Courtesy of
Dow Germanland Anlagengesellschaft mbH

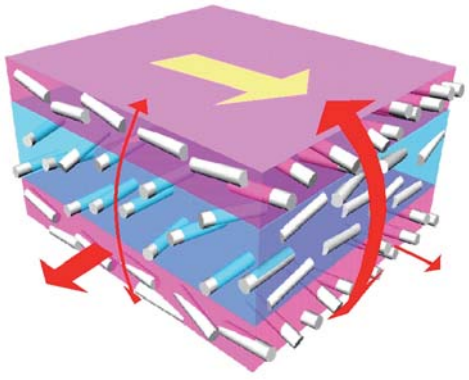
## WORKSHOP: USER MATERIALS IN LS-DYNA

*Type:*
Workshop
*Duration:*
1/2 day
*Workshop fee:*
270 Euro
*Modaration:*
Dr. Tobias Erhart, DYNAmore
*Date:*
28 February

LS-DYNA offers the possibility to implement own material models into the code of the program. Therefore the user developed and compiled material routines will be linked with the corresponding LS-DYNA object-files. The workshop addresses as well to users from the industrial as to users from an academical research background that integrate their own material models in LS-DYNA and are interested in discussing their experience with the implementation in a wider circle of users.

*Contents*

- Demonstration of the developing approach
  - Recommended compiler and compiler options
  - Possibly additional necessary libraries
- Access to data structure
- Implementation of an own material routine in LS-DYNA
- Own models can be discussed in the workshop and on request can be edited



Courtesy of BASF AG

## INFORMATION DAY: SIMULATION OF PLASTICS IN LS-DYNA

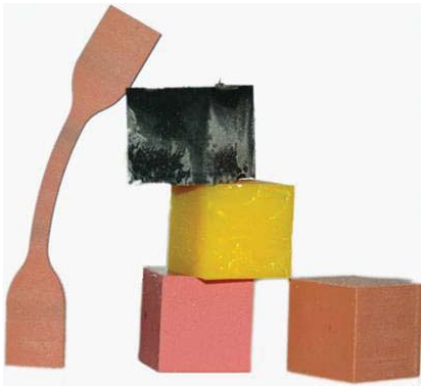
Today, mechanically stressed plastic components are used in nearly all engineering environments. In particular, their use has increased in the automotive industry in recent years. Extremely complex material models are needed to model such components realistically in a finite element simulation. Plastics 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.

In the course of this infoday, 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 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.

*Contents*

- 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
- Various experiments,
  - quasi-static
  - dynamic tests
  - local strain measurement
- Identification of material parameters
- How does the manufacturing process influence the mechanical behavior of plastics?
- User subroutines with material laws of their own
- Examples of use



*Type:*
Information day
*Duration:*
1/2 day (morning)
*Fee:*
Free of charge
*Date:*
14 May

## INFORMATION DAY: DYNAMIC MATERIAL CHARACTERIZATION USING 4A IMPETUS

A core aim of R&D is to reduce development times and costs. Due to higher requirements in a wide range of applications and especially in plastics technology, the number of different types of material 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 manufacturable test pieces under near-real stress with the aid of numeric methods. Based on the available database, 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 course members. 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.

*Contents*

- 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
  - and elastomers

In cooperation with 4a ENGINEERING


*Type:*
Information day
*Duration:*
1/2 day (afternoon)
*Fee:*
Free of charge
*Date:*
14 May

## INFORMATION DAY: COMPOSITE ANALYSIS IN LS-DYNA

*Typ:*
Information day
*Duration:*
1/2 day
*Fee:*
Free of charge
*Lecturer:*
DYNAmore and e-Xstream staff members
*Dates:*
17 April
06 November

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 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.

*Contents*
- 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

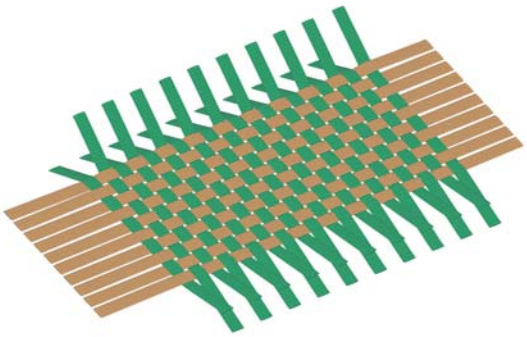
In cooperation with e-Xstream ENGINEERING, MSC Software Company

## INTRODUCTION TO COMPOSITE MODELING IN LS-DYNA

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
950 Euro
*Lecturers:*
Dr. Stefan Hartmann, Dr. Thomas Klöppel, Christian Liebold, all DYNAmore
*Dates:*
18-19 April
07-08 November

Steigende Anforderungen an Steifigkeit 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.

Very important subgroups of "Composites" are 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 technics of this subgroup. The strong anisotropy of these composite structures leads to 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.



*Contents*
- Introduction in composite materials
- Laminate theory
- 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

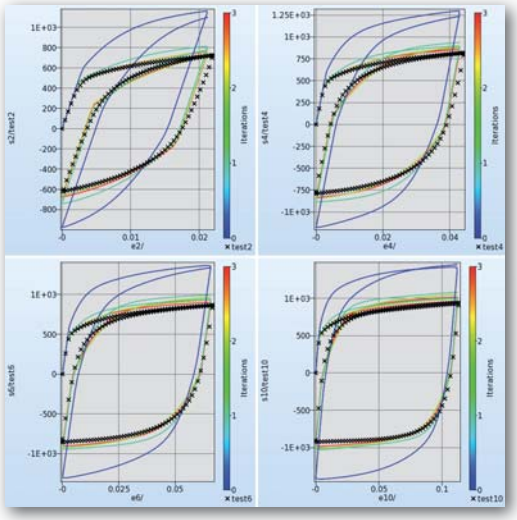
## IDENTIFICATION OF MATERIAL PARAMETERS USING LS-OPT

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 made with a focus on the application of LS-OPT to deDates material parameters. No prior knowledge about optimization or the application of LS-OPT is required.

*Contents*

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



*Type:*
Seminar
*Duration:*
1 day
*Seminar fee:*
475 Euro
*Lecturer:*
Katharina Witowski, DYNAmore
*Date:*
12 April
18 October

## IMPLICIT ANALYSIS USING LS-DYNA

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
950 Euro
*Lecturers:*
Prof. Dr. Martin Pitzer, TH Mittelhessen;
Dr. Tobias Erhart, DYNAmore
*Dates:*
13-14 March
10-11 September

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" have the opportunity to learn about what to bear in mind when converting explicit input decks to implicit input decks. Examples will be given during the seminar to illustrate the functionality of the implicit options.

*Contents*

- When is it reasonable to perform implicit analysis and when explicit analysis?
- Current possibilities for implicit analysis using LS-DYNA (available material models, element types, contacts, etc.)
- What does the syntax of implicit control cards look like?
- Difference between explicit and implicit simulations shown by examples
- Natural frequency analysis
- Which element types are used in implicit analysis?
- Iterative and direct solvers: Theory and application
- Nonlinear solution methods: Newton, BFGS, arc length method
- Modal analysis
- Buckling analysis
- Stress initialization, switching from implicit/explicit and explicit/implicit, springback
- New implicit features: switching between dynamic/static analysis, joints, etc.

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

## INFORMATION DAY: LS-DYNA/IMPLICIT

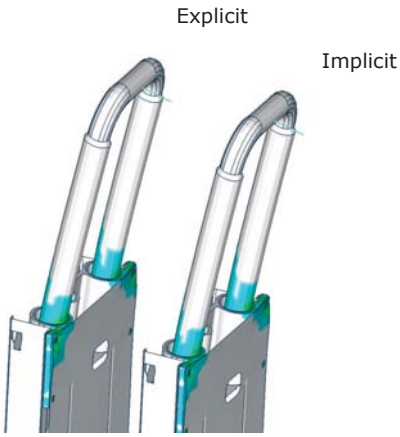
*Type:*
Information day
*Duration:*
1/2 day
*Fee:*
Free of charge
*Date:*
12 March
09 September

At this infoday it will be reported on the current development of LS-DYNA/Implicit. Possible applications will be presented on the basis of examples and the functionality of LS-DYNA/Implicit will be demonstrated being carried out for quasi-static as well as for dynamical problems.

*Contents*

- Status quo of LS-DYNA/Implicit
- For which problems does it makes sense to use LS-DYNA/Implicit?
- Equation solvers
- Possibilities and limits of applications
- Demonstration of different LS-DYNA/Implicit applications
- Planned future development
- Status quo of LS-DYNA/Implicit for MPP

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




Courtesy of PENG - Prof. Pitzer, Gießen

## NVH & FREQUENCY DOMAIN ANALYSIS IN LS-DYNA

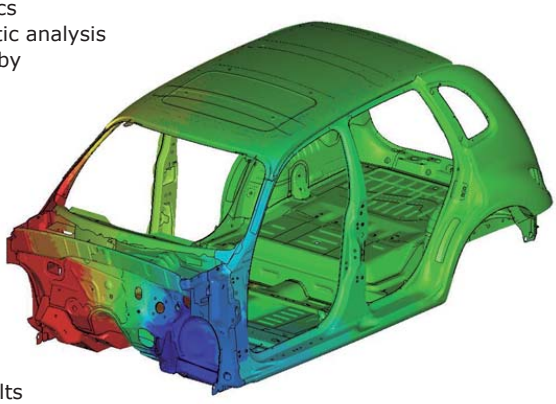
The objective of the training course is to introduce the frequency domain vibration and acoustic features of LS-DYNA to users, and give a detailed look at the application of these features in vehicle NVH simulation.

This course is recommended for engineers who want to run NVH or other frequency domain vibration 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.

*Contents*

- Introduction
  - Overview of the frequency domain features of LS-DYNA
  - Application
  - NVH theory and lab testing technology
  - Frequency domain analysis vs. time domain analysis
  - Fourier transform
    Windowing technique
- Frequency Response Functions
  - Modal superposition method
  - Damping
  - Pre-stress condition
  - Nodal force / resultant force FRF
- Steady state dynamics with harmonic loading
  - Large mass method for enforced motion
- Random vibration with PSD loading
  - Correlated multiple excitations
  - Acoustic wave environment
  - Restart feature
  - Pre-stress condition
  - Random fatigue
    Miner's rule
    S-N fatigue curve
    Steinberg's three band technique
    Dirlik method
- BEM acoustics
  - Helmholtz integral equation
  - Approximate methods
    (Kirchhoff method/Rayleigh method)
  - Collocation BEM
  - Dual collocation BEM for irregular frequency problems
  - Variational indirect BEM
  - Half-space problem
  - Impedance boundary condition
  - Panel contribution analysis
  - Muffler transmission loss analysis
- FEM acoustics
  - Elements used in FEM acoustics
- Coupling of vibration and acoustic analysis
  - Transient simulation followed by acoustic analysis
  - Frequency domain simulation followed by acoustic analysis
  - Full coupling analysis using Kirchhoff method
- Response spectrum analysis
  - Input earthquake spectrum
  - SRSS method
  - NRC grouping method
  - CQC method
  - Double sum method
  - NRC sum method
- Post-processing of analysis results
  - Binary plot databases (d3ssd, etc.)
  - ASCII databases (nodout_ssd, elout_ssd, etc.)
- Workshop

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
1,100 Euro
*Lecturers:*
LSTC and DYNAmore staff members
*Language:*
English
*Date:*
26-27 September



## INFORMATION DAY: ACOUSTICS SIMULATION AND NVH-ANALYSIS WITH FEM AND BEM

At this information day, the theoretical basics of predicting vibro-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.

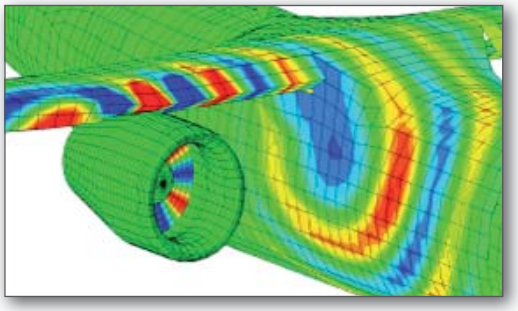
In LS-DYNA, acoustics simulations or general NVH-Analyses can be carried out using the BEM and FEM. For this reason, it is possible to investigate acoustic and vibro-acoustic problems in the time as well as in the frequency domain. Based on these computations, quantities such as the acoustic pressure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

The aim of this information day is to give general information about the simulation of acoustic and vibro-acoustic problems, NVH and other frequency domain analyses using LS-DYNA. Besides the theoretical basics, the current state-of-the-art technology for typical industrial problems will be presented and the possibilities, limits and future developments of LS-DYNA are discussed.

*Contents*

- 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

*Typ:*
Information day
*Duration:*
1/2 day
*Fee:*
Free of charge
*Date:*
23 September



Courtesy of
Hamburg University of Technology

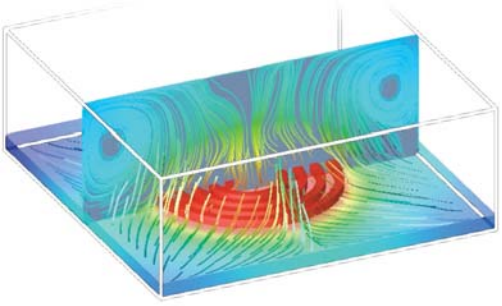
## INFORMATION DAY: MULTIPHYSICS

*Type:*
Information day
*Duration:*
1/2 day
*Fee:*
Free of charge
*Date:*
04 March
28 November

The modern term „multiphysics" can be understood as a synonym for the solution of generally coupled problems. Following this, multi-physical 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 multi-physical 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 multi-physical 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

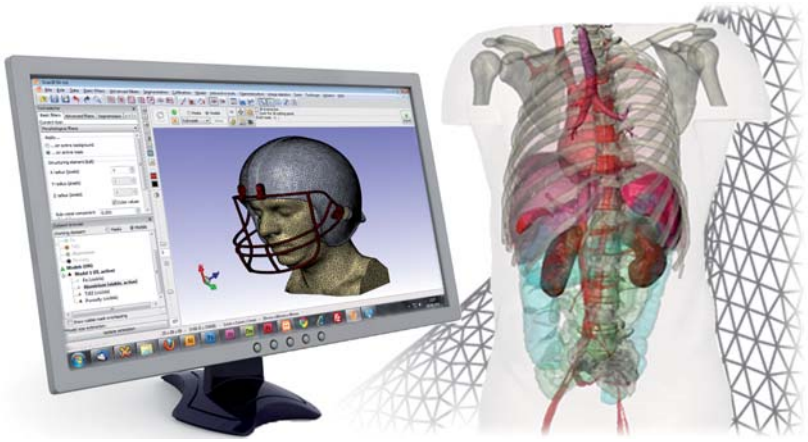
*Type:*
Information day
*Duration:*
1/2 day
*Fee:*
Free of charge
*Date:*
12 November

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. Besides the simulation possibilities, a powerful preprocessor is also required to geometrically capture and discretize irregular biological structures. The software package Simpleware supplies a user-friendly solution to this and also has an interface to LS-DYNA.

In cooperation with simpleware



Courtesy of Simpleware, Inc.

## ALE AND FLUID-STRUCTURE INTERACTION IN LS-DYNA

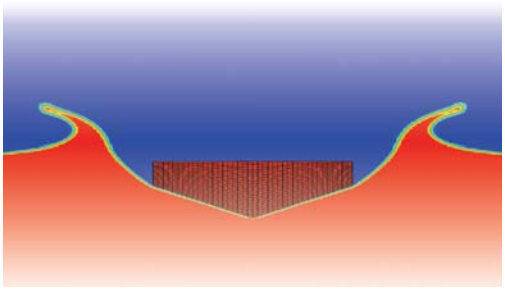
In this seminar, you receive comprehensive information directly from one of the program developers about the latest developments of the features provided by the solver LS-DYNA to analyse fluids and, in particular, the fluid-structure interaction using its Arbitrary Lagrangean Eulerian (ALE) capabilities.

The theoretical background to fluid modeling in LS-DYNA is presented and illustrated with several practical applications. Problems solved during the workshop include tank sloshing, tank dropping (partially and completely filled), viscous flow in a channel, underwater explosion, bird strike, ship collision and acoustics in air and water.

The seminar is directed towards advanced LS-DYNA users, whereas prior knowledge of fluid dynamics is not required.

*Contents*

- Lagrangean formulation (relevant mathematical equations, discretization and numerical solution)
- Eulerian formulation of one material (relevant mathematical equations, operator-split technique, advection ratio)
- ALE formulation of one material (algorithm for mesh smoothing)
- Eulerian formulation of several materials (tensions weighted according to volume fractions, transition reconstruction)
- ALE formulation of several materials (functioning of a moving Eulerian mesh)
- Fluid-structure interaction (method with constraints), penalty-based method, problem of leakage and solution to it
- Examples of application



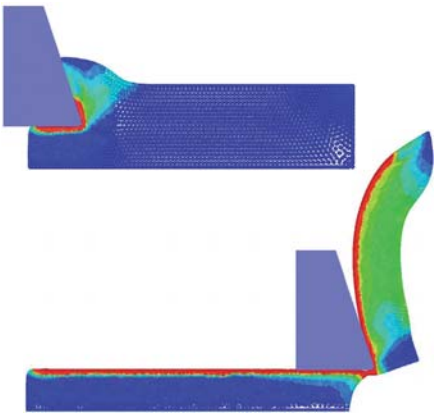
*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
1,100 Euro
*Lecturer:*
Prof. Mhamed Souli, Université Lille / LSTC
*Language:*
English
*Date:*
26-27 September

## MESHLESS METHODS IN LS-DYNA

Attendees of this seminar will be introduced to the application of the meshless “Element-Free Galerkin” (EFG) and “Smoothed Particle Hydrodynamics” (SPH) methods in LS-DYNA. The seminar will outline the theoretical bases and thoroughly refer to the settings required in the LS-DYNA input deck in order to carry out an EFG/SPH simulation. Examples will be used to get an even better understanding of how to use these methods.

The speaker, Dr. Cheng-Tang Wu is a senior software developer at LSTC and was significantly involved in the development and implementation of the meshless methods (EFG/SPH) in LS-DYNA.

This seminar is recommended for engineers who have already worked with LS-DYNA and would like to use a meshless method.



EFG (day 1)

- Introduction
- Overview of current meshless methods
  - Element-Free Galerkin method
  - Reproducing Kernel Particle method
  - HP-Clouds, finite-sphere method, etc.
- Nonlinear EFG formulation
  - Variational functionals
  - Lagrangean and Eulerian kernel
  - Dealing with boundary conditions
  - Area integration and patch test
- Advandayss and limitations of the method
  - Industrial applications
  - Incompressibility limit
  - Numerical aspects
  - Lagrange method vs. Eulerian method
  - Galerkin access vs. collocation method
- Coupling EFG with the finite-element method
- Latest scientific developments in mesh-free methods
- Current status and future plans

SPH (day 2)

- Development (history) of the method
- General possibilities/applications
- Coupling SPH with finite elements
- Principle of the method
  - Characteristic lengths
  - Particle approximation of functions
  - Renormalization
- Neighbor search
- Input parameters using an example
  - Control input
  - Material, sections and parts
  - Output
- Pre- and post processing with LS-PrePost
- Workshop

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
1,100 Euro
(550 Euro per day, can be booked seperately)
*Lecturer:*
Dr. Cheng-Tang Wu, LSTC
*Language:*
English
*Date:*
26-27 September

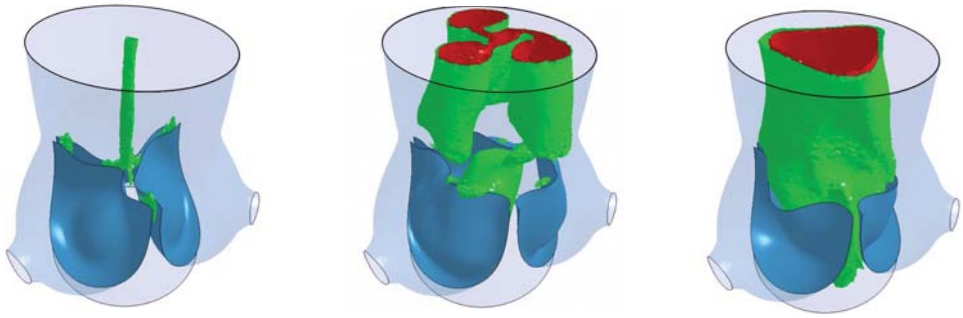
## INFORMATION DAY: POSSIBILITIES FOR COMPUTATIONAL FLUID DYNAMICS (CFD) WITH LS-DYNA

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

Over the past few years, the capabilities of LS-DYNA in computational fluid mechanics have been significantly extended. Since recently, all LS-DYNA users are able to apply a completely new method to simulate viscous, incompressible, laminar and turbulent fluid flows.

On this information day, the various simulation possibilities of LS-DYNA in fluid mechanics are explained. Herein, the strengths of LS-DYNA are illustrated and its limits of applicability due the currently implemented methods are discussed.

*Contents*
- Basic theory of the methods in LS-DYNA
- Turbulence models
- Application possibilities
- Fluid-structure interaction
- Surface/volume coupling
- Strategies in LS-DYNA
- Demonstration of application examples



Fluid-structure interaction of a heart valve

## CFD SOLVERS AND FSI IN LS-DYNA: INTRODUCTION AND APPLICATIONS

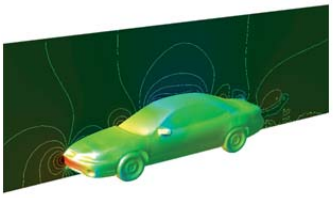
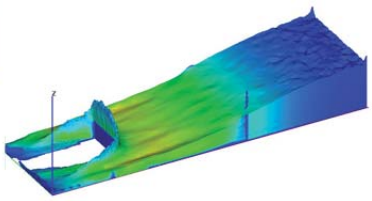
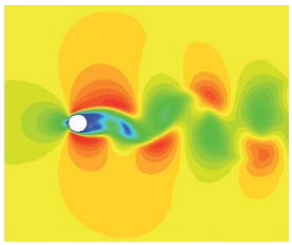
This course provides an introduction to the incompressible fluid solver (ICFD) in LS-DYNA. It focuses on the solution of CFD problems, where the incompressibility constraint may be applied, e. g. ground vehicle, aerodynamics, hemodynamics, free-surface problems, ship hydrodynamics, etc. The solver may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

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. Finally, a brief introduction to the new compressible CESE solver specialized in supersonic flows and shockwave capturing is also given.

*Contents*

- Introduction and applications
- General principles
- Fluid mechanics and CFD concepts
- Fluid volume meshers
- FSI and thermal coupling
- Setting up a pure CFD problem
- Step by step keyword description
- Mesh refinement tools
- Multi-phase problems
- User defined mesh
- Coupling with the structural and thermal LS-DYNA solvers
- Loose FSI coupling
- Strong FSI coupling
- Conjugate heat transfer problems
- Advanced controlling and watching tools
- Introduction to the CESE compressible flow

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
1,100 Euro
*Lecturer:*
Iñaki Çaldichoury, LSTC
*Language:*
English
*Date:*
05-06 March

## ELECTROMAGETIC FIELD SOLVER IN LS-DYNA: INTRODUCTION AND APPLICATIONS

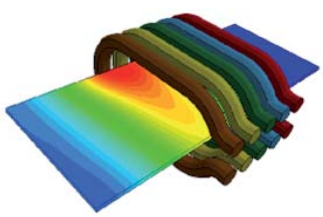
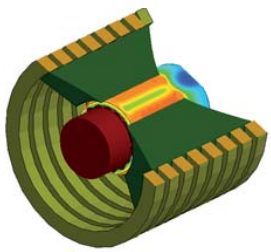
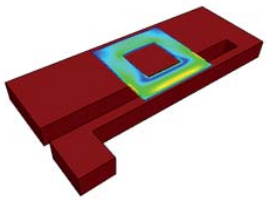
This course provides an introduction to the Electromagnetics (EM) solver in LS-DYNA. The Maxwell equations are solved in the Eddy-Current approximation suitable for cases, where the propagation of electromagnetic waves in air (or vacuum) can be considered as instantaneous. The solver is coupled with 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.

*Contents*

- 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
*Seminar fee:*
550 Euro
*Lecturer:*
Iñaki Çaldichoury, LSTC
*Language:*
English
*Date:*
07 March

## LS-OPT - OPTIMIZATION AND ROBUSTNESS

*Type:*
Seminar
*Duration:*
3 days
*Seminar fee:*
1,425 Euro
(475 Euro per day, can be booked seperately)
*Lecturers:*
Katharina Witowski, Dr. Heiner Müllerschön, both DYNAmore
*Dates:*
12-14 June
20-22 November

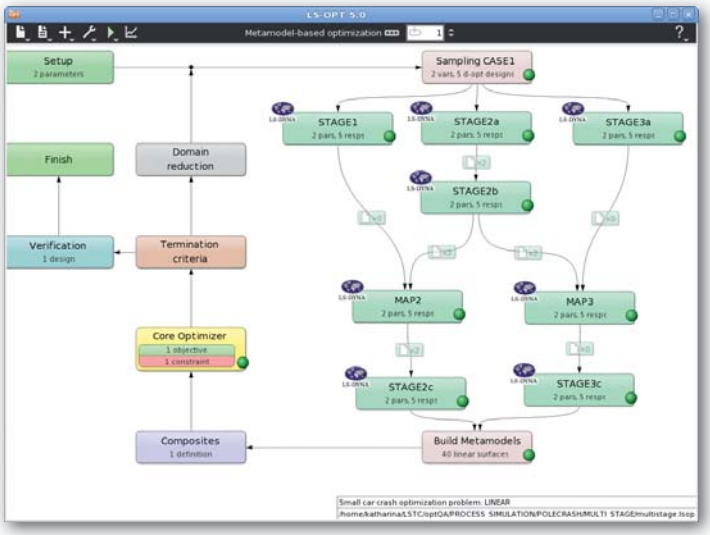
Introduction and optimization (2 days)

LS-OPT is an independent, comprehensive optimization program from LSTC. It is ideal for solving strongly nonlinear optimization problems and is thus highly suitable for use in combination with LS-DYNA. However, LS-OPT can also be combined with any other solver. LS-OPT functions on the basis of a special, highly effective response surface method. The program also includes stochastic methods for assessing the robustness of FE models and illustrating dependencies between optimization variables and desired values. Input from the user is supported by a comfortable graphical user interface.

The seminar gives an introduction to the program LS-OPT. General theory aspects of the Response Surface Method are discussed and the possibilities of applying this method in LS-OPT are especially 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 by working on practice examples.

*Contents*

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

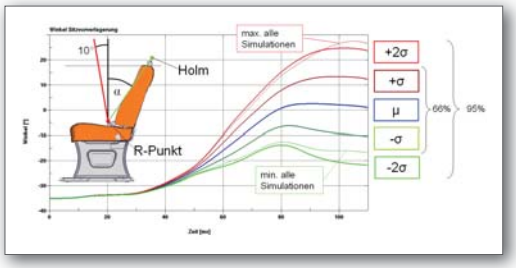



LS-OPT V5 Graphical User Interface

Robust Design (1 day)

In recent years, methods for stochastic analysis and assessing the robustness of FE models have been implemented in LS-OPT. These features allow to answer questions such as:

- What is the probability of a specific failure limit being exceeded?
- Is my solution robust or does a minor alteration to my input variables lead to a completely different result?
- Is the dependence between input variables and the answer (solution) chaotic or predictable?
- How great is the correlation between variables and answers or between answers and answers?




Courtesy of Daimler AG

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 probability will be given and the methods implemented in LS-OPT are discussed.

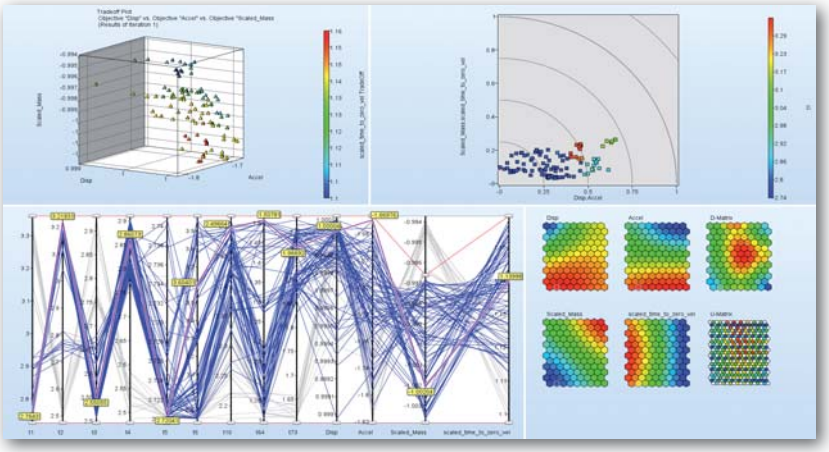
To attend the module "Robust Design", prior attendance at the module "Introduction and optimization" is recommended.

## INFORMATION DAY: OPTIMIZATION, DOE STUDIES AND ROBUSTNESS ANALYSES

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

On this information day, several lectures will be presented on application examples and solution strategies regarding optimization problems, sensitivity studies, design studies with meta-models as well as robustness and reliability investigations. Moreover, new developments in our software products LS-OPT and GENESIS will be illustrated as well as aims and 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 deDateing 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)),
- a clearly-arranged graphical user interface 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.

## THEORETICAL ASPECTS OF STRUCTURAL OPTIMIZATION

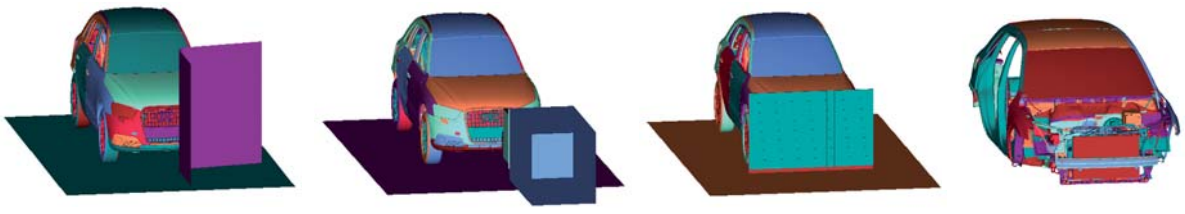
*Type:*
Seminar
*Duration:*
1 day
*Seminar fee:*
550 Euro
*Lecturer:*
Dr. Stefan Schwarz,
Dr. Ing. h.c. F.
Porsche AG
*Dates:*
11 June
19 November

The aim of this class is to understand the basic principles of structural optimization techniques (e.g. response surface methods, gradient based methods, genetic and stochastic search methods) and to discuss the capabilities and limits of the different methods. The methods are illustrated with examples particularly from the automotive industry.

Various definitions related to structural optimization techniques as topology, topography and topometry optimization are used frequently. These methods are usually effectively used in linear finite element analysis. For the optimization of nonlinear systems usually gradient based methods (numerical/ analytical), response surface methods, or genetic and stochastic search methods are applied. The aim of this class is to understand the basic principles of structural optimization techniques (e.g. response surface methods, gradient based methods, genetic and stochastic search methods) and to discuss the capabilities and limits of the different methods. The methods are illustrated with examples particularly from the automotive industry.

*Contents*

- Introduction to mathematical optimization
- Classification of different methods
- How to select the right method
- Possibilities and limits of the different methods
- Effectivity of the algorithms
- Pros and cons of the methods
- Correct definition of an optimization problem
- Interpretation of results



Courtesy of Audi AG

## STRUCTURAL OPTIMIZATION WITH GENESIS

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, deDates 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.

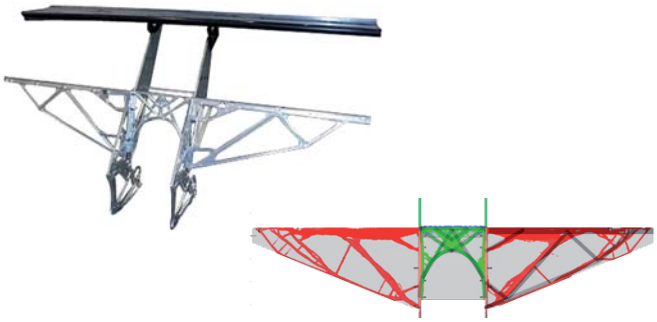
The seminar gives an introduction to the GENESIS program and to the graphical user interface Design Studio for GENESIS. The various optimization concepts (topology, topometry, topography, sizing and form optimization) as well as areas of application are presented and discussed. Selected problems are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

*Contents*

- Introduction to topology, topometry, topography, sizing and form optimization
- Pre- and post processing 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

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
950 Euro
*Lecturer:*
VR&D and DYNAmore staff members
*Dates:*
01-02 July
25-26 November

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



## INFORMATION DAY: INTEGRATED OPTIMIZATION WITH ANSA, LS-OPT UND META

The current versions of LS-OPT and ANSA support simple coupling between ANSA and LS-OPT. For example, ANSA offers excellent possibilities for parameterized changes to FE meshs by means of morphing technologies. The control parameters for morphing are passed to LS-OPT and modified and controlled there. Due to this, form optimizations or robustness analyses taking into account geometrical changes can be implemented very easily. In addition to this, any optimization variables desired can be defined in the FE input files in ANSA and be passed to the optimization process in LS-OPT.

Furthermore, the META post processor 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.

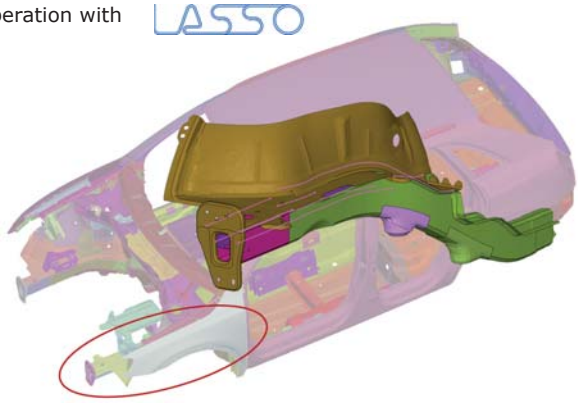
This infoday shows how ANSA and META can be used together with LS-OPT for optimization and stochastic analyses. Examples from industrial practice will also be presented.

*Contents*

- 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

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

In cooperation with



Courtesy of Audi AG

## INFORMATION DAY: LS-DYNA APPLICATIONS IN CIVIL ENGINEERING

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

With the increasing number of possibilities of LS-DYNA in implicit dynamics also engineering problems in long time dynamics can 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 servicability 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 defence 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 facades-structures subjected to blast loads. Thus state-of-the-art simulation techniques can contribute to a more efficient dimensioning of cross sections.

The target 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 saver designs, as well as the potential of more economic dimensioning of structures will be the benefit.

*Contents*

- Explicit and implicit applications, ground 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 defence (explicit):
  - Blast loads at surface
  - Blast loads at mountings

Courtesy of Institut für Mechanik, Universität Karlsruhe (TH) and Dr.-Ing. Rainer Melzer

## CONCRETE AND GEOMATERIAL MODELING WITH LS-DYNA

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
1,100 Euro
*Lecturer:*
Dr. Len Schwer,
Schwer Engineering &
Consulting Services
*Language:*
English
*Date:*
05-06 December

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.

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## ANSA AND METAPOST FOR LS-DYNA

*Type:*
Seminar
*Duration:*
2 days,
can be booked
sepertely
*Seminar fee:*
On request
*Location:*
Stuttgart / Leinfelden-Echterdingen
*Date:*
On request

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. ANSA offers an extensive interface to LS-DYNA. It also provides excellent meshing capabilities. Speakers from LASSO and DYNAmore will give participants an insight into the entire process chain ANSA – LS-DYNA – METApost.

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

Day 2: METAPOST postprocessing
- Introduction to the LS-DYNA interface of METApost
- Result evaluation 3D and xy plots with METApost
- Interpretation of results
- Important plausibility checks
- Model preparation and result evaluation with practical crash-examples

The seminars ANSA and METAPOST can be booked independently.

In cooperation with LASSO

## MEDINA INTERFACE AND MIDAS FOR LS-DYNA

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
On request
*Location:*
Stuttgart / Leinfelden-Echterdingen
*Date:*
On request

This seminar is for engineers who are interested in the application of LS-DYNA using MEDINA as a pre- and postprocessor and MIDAS for data managment. The seminar will focus on the LS-DYNA interface of MEDINA. Thereby instructors from DYNAmore will explain possible element types, material definitions, contact types boundary conditions as well as appertaining optional adjustments. Experienced employees of T-Systems will present the implementation of these specifications using MEDINA. A basic knowledge of MEDINA is required in order to participate.

*Contents*
- Which problems may be solved by LS-DYNA and how to define them using MEDINA?
- Which element types are available and how to define them in MEDINA?
- How to use the different contact definitions and how to implement the adjustment in MEDINA?
- How to specify a chosen material model in MEDINA?
- Spotweld Modeling
- Model control in MEDINA using criteria for LS-DYNA
- Handling of computation variants and mesh modifications
- Evaluation of results using MEDINA (interpretation of results, important checks of plausibility)
- Tutorial: Model setup and evaluation of results by means of practical examples

In cooperation with T-Systems

## HYPERWORKS FOR LS-DYNA

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
On request
*Location:*
Stuttgart / Böblingen
*Date:*
On request

The main application areas of LS-DYNA are crash, metal forming, impact problems or other highly nonlinear tasks. Furthermore LS-DYNA can be used advandaysously 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.

*Contents*
- Which problems may be solved by LS-DYNA?
- What is the difference between implicit and explicit time integration?
- How to start a LS-DYNA simulation?
- Which element types are available in LS-DYNA and how to define them in Hypermesh?
- How to use the different contact options?
- How to specify a chosen material model in HyperMesh?
- How to implement crash simulations and other dynamical computations and how to edit the models in HyperMesh?
- Evaluation of results using HyperMesh / HyperView / HyperGraph
- Tutorial: Model setup and evaluation of results by means of practical crash examples

In cooperation with Altair

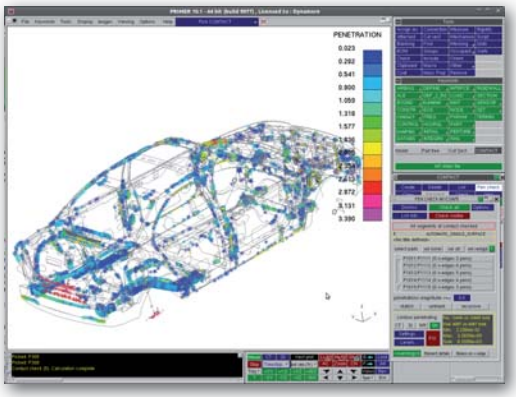
ANSA, MEDINA and HYPERWORKS seminars on request. Please contact us.

## PRIMER AS PREPROCESSOR 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 implement very specific LS-DYNA settings, such as almost 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 superfluous 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.

In this seminar the practical use of PRIMER is arranged for the participant. All important functions are described and demonstrated in the context of a Workshops. On the basis of many training examples the participant learns the safe operation for different areas of application.

In cooperation with ARUP



*Type:*
Seminar
*Duration:*
1 day
*Seminar fee:*
475 Euro
*Lecturer:*
Daniel Keßler, DYNAmore
*Language:*
German
*Date:*
22 April
12 September

## INFORMATION DAY: PRIMER AS PREPROCESSOR 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 implement very specific LS-DYNA settings, such as almost 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 superfluous 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. This information day will provide attendees with an overview of the options of, and limitations to, the PRIMER preprocessor. The event is organised in collaboration with Arup, the developer and provider of PRIMER.

In cooperation with ARUP

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

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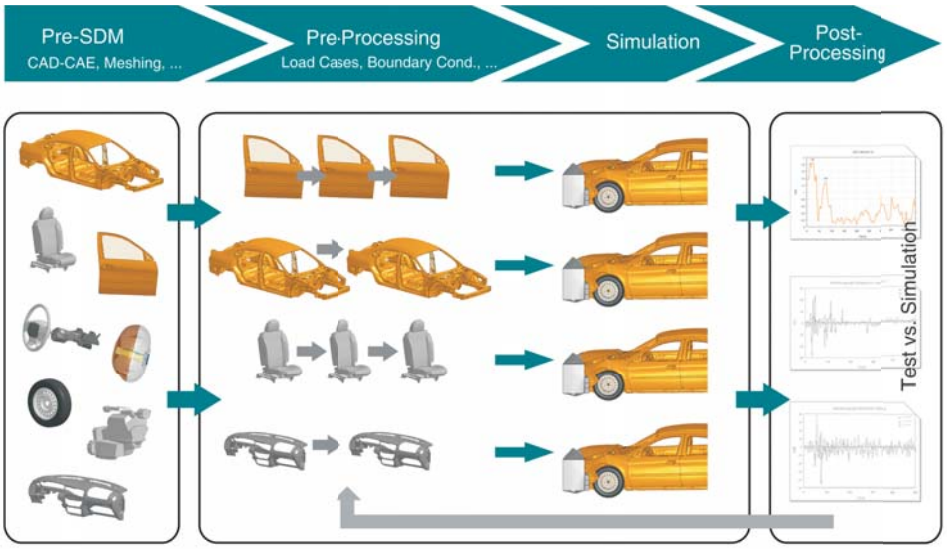



- CAx data management
- Process integration
- Process monitoring
- Generating reports
- IT consulting
- IT products

DYNAmore provides a wide range of services for developing software and integrating data management systems for virtual product development. A balanced mix of computer scientists and engineers with IT and CAE experience guarantee professional software development, making DYNAmore an ideal partner for your tasks in a CAx environment.

More information
www.dynamore.de/de/it-dienste

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

Today, simulation data management (SDM) is a highly relevant topic in the computer-aided engineering (CAE) of vehicles. While a few years ago, a vehicle model to analyze its crashworthiness consisted of only one large input file, such models are nowadays constructed using modules which comprise 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.

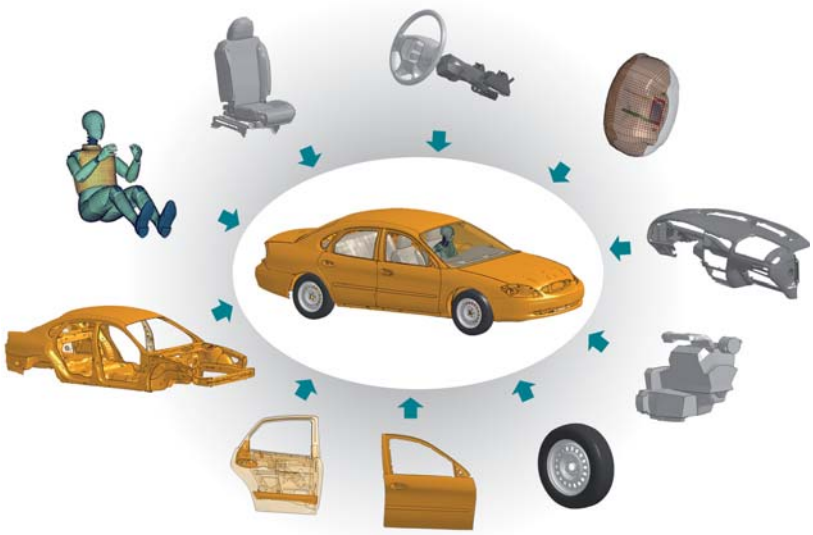
Among others, the administration of these model components in a multi-user environment as well as the automated simultaneous preparation of several load cases for simulation are demanding challenges for an SDM system. The automated data flow from CAD to CAE, i.e. from the geometrical representation to meshed components, is another important subject. This also includes the demand for consistent and transparent meta data relating to the process chain of 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 cooperation with partner companies. The above-mentioned topics from process automation and simulation data management will be jointly discussed.

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



## INFORMATION DAY: CLOUD TECHNOLOGY FOR LS-DYNA

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 ressources result high cost saving potential for the whole IT budget in large concerns and in small enterprises too.

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.

*Contents*
- Introduction to cloud technology
- Services related to grid framework?
- How to use LS-DYNA on a grid system?
- How to achieve a good performance?

*Type:*
Information day
*Duration:*
1/2 day
*Fee:*
Free of charge
*Date:*
2 May

## LS-DYNA INSTALLATION AND SERVICE FOR LINUX-CLUSTER-SYSTEMS

This seminar should act as a spotter for user and administators of Linux Cluster-Systems for installation and service of LS-DYNA. The basics for the adminiatration of Linux Cluster-Systems will be presented first. The course instructor will make some remarks to the experience with RedHat, SuSE or Scientific Linux as well as to Open Source Tools like C3, Gangila, Nagios and OSCAR.

Another main point is the installation and integration of different network technologies like Gigabt-Ethernet, Myrinet2000 and InfiniBand. The necessary kernel patches and software will be discussed. Networks like MPI-Visions is also a subject. Finally the installation of LS-DYNA and several tips will be discussed.

In cooperation with NEC

*Type:*
Seminar
*Duration:*
2 days
*Seminar fee:*
950 Euro
*Lecturer:*
Dr. Andreas Findling, NEC HPC Europe GmbH
*Date:*
On request

## SWITCHING TO LS-DYNA

*Type:*
Seminar
*Duration:*
1 day
*Seminar fee:*
475 Euro
*Lecturer:*
Dr. Tobias Graf, DYNAmore
*Dates:*
11 March
08 July

LS-DYNA are increasingly common in the simulation of crash and pedestrian safety. This seminar is designed to enable simulation engineers already familiar with other relevant programs to switch to LS-DYNA quickly and efficiently.

Experienced users will be provided with a compact introduction to LS-DYNA simulation. As part of this seminar, specific settings and special properties of LS-DYNA will be discussed, and the various approaches to modelling and crash and occupant safety simulations outlined. Features differing from other programs will be mentioned specifically. Benefits and shortcomings of the individual approaches will be discussed.

*Contents*
- LS-DYNA overview – special features
- DeDateation of the time step size and mass scaling in LS-DYNA
- Most important types of elements for solids, shells and beam elements
- Contact modelling in LS-DYNA
- Frequently used material models
- Input and output formats, file organisation
- Energy gradients, interpretation
- Examples

Courtesy of Adam Opel AG

## SUPPORTDAY: LS-DYNA

*Type:*
Supportday
*Duration:*
1/2 day
*Fee:*
Free of charge
*Dates:*
18 January
15 February
19 April
17 May
21 June
18 October
15 November

At the support days you are invited to come to our office in Stuttgart-Vaihingen bringing along with you your LS-DYNA jobs and/or your input files. Experienced employees of DYNAmore will then try to optimise your input files together with you or to solve problems in your computation. It is very often the easiest way to answer your question concerning your LS-DYNA model straight at the screen. How can I model my problem with LS-DYNA? You can also provide drawings or CAD data to discuss your problem. We can discuss items related to a already prepared LS-DYNA Input, that will be provided by you.

Furthermore you may provide some data in advance. This would allow us to be prepared for our conversation.

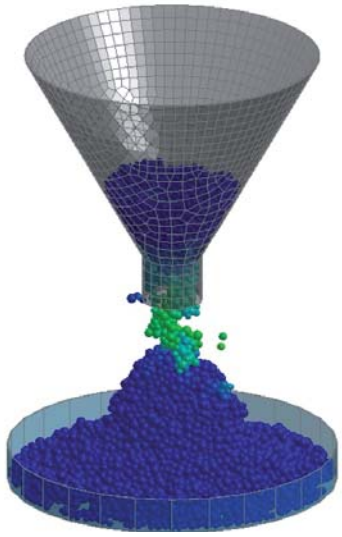
Please register ahead of time for these days – ideally with a specification of the load case, so that we will be able to prepare for your visit.

## WEBINARS – NEW FEATURES IN LS-DYNA

In webinars, new developments in LS-DYNA are presented and their application explained. The aim is partly to inform LS-DYNA users about new calculation methods and partly to give interested parties who have already gained experience using other explicit FE solvers an overview of the features of LS-DYNA.

*Type:*
Webinar
*Duration:*
40 - 60 minutes
*Fee:*
Free of charge
*Dates:*
Dates will be announced in due course

Details are given about new program versions and the resulting new application potentials are also outlined. Additionally, planned future developments and trends are presented together with corresponding background information. The main topics of the webinars are always adapted to current developments and announced shortly beforehand in our information mails and on our Internet page www.dynamore.de.



Examples of possible topics:

- Discussions about new LS-DYNA releases
- Hardware performance: scaling, MPI, hybrid MPP/SMP, GPUs, etc.
- Joining techniques, welding point/bonding failures
- Material modeling: plastics, composites, high-tensile steels
- New element formulations
- Further developments in LS-DYNA/implicit
- Special areas: ALE, CPM, EFG, SPH, DEM, isogeometric approaches, etc.
- Flow simulation and FSI
- New developments in LS-PrePost and LS-OPT
- DYNAtools for compressing data, testing models, converting output data
- ...

## VOCATIONAL TRAINING AS A SIMULATION ENGINEER IN LS-DYNA FOR VARIOUS APPLICATION AREAS

This offer gives you the chance to receive complete comprehensive instruction in your field of use. The course is made up of certified simulation engineer training packages 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 training to become a simulation engineer using LS-DYNA. Please get in touch with us.

### LS-DYNA FOR NONLINEAR STRUCTURAL MECHANICS (CRASH)

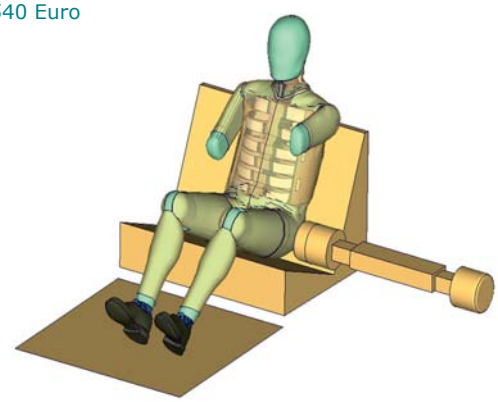
Professional education course to become a certified simulation engineer in nonlinear structural mechanics with LS-DYNA.

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 courses, you will have the necessary know-how to meet industrial requirements as a simulation engineer. On completion of all courses within the package, you will receive a certificate which declares you to be a qualified LS-DYNA simulation engineer in nonlinear structural mechanics.

*Seminar*
- Introduction to LS-DYNA: Basics - 2 days
- Introduction to LS-DYNA: Advanced Topics - 1 day
- Contacts in LS-DYNA - 1 day
- Joining technology for crash calculation using LS-DYNA - 2 days
- Basics in modeling metallic materials - 2 days

Package price: 3,540 Euro

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



### LS-DYNA FOR SIMULATING OCCUPANT SAFETY

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

With this package, you receive comprehensive training to calculate the design of occupant safety systems. After attending in these courses, 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 which declares you to be a qualified LS-DYNA simulation engineer in occupant safety simulation.

*Seminar*
- Introduction to LS-DYNA: Basics - 2 days
- Contacts in LS-DYNA - 1 day
- Introduction to occupant safety simulation using LS-DYNA - 2 days
- LS-DYNA dummy and impactor modeling - 1 day
- Introduction to modeling and airbag simulation - 2 days

Package price: 3,540 Euro

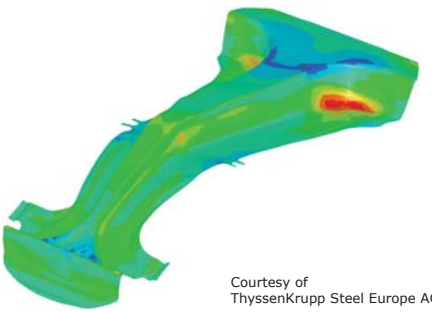
### LS-DYNA FOR METAL FORMING

Professional training course to qualify as a certified simulation engineer in metal forming using LS-DYNA

After taking part in these seminar courses, as a simulation engineer you are now able to carry out forming simulations in an industrial environment. On completion of all courses within the package, you receive a certificate which declares you to be a qualified LS-DYNA simulation engineer in forming processes.

*Seminar*
- Introduction to LS-DYNA: Basics - 2 days
- Introduction to LS-DYNA: Further Topics - 1 day
- Contacts in LS-DYNA - 1 day
- Modeling forming processes using eta/DYNAFORM - 2 days
- Simulating forming processes using LS-DYNA - 2 days

Package price: 3,540 Euro



Courtesy of
ThyssenKrupp Steel Europe AG

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- Detailed search function

### www.dynaexamples.com

- Comprehensive collection of examples of various LS-DYNA training courses
- Images and animations
- LS-DYNA input decks
- Key word search

### www.dummymodels.com

- Technical information about LS-DYNA dummy models

### www.lsoptsupport.com

- LS-OPT support site
- General information
- Examples
- Documents
- FAQs, How-Tos

### www.dynasupport.com

- LS-DYNA support site
- Tutorials
- Release notes
- FAQs, How-Tos

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- Download area for software and documentation
- Current information and offers
- Seminar dates, booking and descriptions
- Contact addresses
- Conference information
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## DYNAMORE LECTURERS

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

B.E., M.Sc. Reuben D´Souza
Support airbags
Areas of expertise:
Occupant safety, airbag simulation
Academic studies:
Mechanical engineering

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

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

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

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

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

Dr.-Ing. Andre Haufe
Manager metal forming
Areas of expertise:
Material modeling, forming simulations, connections
Academic studies:
Civil engineering

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

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

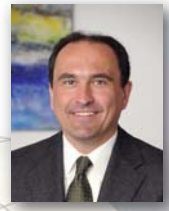
Dr.-Ing. Thomas Klöppel
Software developer LS-DYNA
Areas of expertise:
Composites, FE theory
Academic studies:
Mathematics

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

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

Dipl.-Ing. David Lorenz
Area of expertise:
Thermal forming processes
Academic studies:
Mechanical engineering

Dr.-Ing. Heiner Müllerschön
Manager competence center optimization and process integration
Areas of expertise:
Optimization, robustness analysis
Academic studies:
Civil engineering



Dr. Thomas Münz
Manager headquarters and engineering services
Areas of expertise:
Material modeling
Academic studies:
Techno-mathematics

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

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

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

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

## EXTERNAL LECTURERS

Dipl.-Ing. Paul Du Bois
Consultant
Lecturer of the seminars:
- Crashworthiness simulation
- Explosives modeling for engineers
- Blast modeling with LS-DYNA
- Penetration modeling with LS-DYNA

Dr. Iñaki Çaldichoury
Livermore Software Technology Corporation (LSTC) – Developer LS-DYNA
Lecturer of the seminars:
- CFD solvers and FSI in LS-DYNA: introduction and applications
- Electromagetic field solver in LS-DYNA: introduction and applications

Dr.-Ing. Markus Feucht
Daimler AG
Lecturer of the seminars:
- Component Connections in LS-DYNA
- Material and failure models (mesh dependence/tri-axial condition)

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

Prof. Dr.-Ing. Martin Pitzer
Technische Hochschule Mittelhessen
University of Applied Sciences
Lecturer of the seminar:
- Implicit analysis with LS-DYNA

Dr.-Ing. Stefan Schwarz
Dr. Ing. h.c. F. Porsche AG
Lecturer of the seminar:
- Theoretical aspects of structural optimization

Dr. Len Schwer
Schwer Engineering & Consulting Services
Lecturer of the seminars:
- Concrete and geomaterial modeling
- Explosives modeling for engineers
- Blast modeling with LS-DYNA
- Penetration modeling with LS-DYNA

Prof. Mhamed Souli
Universität Lille/Livermore Software Technology Corporation (LSTC)
Lecturer of the seminar:
- ALE und fluid-structure interaction in LS-DYNA

Dr. Cheng-Tang Wu
Livermore Software Technology Corporation (LSTC) – Programmentwickler
Lecturer of the seminar:
- Meshless methods in LS-DYNA

## 9th EUROPEAN LS-DYNA CONFERENCE

*Type:*
Konferenz
*Duration:*
2 days
*Seminar fee:*
500 GBP Industrie,
350 GBP Hochschule
*Date:*
3.-4. June 2013
*Ort:*
Manchester, UK

3 - 4 June 2013 – Manchester, UK

The 9th European LS-DYNA conference gives LS-DYNA users from all over the world the opportunity to exchange experiences, obtain first hand information and find out more about applications using LS-DYNA. The event will be held in the UK at the Central Convention Complex in Manchester city center.

User presentations will form a central part of the event. Here, experiences concerning simulations using LS-DYNA and LS-OPT will be exchanged and new ideas discussed. As well as general overviews being presented, contributions regarding the many diverse application areas of LS-DYNA and LS-OPT are also scheduled. Program developers from LSTC will be attending in order to report about new features in LS-DYNA and LS-OPT.

In an exhibition which is running parallel to the conference, you'll also receive up-to-date news all about LS-DYNA and LS-OPT hardware and software.

Of course, enough time has been planned for users to discuss and exchange their experiences with one another.

A range of seminars will also be held as part of the conference. Check our conference web page for more information.

Central Convention Complex, Manchester, United Kingdom
Courtesy of Manchester Marketing

### Event location
Manchester Central Convention Complex, UK
www.manchestercentral.co.uk

### Dates
| | |
|---|---|
| Abstract deadline: | 31 December 2012 |
| Conference: | 3 - 4 June 2013 |

### Further information
https://arup.cvent.com/euroconference

### Organization
The conference is being organized by Arup in collaboration with Alyotech, DYNAmore, DYNAmore Nordic and LSTC.

## 12th LS-DYNA FORUM

*Type:*
Konferenz
*Duration:*
1,5 days
*Seminar fee:*
kostenlos
*Date:*
24.-25. September
*Ort:*
Filderstadt (Stuttgart)

24 - 25 September 2013
– Filderstadt (Stuttgart), Germany

The 12th LS-DYNA Forum is a free event taking place at the Filharmonie in Filderstadt near Stuttgart in Germany. The forum program is divided into two sections:

- Developer Forum

On the afternoon of the 24th September, a developer meeting will be held titled "Background information and new developments in LS-DYNA and LS-OPT". Presentations given by program developers will inform participants about current development topics. The presentations are intended to stimulate discussions and the exchange of experience between users and developers.

- LS-DYNA Forum

On 25th September, renowned speakers from industrial companies and universities will be giving selected speeches on various LS-DYNA and LS-OPT application fields. Among others, the main topics will include crash, occupant safety and metal forming. In an accompanying trade exhibition, the latest products concerning LS-DYNA and LS-OPT will also be presented.

Both events are free of charge and can be booked either jointly or separately. To help us with our planning, please register promptly.

Filharmonie in Filderstadt (Stuttgart), Germany

During the week of the LS-DYNA Forum, we will also be offering seminars for advanced users, e.g. "ALE and fluid structure interaction in LS-DYNA", "Mesh-free methods in LS-DYNA" and "NVH & frequency domain analysis in LS-DYNA".

### Event location
FILharmonie Filderstadt, Germany
www.filharmoniefilderstadt.de

### Further information (as from spring 2013)
www.dynamore.de/forum13

# DIPLOMA AND MASTER THESES

In collaboration with the following companies: Adam Opel AG, Audi AG, Daimler AG and Dr. Ing. h.c. F. Porsche AG

Are you interested in highly complex applications concerning the finite elements method?

We'd be delighted 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. Specially conceived for crash 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 concerned with the following topics:

- Material modeling: foams, plastics, layers of adhesive
- Pedestrian safety
- Optimization and robustness tests using LS-OPT (optimization program)
- Forming
- Modeling types of join
- Biomechanics
- Developing process integration software
- Comparing new simulation techniques

The subject themes offered are handled in cooperation 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

Courtesy of
Adam Opel AG

Courtesy of
Daimler AG

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

EADS Innovation Works
TCC5 – Engineering, Physics, IT, Security Services & Simulation
Simulation Optimisation

**Diplomarbeiten**

**Masterarbeiten**

**Bachelorarbeiten**

**Praktika**

EADS Innovation Works führt Forschungsprojekte für sämtliche Geschäftsbereiche der EADS durch. Im Aufgabenspektrum von Simulation und Visualisierung bieten wir Studenten/Innen der Ingenieurwissenschaften Möglichkeiten für Diplom-, Master-, Bachelorarbeiten und Praktika.

**Dynamische Simulation von Flugzeugkomponenten**

Mit Ihrem betreuenden Professor zusammen definieren wir eine Aufgabe für Sie im Bereich der Simulationstechnologie (FEM, MKS, HPC) in unseren Tätigkeitsfeldern Stochastische Simulation, Optimierung, Visualisierung, Komponenten- und Werkstoff-modellierung, Schnittstellendefinition und Prozessbetrachtung.

Einsatzort: Hamburg

Beginn: jederzeit möglich

Das Angebot richtet sich an Studierende der Fachrichtungen Maschinenbau, Luft- und Raumfahrttechnik, Fahrzeugbau und Informatik mit besonderem Interesse an Simulationsthemen.

Ihre Ansprechpartner:

| | | |
|---|---|---|
| Herr Dietmar Vogt | Tel: 040/74384252 | dietmar.vogt@eads.net |
| Herr Sönke Klostermann | Tel: 040/74382542 | soenke.klostermann@eads.net |

Zusätzliche Informationen erhalten Sie bei

| | | |
|---|---|---|
| Prof. Dr. Uli Göhner | Tel.: 0831/2523-198 | ulrich.goehner@fh-kempten.de |

EADS

## 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, complementary additional programs as well as numerous FE models for crash simulations (dummies, barriers, pedestrians, etc.).

The range of services is completed by assured, qualified support for all application fields, together with seminars, 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 the development of software for solver technology and simulation data management, as well as consulting and support for modern, massively parallel computer systems.

### LS-DYNA – a solution for nonlinear tasks

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 increasingly being implemented in the automotive, aircraft and aerospace industries. Further areas of application include biomechanics, 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 PCs.

### LS-PrePost – calculation analysis and definition

LS-PrePost is a pre- and post processor with modified input decks, which can be used to visualize results calculated in LS-DYNA. An intuitive graphic interface makes it user-friendly. Options for handling and visualizing LS-DYNA input decks are available to help you prepare input data.

### LS-OPT – optimization / robustness testing of nonlinear systems

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

### GENESIS – optimization software for large linear systems

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

### FEMZIP

This is a software program which allows the results obtained from calculations to be drastically reduced, thus enabling the results to be viewed, sent and archived faster.

### Validated FE models for standard load cases

FE models
In vehicle assessment, tests are carried out under comparable conditions. In order to do this, accurately specified barriers and dummies are used as a means of testing. DYNAmore develops and markets FE models of such test pieces.

Dummy models
To calculate occupant values, DYNAmore develops the following models for the automotive industry (PDB): Eurosid-1, USSID, ES-2, ES-2re, BioRID-2 and WorldSID. The portfolio is completed by models developed by the hardware dummy manufacturer Humanetics and by LSTC.

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 work group by Daimler, Dr. Ing. h.c. F. Porsche, Lasso and Peng.

Human models
As well as dummy models, there is also the option of using human models to investigate vehicle safety. The models supplied 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 calculation of sheet metal and pipe forms. 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 deep-drawing, stretch-forming, pipe bending, hydroforming and thermal deep-drawing.

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

## Calculation services

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

- Nonlinear statics and dynamics
- Crash calculation
- 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
At our offices in Dresden and Ingolstadt, we develop software for our customers who are principally active in the automotive industry. We specialize in customer-specific software solutions in CAE 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.

## Support – Consulting – Sales – Training Courses

Products
All the 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 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
As well as giving numerous seminars on the various areas of application of LS-DYNA and LS-OPT, DYNAmore also holds other seminars concerned with pre-und post processor topics. All seminars can be individually aligned 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 workshops on a range of different subjects.

## Information

You can find out more about DYNAmore and LS-DYNA on the Internet under www.dynamore.de.

### 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

- 65 employees in Germany
- 20 employees working in our subsidiaries in Sweden and Switzerland
- Our customers include over 150 industrial companies and more than 100 universities in Germany and Austria, Switzerland, Italy, Spain, Portugal, Benelux, Turkey, Czech Republic, Slovenia, Poland and Rumania, and together use well over 50,000 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 and in Berlin as well 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.

## ORGANIZATIONAL INFORMATION

### 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:

- Dresden Branch Office
  Pohlandstraße 19, D-01309 Dresden
  Tel: +49 (0)351 - 31 20 02 - 0
- Ingolstadt Branch Office
  Donaustr. 7, D-85049 Ingolstadt
  Tel: +49 (0)841 - 12 60 48 - 34
- Berlin Branch Office
  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 - 6 33 61 62
- DYNAmore Nordic AB
  Brigadgatan 14, SE-587 58 Linköping, Sweden
  Tel: +46 (0)13 - 23 66 80
- 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'll also 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. If any places are still vacant, students may attend the seminars free of charge (please show your enrolment certificate).

### Course times

Seminars: 9:00 - 17:00 (unless otherwise indicated).
Information days: generally 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. 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 fewer than four applications without reduction requests are 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 55 or 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 contact for our own promotional purposes. You may at any time revoke these commitments. For this, please contact DYNAmore GmbH by telephone or in writing.

### Further information

Seminars on the Internet
You'll find current information and new developments concerning LS-DYNA on our website under www.dynamore.de. You'll also find up-to-date details about our seminars and events here, such as webinars, additional or modifications to dates and further information events.

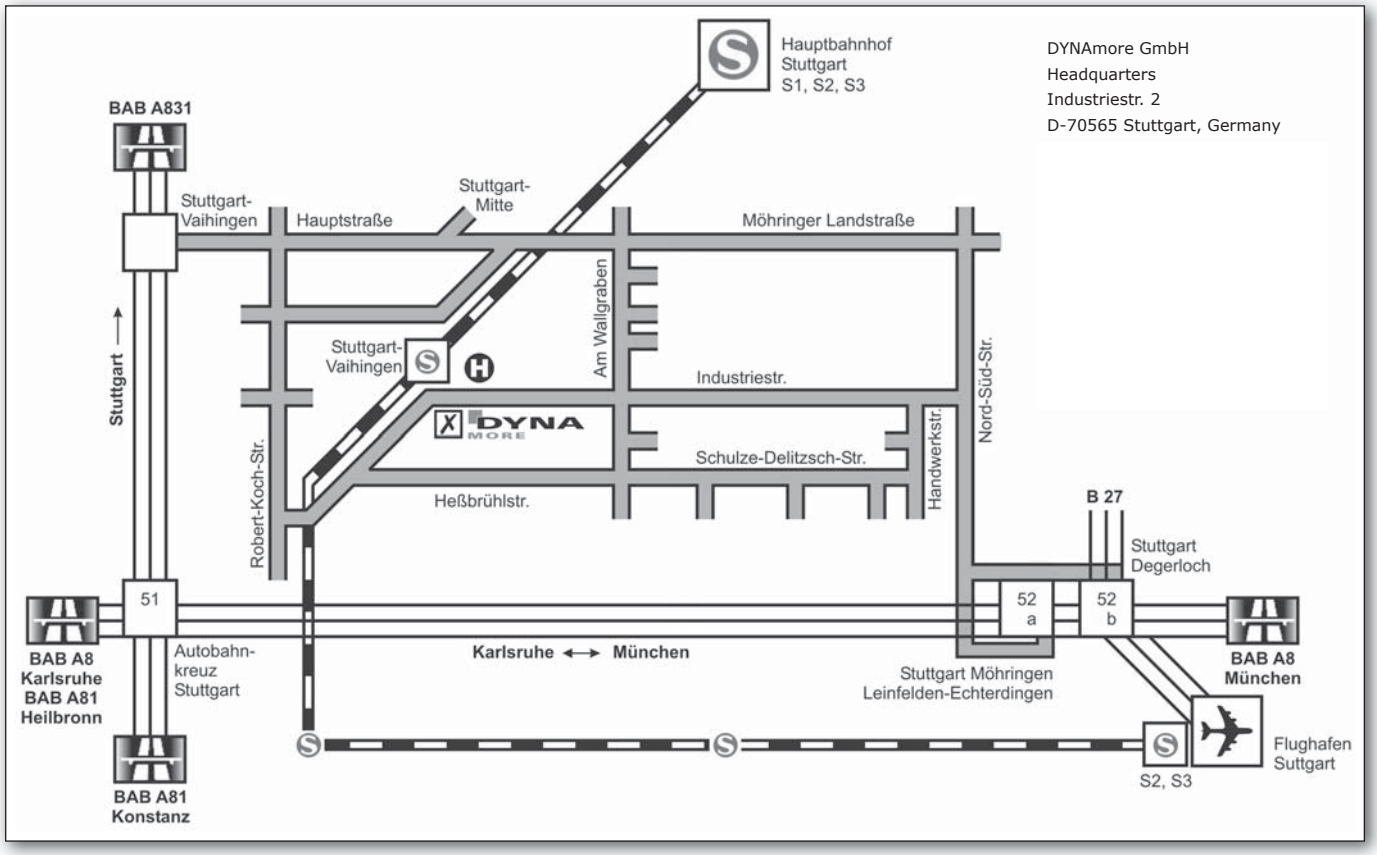
Info-mail
If you would like to be informed by email about current events and new developments in the LS-DYNA world, we would be happy to send you our DYNAmore info-mail. To register, send us an email to info@dynamore.de.

### Contact partner

Organization
Miriam Lang, Ulrike Kraus
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, Germany

### Arriving by car

AFrom 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 tram (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 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 tram station.

Stuttgart Main Railway Station
Take the 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 tram station.

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

DYNAmore headquarters Stuttgart

Imprint

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CEO:
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Dipl.-Math. Ulrich Franz
Court of registration/Seat: Stuttgart
Registration Number: HRB 733694

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Address for window envelope

DYNAmore GmbH
Industriestr. 2
D-70565 Stuttgart
Germany

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

### ❑ DYNAstart Personal (private)

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

- License for LS-DYNA, LS-PrePost, LS-OPT
- Operable using Windows/Linux
- Model size limited to 10,000 elements
- No composites
- No MPP possibilities
- 1st month, telephone support hotline
- 11 further months, email support

Annual rental fee: 90 Euro *

### ❑ DYNAlab (research, teaching)

- License for LS-DYNA (any number of processors), LS-PrePost, LS-OPT
- Only for research and teaching purposes - rental per institute / faculty

Annual rental fee: 1,000 Euro *

### ❑ DYNAstart Professional (industry)

- License for LS-DYNA, LS-PrePost, LS-OPT

Annual rental fee: 5,000 Euro *

Sender

Company / University: _____

Dept. / Institute: _____

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Street: _____

ZIP code, town/city: _____

Tel: _____

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E-Mail: _____

Date, signature: _____

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

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SCAN THIS PAGE AND SEND IT VIA E-MAIL TO SEMINAR@DYNAMORE.DE

Address for window envelope

DYNAmore GmbH
Industriestr. 2
D-70565 Stuttgart
Germany

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

### INTRODUCTORY CLASSES
❑ Introduction to LS-DYNA
Optional: ❑ Basics (days 1 and 2)
❑ Advanced Topics (day 3)
❑ Introduction to LS-PrePost
❑ Infoday: DYNAstart

### BASICS/THEORY
❑ Infoday: Verification and Validation
❑ Element Types and Nonlinear Aspects
❑ Workshop: User Interfaces

### CRASH
❑ Crashworthiness Simulation
❑ Joining Techniques
❑ Contact Definitions
❑ Infoday: Simulation of Drop Tests
❑ Failure of Fiber-Reinforced Polymers

### DEFENSE
❑ Explosives Modeling
❑ Blast Modeling
❑ Penetration Modeling

### PASSIVE SAFETY
❑ Introduction to Passive Safety
❑ Dummy/Pedestrian Impactor Modeling
❑ Infoday: Dummy Models
❑ Infoday: Human Models
❑ Introduction to Airbag Modeling
❑ CPM Airbag Modeling
❑ Supportday: Occupant Safety

### METAL FORMING
❑ Metal Forming with eta/DYNAFORM
❑ Metal Forming with LS-DYNA
❑ Infoday: Trends in LS-DYNA and eta/DYNAFORM
❑ Infoday: EM/Thermomechanical Forming
❑ Thermomechanical Forming

### MATERIAL
❑ Modeling Metallic Materials
❑ Material Failure
❑ Polymers/Elastomers
❑ Workshop: User Materials
❑ Infoday: Simulation of Plastics
❑ Parameter Identification with LS-OPT
❑ Infoday: Composite Analysis
❑ Introduction to Composite Modeling
❑ Infoday: 4a-Impetus

### IMPLICIT CAPABILITIES
❑ Implicit Analysis
❑ Infoday: LS-DYNA/Implicit
❑ NVH & Frequency Domain Analysis
❑ Infoday: Acoustics with FEM and BEM

### MULTIPHYSICS/BIOMECHANICS
❑ Infoday: Multiphysics
❑ Infoday: Biomechanics
❑ ALE and FSI
❑ Meshless Methods
Optional: ❑ EFG only ❑ SPH only
❑ Infoday: CFD
❑ New CFD Solvers and FSI
❑ Electromagetic Field Solver

### OPTIMIZATION
❑ LS-OPT – Optimization & Robustness
Optional: ❑ days 1 and 2
❑ day 3
❑ Infoday: Optimization/Robustness
❑ Basics of Structural Optimization
❑ GENESIS - Structural Optimization
❑ Infoday: ANSA/LS-OPT/META

### CIVIL ENGINEERING
❑ Infoday: LS-DYNA Applications
❑ Concrete and Geomaterial Modeling

### PRE- AND POSTPROCESSING
❑ Pre- and Postprocessing with
❑ ANSA ❑ METApost ❑ HyperWorks
❑ MEDINA Interface/MIDAS
❑ PRIMER
❑ Infoday: PRIMER

### CAE/IT ENVIRONMENT
❑ Infoday: Process Automation/SDM
❑ Infoday: Cloud Technology
❑ LS-DYNA on Cluster Services

### SUPPORT/SERVICE/WEBINARS
❑ Switch to LS-DYNA
❑ Supportday: LS-DYNA
❑ Webinars

Date (please specify): _____

All seminars are available in English language on demand. Please indicate your preferred language ❑ German ❑ English (to be confirmed)

### Sender

Company / University: _____

Dept. / Institute: _____

Title, first/last name: _____

Street: _____

ZIP code, town/city: _____

Tel: _____

Fax: _____

E-Mail: _____

Date, signature: _____

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