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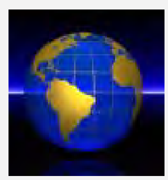

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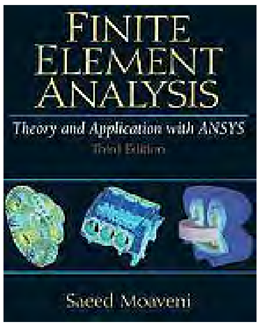

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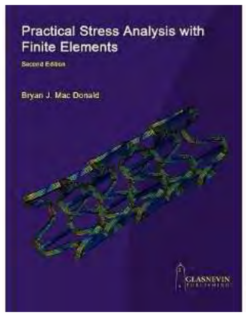

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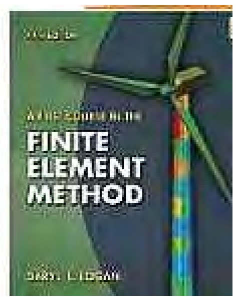

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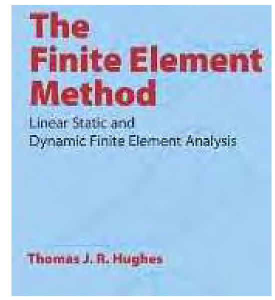

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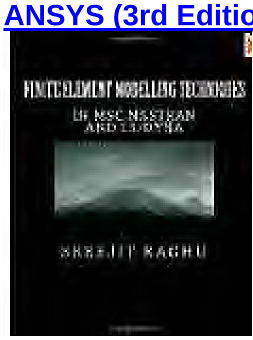

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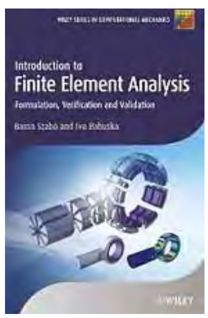

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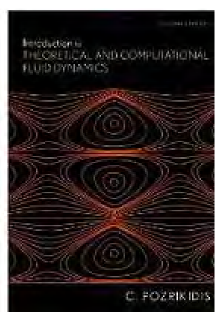

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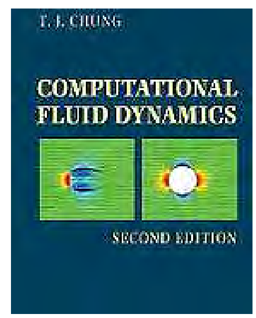

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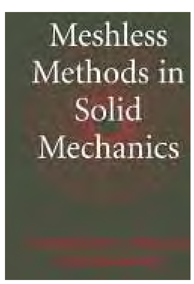

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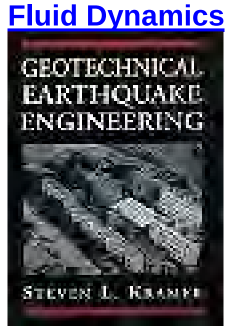

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Modeling Resin Transfer Molding Using LS-DYNA

Art Shapiro, LSTC, shapiro@lstc.com

Automotive Composites: Modeling Resin Transfer Molding (RTM) using LS-DYNA

Resin Transfer Molding (RTM) is a closed mold process for making composite materials.

The manufacturing process consists of:

1. Laying a fiber (e.g., glass, carbon) mat inside a mold cavity
2. Injecting a resin to fill the voids in the fiber mat
3. Creating an environment for the resin to cure

This discussion focuses on using LS-DYNA to model step 2. The objective is to determine the progression of the resin front position and identify hard-to-fill regions. Resin flow through the fiber mat is described by Darcy's law. Darcy's law is a phenomenological derived constitutive equation that describes the flow of a fluid through a porous medium. It is analogous to Fourier's law in the field of heat conduction. There are many papers in the literature presenting methodologies on how to use FE heat transfer codes to model porous media flow. A significant drawback to this approach is the lack of a direct computational method to predict the flow front position which is the primary objective of the calculation. LS-DYNA can predict the flow front position using an ALE computational method.

Darcy's Law

Darcy's law is a phenomenological derived constitutive equation that describes the flow of a fluid through a porous media.

$$\frac{\Delta P}{L} = \frac{\mu}{k} V$$

k	permeability [m^2]	L	length of flow channel [m]
V	flow velocity [m/s]	ΔP	pressure drop [Pa]
μ	fluid viscosity [Pa s]		

Ergun Equation - LS-DYNA uses the Ergun equation to model fluid structure interaction (i.e, resin to fiber mat). The Ergun equation is based on the superposition of two asymptotic solutions, one for very low Reynolds number flow (first term on right) and one for high Reynolds number flow (second term on right).

$$\frac{\Delta P}{L} = \frac{\mu}{K_1} V + \frac{\rho}{K_2} V^2$$

$$K_1 = \frac{\varepsilon^3 D^2}{150(1-\varepsilon)^2} \qquad K_2 = \frac{\varepsilon^3 D}{1.75(1-\varepsilon)}$$

K_1 constant in viscous term [m^2] (this is not permeability)
K_2 constant in inertia term [m] (this is not permeability)
D equivalent spherical diameter [m]. Ergun developed this equation to model flow in chemical extraction columns. These vertical cylindrical tanks are packed with irregular shaped objects (e.g., Raschig rings, ceramic saddles). D is a length scale representing the equivalent diameter of the packing material relative to an enclosing sphere.
ΔP pressure drop [Pa]
L length of flow channel [m]
V fluid velocity [m/s]
μ fluid viscosity [Pa s]
ε porosity, (void volume)/(total volume)
(note: some publications give ε_f = (fabric volume)/(total volume).
ρ fluid density [kg/m^3]

Ergun equation ↔ Darcy's Law - If we only consider the first (viscous) term in the Ergun equation, then K_1=k and we can use the Ergun equation (see CONSTRAINED_LAGRANGE_IN_SOLID keyword) to model RTM porous media flow.

$$\frac{\Delta P}{L} = \frac{\mu}{K_1} V = \frac{\mu}{k} V$$

Fluid material model - The fluid density and viscosity are entered using the *MAT_NULL keyword. An equation of state is needed to relate the pressure to the fluid compressibility. The Gruneisen equation of state is

$$P = \frac{\rho_0 C^2 \vartheta \left[1 + (1 - {}^{\gamma_0}/_2)\vartheta - \frac{a}{2}\vartheta^2\right]}{\left[1 - (S_1 - 1) - S_2 \frac{\vartheta^2}{(\vartheta+1)} - S_3 \frac{\vartheta^3}{(\vartheta+1)^2}\right]^2}$$

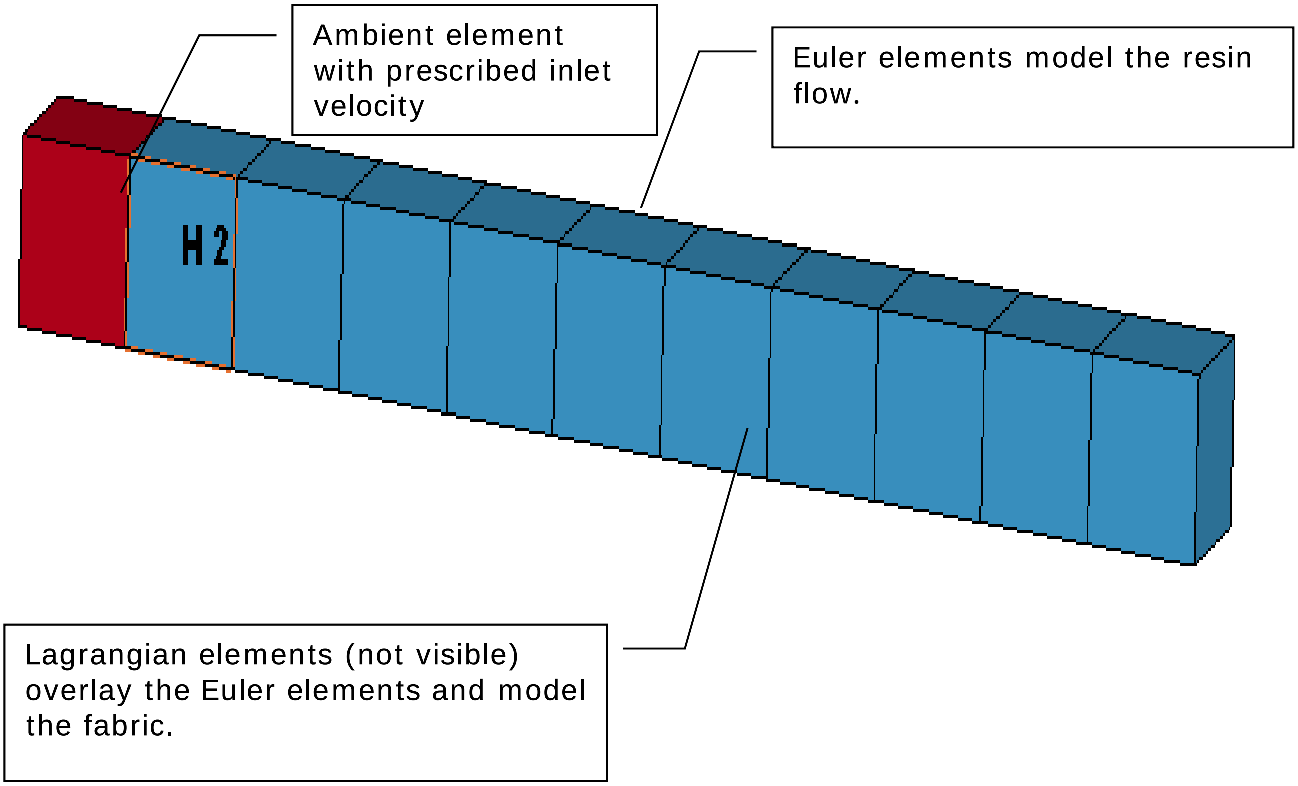
Set all *EOS_GRUNEISEN input parameters equal to zero (except for the sound speed C) to model an incompressible fluid near atmospheric pressure. This then simplifies to

$$P = \rho_0 C^2 \vartheta$$

Where $\vartheta = {}^{\rho}/_{\rho_0} - 1$

Simple test problem

The objective is to calculate the pressure drop over the length of the rod due to a porous media flow.



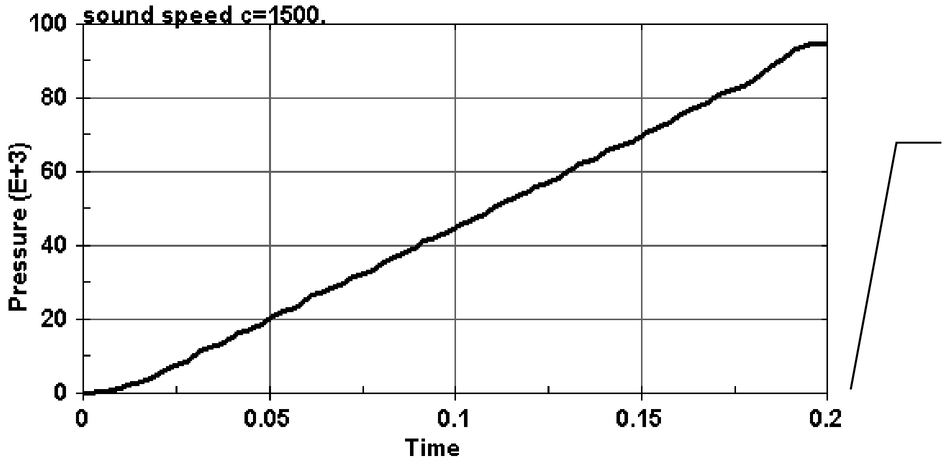
The design parameters are:

flow velocity	V = 0.0005 [m/s]	fill time	t = L/V = 200 sec
channel length	L= 0.1 m	initial fill	vacuum
resin viscosity	μ = 0.2 Pa s	permeability	k = 1.e-10 m^2

The pressure drop (or, entry pressure) can be calculated using the Ergun equation.

$$P = \frac{\mu}{k} VL = \frac{0.2}{1.e-10}(5.e-04)(0.1) = 1.e+05$$

The following figure is the pressure time history for the first flow element (H2) showing good agreement with the hand calculation.



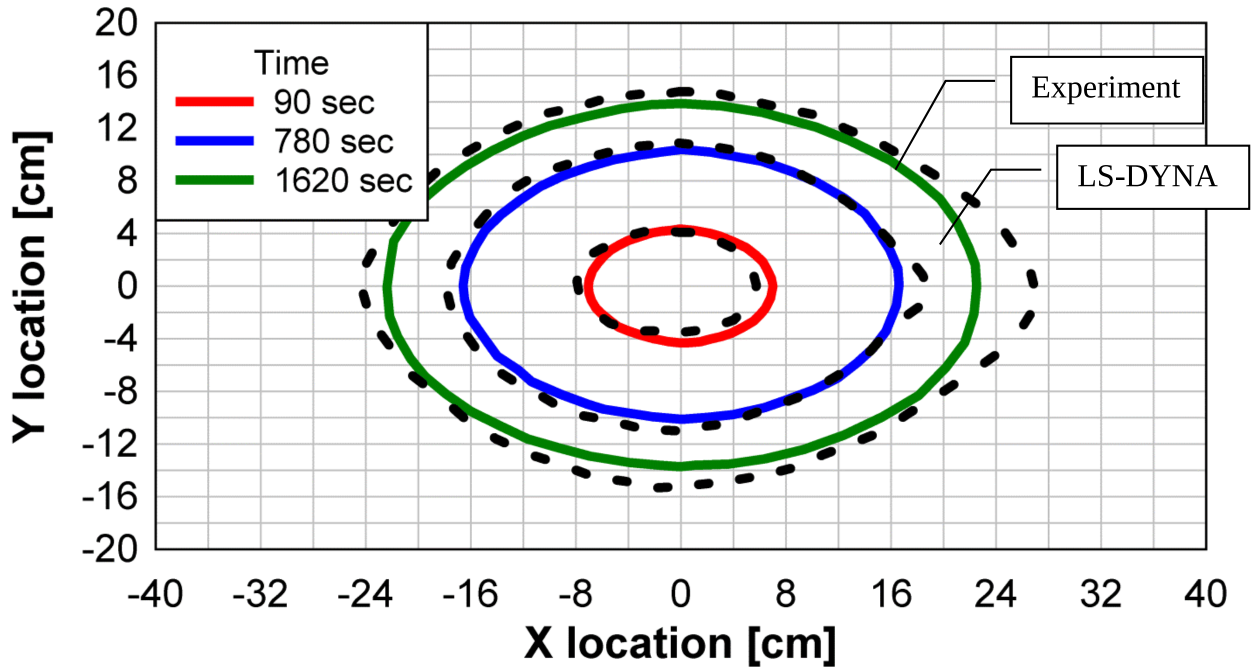
Problem is time scaled by 1000 as explained below. Therefore, end time is 0.2

Validation with experiment

The validation model is from "Fluid Flow Modeling of RTM for Composite Material Wind Turbine Blade Structures", Sandia National Laboratory, SAND2004-0076, June 2004, http://windpower.sandia.gov/abstracts/040076A.pdf. Chapter 5 in this report presents experimental results (see fig. 60 and table 28 for experiment SA08-01) for manufacturing a thin flat plate with an orthotropic fabric layup. Design parameters for experiment SA08-01 are:

- Inlet pressure P = 160 kPa
- fluid viscosity $\mu = 0.2$ Pa s
- fluid density r = 1160 kg/m^3
- permeability $k_x = 9.90e-11$ $k_y = 3.47e-11$

The following figure shows LS-DYNA calculated flow front positions compared with experiment at different times.



Time Scaling: Porous media mold filling is a slow process taking seconds to minutes. This presents a time step dilemma. The computer computational time will be very long (and, may be prohibitive) if the default explicit time step is used. However, we can artificially increase the flow speed similar to common practice used in artificially increasing punch velocity in metal stamping. The objective is to decrease run time by

1. increasing the flow velocity so the dies fill quicker
2. increasing the explicit time step by sound speed scaling

but constrained to maintain the same pressure drop as the original problem.
There are 3 parameters that require adjusting. The resin flow velocity, resin permeability, and sound speed used in the EOS. The flow velocity and permeability are coupled as described below. A value for the sound speed is selected to impose the restriction of incompressible flow.

1. Increasing the flow velocity

We will use the same procedure that has proven successful for speeding up metal stamping problems. The punch velocity is artificially increased in metal stamping. Here, we will artificially increase the flow velocity. To keep the pressure drop the same, the permeability, k, has to be scaled by the same amount as the flow velocity, V.

We will velocity scale the rod problem by 1,000

$$P = \frac{\mu}{(1000 * k)}(1000 * V)L = \frac{0.2}{1.e-07}(5.e-01)(0.1) = 1.e+05$$

2. Increasing the explicit time step

The explicit time step is calculated by

$$\Delta t = \frac{l}{C}$$

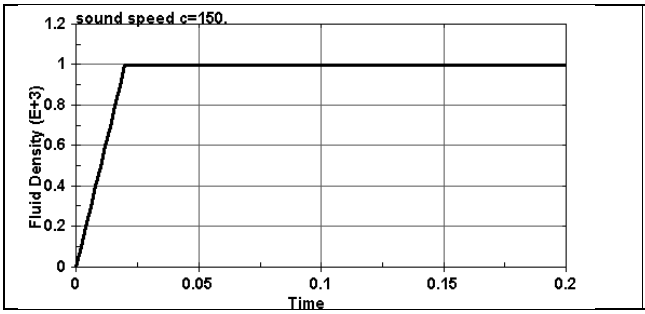
where l is a length scale (e.g., element edge length) and C is the speed of sound (1500 m/s for water). For a set value of l, as we decrease C, the time step becomes larger as shown in the following table.

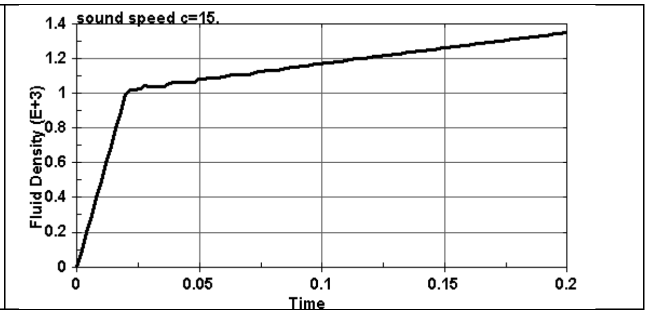
C [m/s]	dt = edge/C = 0.01/C
1500. (real)	6.6e-06
150.	6.6e-05
15.	6.6e-04

However, according to the EOS, the element becomes more compressible.

$$\Delta\rho = \frac{P}{C^2}$$

We want to make C as small as possible but maintain the constraint of incompressible flow. The following figures show the density time history for element H2 in the rod problem. The initial density is zero because the element is empty. A completely filled element should have a density of 1000. A value of C=150 (i.e., 10 times smaller than real life) is sufficient to maintain incompressible flow, whereas a value of C=15 shows a density increase. A few more numerical experiments can be run to determine if a value below 150 (e.g., C=75) can be used.





d3VIEW – A Post-simulation Analysis Software

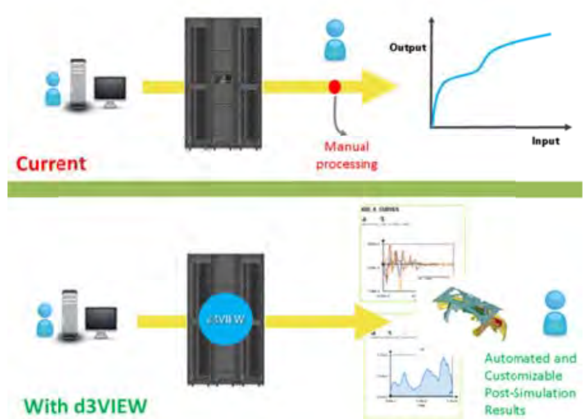
Suri Bala – d3View

Introduction

d3VIEW is a post-simulation analysis software with data-management, mining, collaboration and visualization capabilities for LS-DYNA simulations. It has been in active development for over 7 years with a single objective to eliminate manual post-simulation analysis and to provide tools to enable product development teams to visualize and analyze product performance data and spend less time in data search.

Why d3VIEW?

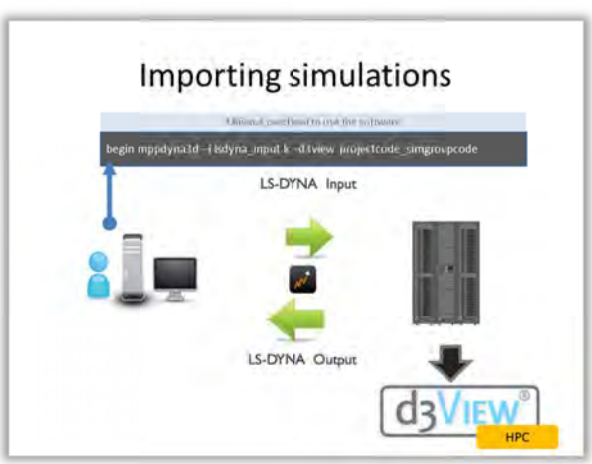
Post-simulation analysis has been loosely defined as "post-processing" with no structure and automation. HPC systems have been used successfully over the years but they have limited understanding of the simulation data, resulting in simply transferring the simulation data back to the user's workstation. The transfer cost, time spent in data-compression, and interpretation is repetitive and consumes a vast amount of time and effort. d3VIEW™ eliminates manual post-processing by performing all data extraction and storage on the HPC servers and provides great control in defining the type of extraction in the form of customization templates. It accompanies this with advanced visualization and collaborative capabilities.



d3VIEW – A Post-simulation Analysis Software

What is the lifecycle of the single simulation when processed by d3VIEW?

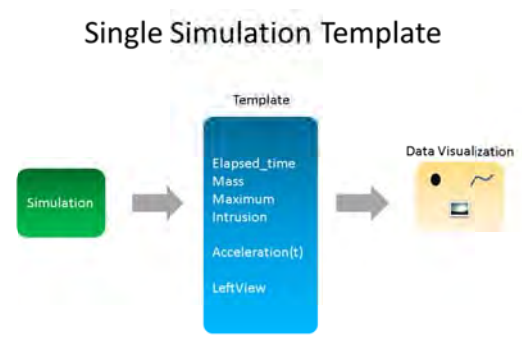
The simulation that originates from the user is first run on the HPC and remains unchanged. When the option "-d3view" is invoked by the user, d3VIEW processes the simulation output to perform post-simulation analysis that consist of standard processing and the user's responsetemplate definition. The control is then handed back to the script to return the output to the user. The work flow is as shown in the diagram below. d3VIEW does not alter the contents of the original files from the solver. It works in a scratch directory thereby preserving the original files.



The above diagram shows the lifecycle of a single simulation job when processed by d3VIEW

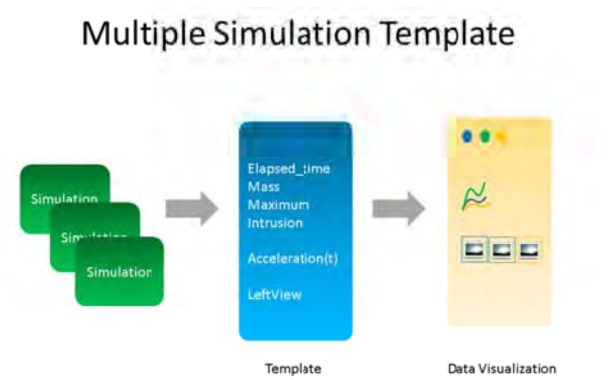
How does a Responsetemplate work?

The responsetemplate is associated with a simulation group and every simulation in this group is passed through all the responsetemplates that belongs to a simulation group. The following image shows the workflow of a single simulation when it is completed on the server.



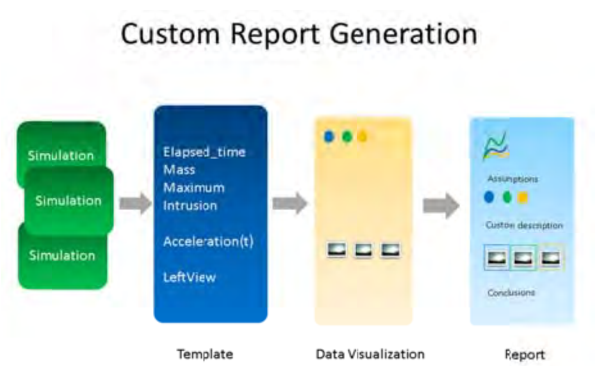
Can I have multiple simulations be processed by a single response template ?

Yes. Responsetemplates can process multiple simulations and adapt itself according to the number of simulations. The data flow for multiple simulations are shown below.



What are Reports and how does it different from a Response template?

The responsetemplate is simply a collection of responses that are important to understand how a simulation has performed. It provides no control on how the list of responses are to be shown for visualization purposes. For example, we may want the responses “elapsed_time” and the “number of CPUs” as two responses but perhaps we want them to be shown in a custom order to convey the message to the team. The Report allows that by allowing the user to pick what responses are to be shown, in what order and how. This allows the users to define custom order to suit their needs of communication. Report essentially works gets its data from a Responsetemplate and renders it in the format defined by the user. The following image shows how the Report works in conjunction with Responsetemplate.



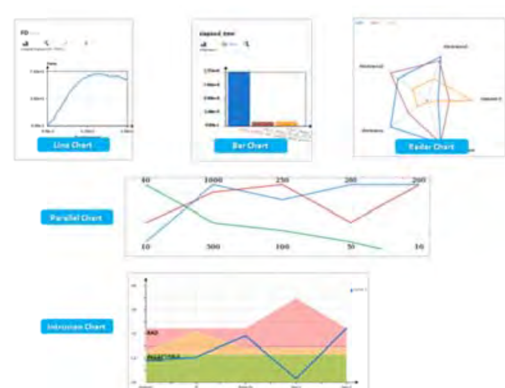
What are the data visualization options? Once the responses are defined as being part of a response template, d3VIEW provides abilities to visualize the scalar, vector and view responses for single or multiple simulations as shown below.

Scalar responses are key-value pair such as “mass=2000lb”, “elements=200000”, etc. They can also be based on curves such as “maximum of acceleration”, etc. Vector responses are simple time-history based curves such as “acceleration(t), force(displacement)”. Both scalar and vector responses can be defined as composite responses which are expressed using values of other responses.

Examples of composite responses include “total_elements=solid+shell+beam” or “acceleration-displacement=Crosspplot(Filter(‘accelear tion’,’sae’,’60’), ‘displacement’)”.
View responses are images and movies from the simulation graphics data. D3VIEW provides standard templates to process the graphical data in addition to defining custom templates to extract a particular view. Examples of view responses include “left_view with all parts, left_view with part 22 and a contour of plastic_strain with fringe ranges of 0.1 and 0.3”. View responses can also be of automated extractions such as “all parts whose maximum value of plastic-strain at any state exceeds 0.2”.

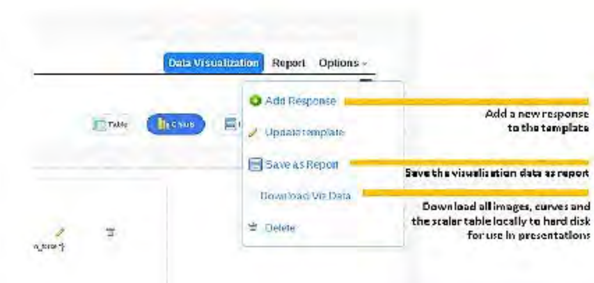
Extracted data is available for every single simulation and hence can be viewed side-by-side across thousands of simulations from any project or any simulation group.

What different types of chartings are available? There are several scientific charting capabilities to visualize large complex data sets. Some of them are as shown in the figure below



Can I save the visualization data as a report or download the data for use in my own presentations?

Yes. You can download all visualization data as either a report within d3VIEW or download the set of images and curve outputs locally on to a disk for use in custom presentations. The available options are shown below.



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Other sources of information

You can get more information from http://www.d3view.com or by writing to info@d3view.com. To get a live demonstration of d3VIEW, you can write to us and we will show the product live using the hosted application. You can also get a 30-day no-fee license from Marsha Victory (marsha@lstc.com) to get a local copy of the software

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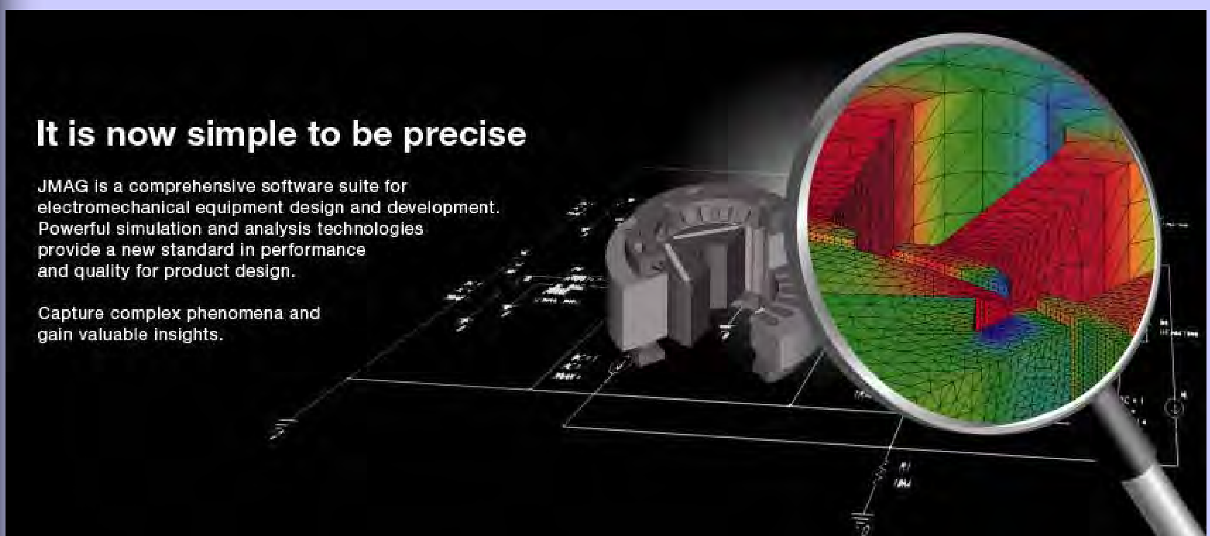

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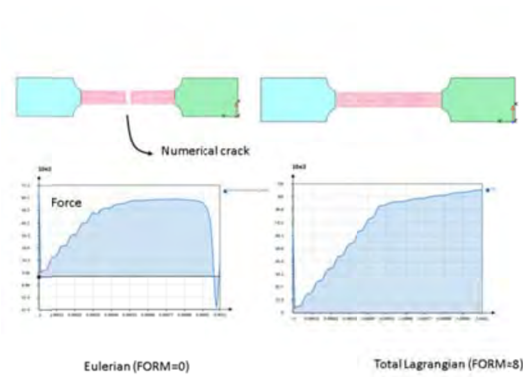
Recent Capabilities in Smooth Particle Hydrodnamics (SPH) in LS-DYNA

Suri Bala – Dr. Jingxiao Xu - LSTC

There have been some recent capabilities in SPH that allows great flexibility to model high-velocity and large deformation problems. This article showcases these capabilities along with necessary keywords that show how to specify them in LS-DYNA. This article would not be possible with the help of Dr. Jingxiao Xu of LSTC. It must also be noted that several images and movies in this article are from d3VIEW.

Tensile Instability:

Tensile instability is a condition where particles loose interaction when large tensile forces act on them resulting in purely numerical crack. There has been several techniques to address this issue and one of them that solves this problem in LS-DYNA is the use of “Total Lagrangian” formulation by using the FORM=7 or 8 parameter in *CONTROL_SPH keyword. When this new kernel formulation is used, the SPH particles in the support domain remain constant during the simulation. In the default kernel formulation, the support domain is instantaneously computed either using a sphere or an ellipse which causes different particles to be detected to influence the current particle. When using the “Total-Largrangian” formulation, the support domain is computed during the initialization for each particle and this remains fixed during the remainder of the simulation. In the figure below, the active particles (particles in the support domain for a given particle) is highlighted below to show how the two formulations work.



Convert eroded solid elements to SPH

In traditional finite element analysis, when a solid element reaches a failure value based on any user-defined criteria such as plastic_strain, stress, etc, the solid element all history variable is voided and is removed from the calculation. This results in a physical void in the material and causes a springback in the neighboring elements.

Recent Capabilities in (SPH) in LS-DYNA

One of the recent options has been the ability to convert such eroded solid elements into SPH particles and allow interaction between the particle and the neighboring elements. The keyword that allows this definition is *DEFINE_ADAPTIVE_SOLID_TO_SPH keyword. The newly created SPH particle at the center-of-mass of the eroded solid elements can be specified to belong to an existing SPH part ID or a new SPH part ID. By default, the newly created SPH particle does not interact with any neighboring element and will behave as an independent particle. This is useful for debris simulation. However, if desired, the parameter ICPL (coupling parameter) can be set to 1 to turn-on coupling between the SPH particle and the other neighboring solid elements. The choice of when the coupling should start can be specified using the IOPT (coupling option). The default value of IOPT=0 specifies the coupling to act as a constraint from the beginning of the simulation. This is useful in situations where the SPH particles and the solid elements are modeled as a tied interface. When IOPT=1, the coupling will start when the solid elements erode. It must be noted that when IOPT=1, although the coupling will start at the time of solid element erosion, the SPH will be created at time zero.

Modeling SPH particle interaction with ALE material:

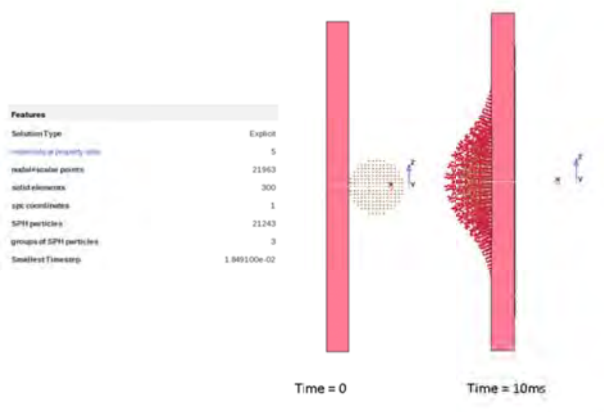
Until now, SPH particles could interact with each other through particle approximation theory and also with other lagrangian elements through contact-impact interface definitions. With a new option of CTYPE=14 in CONSTRAINTED_LAGRANGE_SOLID, SPH particles can now interact with ALE elements.

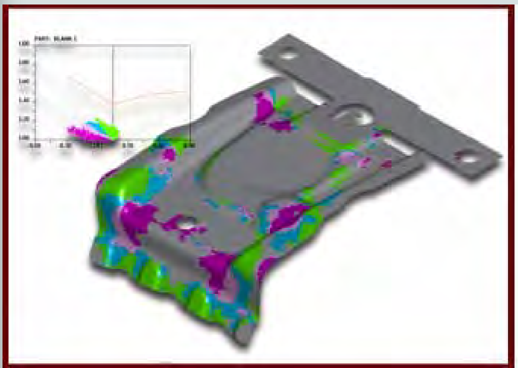
SPH to SPH particle interaction using Contact-Impact treatment:

SPH particle interaction within a single part or with particles from other parts can be modeled using the particle approximation theory. This approach causes both the tensile (dilation) and compressive (compression) forces to be coupled between the particles. However, in certain situations, there may be a need to couple only the compressive forces. This can now be modeled using a contact-impact treatment using the *DEFINE_SPH_SPH_COUPLING. The penetration between two SPH particles is computed based on the average respective smoothing lengths.

The penetration is removed using a penalty stiffness based on the material properties as in traditional contacts. The penalty factor can be controlled using the parameter PFACT which is by default set to 0.1.

The following figure shows the initial and final deformation states for the model with SPH to SPH coupling defined.





DYNAFORM™ V5.8.1 Released

Die System Simulation Solution Offers Enhanced Die Face Engineering Capabilities

We are pleased to announce the availability of DYNAFORM™ Version 5.8.1. This latest release is now available for immediate download and delivers a robust environment for engineers to simulate and analyze the entire die system.

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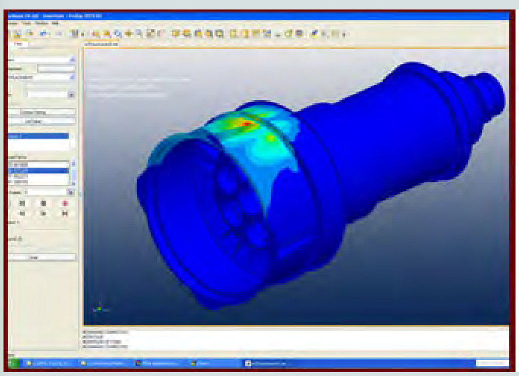

PreSys™ R3 Released

We are pleased to announce the availability of the latest version our advanced finite element modeling solution, PreSys™, part of the Inventium Suite™ of simulation products. The R3 release is now available and will deliver an improved experience for engineers who need to build complex finite element models for nonlinear impact, durability, vibration and thermal analysis.

LS-DYNA CAE Modelers for Material Parameter Conversion

DatapointLabs / Matereality

Matereality CAE Modelers are software tools that can be used to perform the conversion of raw material properties into CAE software. CAE Modelers are capable of automating complex conversions including rate dependent models for crash simulations.

Features:

- Converts material data to material model parameters
- Single point and curve/multi-curve data conversion
- Graphical User Interface for model parameter tuning and modification
- Outputs for latest and older CAE software versions
- Supported Material Models for LS-DYNA: Mat 24 – CP / LCSR / LCSS

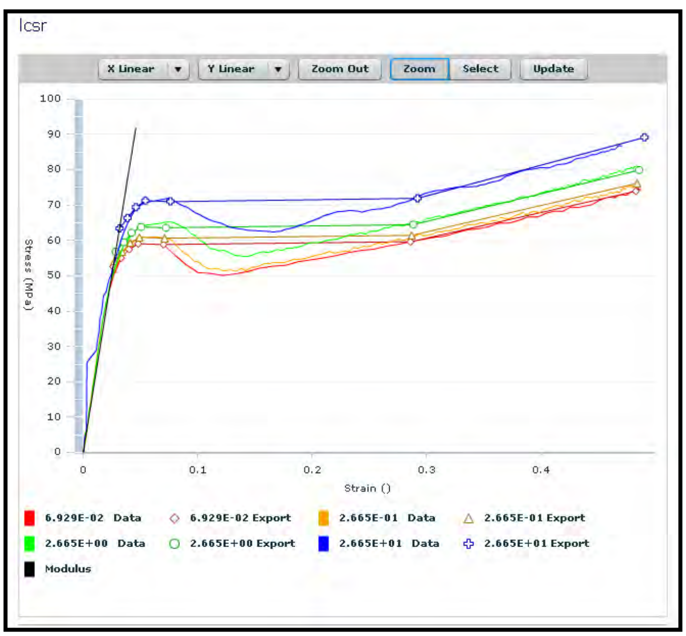

Figure 1 LS-DYNA CAE Modeler is used to create MAT 24 material card.
Source: Matereality

About Matereality

Matereality, L.L.C., based in the United States, hosts cloud material databases for use in product design and manufacturing enterprises.

Solutions range from small personal databases to Data Servers for large manufacturing enterprises. With this ready-for-deployment patented technology, every company can now afford to have a fully functional, secure material database that can grow proportionate to its needs and budget. The database can collect and store any properties of any materials. All databases are empowered by a suite of web-based software that allows users work to with material data, for trend visualization, CAE modeling and database building. Support services include material data loading and material testing to populate the database with accurate data. The company serves a diverse user base including automotive, appliance, tier-one, material suppliers and processors, electronics, mold makers, medical devices, and consumer product verticals.

For more information, visit www.matereality.com,
telephone 1-607-257-1784 email to info@matereality.com

FEA Chinese Version 中 文 版

FINITE ELEMENT ANALYSIS fea INFORMATION.COM

LS－DYNA 最新资讯

2012 中文第一期

*LS-DYNA*在中国;

*LS-DYNA*最新发展动态

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2. **Introduce Dalian Fukun;**
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4. **Introduce LSTC China Distributors;**
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3. **LSTC distributors in China**
4. **LS-DYNA Course / Training in China**
5. **Conferences - Events**

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BETA CAE Systems S.A.

www.beta-cae.gr

BETA CAE Systems S.A.– ANSA

Is an advanced multidisciplinary CAE pre-processing tool that provides all the necessary functionality for full-model build up, from CAD data to ready-to-run solver input file, in a single integrated environment. ANSA is a full product modeler for LS-DYNA, with integrated Data Management and Process Automation. ANSA can also be directly coupled with LS-OPT of LSTC to provide an integrated solution in the field of optimization.

BETA CAE Systems S.A.– μETA

Is a multi-purpose post-processor meeting diverging needs from various CAE disciplines. It owes its success to its impressive performance, innovative features and capabilities of interaction between animations, plots, videos, reports and other objects. It offers extensive support and handling of LS-DYNA 2D and 3D results, including those compressed with SCAI's FEMZIP software

Participant Solutions

CRAY

www.cray.com

The Cray XK6

The Cray XK6 supercomputer combines Cray's proven Gemini interconnect, AMD's leading multi-core scalar processors and NVIDIA's powerful many-core GPU processors to create a true, productive hybrid supercomputer

Cray XE6™ and Cray XE6m™ Supercomputers

The Cray XE6 scalable supercomputer is engineered to meet the demanding needs of capability-class HPC applications. The Cray XE6m is optimized to support scalable workloads in the midrange market.

Cray XMT™ System

The Cray XMT supercomputing system is a scalable massively multithreaded platform with a shared memory architecture for large-scale data analysis and data mining. The system is purpose-built for parallel applications that are dynamically changing, require random access to shared memory and typically do not run well on conventional systems.

Cray CX1000™ High(brid) Performance Computers

The Cray CX1000 series is a dense, power efficient and supremely powerful rack-mounted supercomputer featuring best-of-class technologies that can be mixed-and-matched in a single rack – creating a customized hybrid computing platform to meet a variety of scientific workloads.

Cray Sonexion 1300™ Storage System

The Cray Sonexion 1300 system is an integrated, high performance storage system that features next-generation modular technology to maximize the performance and capacity scaling capabilities of the Lustre file system.

Cray also offers custom and third-party storage and data management solutions

Participant Solutions

DatapointLabs

www.datapointlabs.com

Testing over 1000 materials per year for a wide range of physical properties, DatapointLabs is a center of excellence providing global support to industries engaged in new product development and R&D.

The company meets the material property needs of CAE/FEA analysts, with a specialized product line, TestPaks®, which allow CAE analysts to easily order material testing for the calibration of over 100 different material models.

DatapointLabs maintains a world-class testing facility with expertise in physical properties of plastics, rubber, food, ceramics, and metals.

Core competencies include mechanical, thermal and flow properties of materials with a focus on precision properties for use in product development and R&D.

Engineering Design Data including material model calibrations for CAE Research Support Services, your personal expert testing laboratory Lab Facilities gives you a glimpse of our extensive test facilities Test Catalog gets you instant quotes for over 200 physical properties.

Participant Solutions
ETA – Engineering Technology Associates

www.eta.com

Inventium Suite™

Inventium Suite™ is an enterprise-level CAE software solution, enabling concept to product. Inventium's first set of tools will be released soon, in the form of an advanced Pre & Post processor, called PreSys.

Inventium's unified and streamlined product architecture will provide users access to all of the suite's software tools. By design, its products will offer a high performance modeling and post-processing system, while providing a robust path for the integration of new tools and third party applications.

PreSys

Inventium's core FE modeling toolset. It is the successor to ETA's VPG/PrePost and FEMB products. PreSys offers an easy to use interface, with drop-down menus and toolbars, increased graphics speed and detailed graphics capabilities. These types of capabilities are combined with powerful, robust and accurate modeling functions.

VPG

Advanced systems analysis package. VPG delivers a unique set of tools which allow engineers to create and visualize, through its modules--structure, safety, drop test, and blast analyses.

DYNAFORM

Complete Die System Simulation Solution. The most accurate die analysis solution available today. Its formability simulation creates a "virtual tryout", predicting forming problems such as cracking, wrinkling, thinning and spring-back before any physical tooling is produced

Visual-Crash

Visual Crash for LS-DYNA helps engineers perform crash and safety simulations in the smoothest and fastest possible way by offering an intuitive windows-based graphical interface with customizable toolbars and complete session support. Being integrated in ESI Group's Open VTOS, an open collaborative multi-disciplinary engineering framework, Visual-Crash for DYNA allows users to focus and rely on high quality digital models from start to finish. Leveraging this state of the art environment, Visual Viewer, visualization and plotting solution, helps analyze LS-DYNA results within a single user interface.

vibro-acoustic software

With ESI's vibro-acoustic software you no longer have to. account for noise and vibration right at the design stage - no more costly delays or panic driven test-based solutions. Our vibro-acoustic software has everything you need to diagnose potential noise and vibration problems up front in your development process. Manage risk by identifying possible problem areas that may need more detailed modeling or test based development, while you still have time to make an impact on the product!

VA One

VA One is a complete solution for simulating the response of vibro-acoustic systems across the full frequency range. VA One seamlessly combines Finite Elements (FE), Boundary Elements (BEM) and Statistical Energy Analysis (SEA) in ONE model. It is the only simulation code on the market today that contains the complete spectrum of vibro-acoustic analysis methods within ONE common environment.

Participant Solutions
GNS - Gesellschaft für Numerische Simulation mbH

www.gns-mbh.com

Animator4

A general finite element post-processor and holds a leading position in its field. Animator4 is used worldwide by almost all automotive companies, a great number of aerospace companies, and within the chemical industry.

Generator2.

A specialized pre-processor for crashworthiness applications and has become very successful in the field of passenger safety and pedestrian protection. It is mainly used as a positioning tool for finite element component models by a great number of automobile companies throughout the world.

Indeed

An easy-to-use, highly accurate virtual manufacturing software that specializes in the simulation of sheet metal forming processes. Indeed is part of the GNS software suite and works concurrently with all other GNS software products.

OpenForm

A pre- and post-processor independently of a particular finite element forming simulation package. The software is extremely easy to handle and can be used as was designed to enable those who are not finite element experts to carry out multi-stage forming simulations with even complex multi purpose finite element codes.

Gompute is owned, developed and operated by Gridcore AB in Sweden. Founded in 2002, Gridcore is active in three areas: Systems Integration, Research & Development and HPC as a service.

Gridcore has wide experience of different industries and applications, developed a stable product portfolio to simplify an engineer/scientist's use of computers, and has established a large network of partners and collaborations, where we together solve the most demanding computing tasks for our customers. Gridcore has offices in Gothenburg (Sweden), Stuttgart (Germany), Durham NC (USA) and sales operations in The Netherlands and Norway.

The Gridcore developed E-Gompute software for internal HPC resources gives end users (the engineers) a easy to use and complete environment when using HPC resources in their daily work, and enables collaboration, advanced application integrations, remote pre/post, accounting/billing of multiple teams, license tracking, and more, accelerating our customers usage of virtual prototyping.

HYCRASH

Easy-to-use one step solver, for Stamping-Crash Coupled Analysis. HYCRASH only requires the panels' geometry to calculate manufacturing process effect, geometry of die are not necessary. Additionally, as this is target to usage of crash/strength analysis, even forming analysis data is not needed. If only crash/strength analysis data exists and panel ids is defined. HYCRASH extract panels to calculate it's strain, thickness, and map them to the original data.

JSTAMP / NV

As an integrated press forming simulation system for virtual tool shop the JSTAMP/NV meets the various industrial needs from the areas of automobile, electronics, iron and steel, etc. The JSTAMP/NV gives satisfaction to engineers, reliability to products, and robustness to tool shop via the advanced technology of the JSOL Corporation.

JMAG

JMAG uses the latest techniques to accurately model complex geometries, material properties, and thermal and structural phenomena associated with electromagnetic fields. With its excellent analysis capabilities, JMAG assists your manufacturing process

Participant Solutions
LSTC
Livermore Software Technology Corp.

www.lstc.com

LS-DYNA

A general-purpose finite element program capable of simulating complex real world problems. It is used by the automobile, aerospace, construction, military, manufacturing, and bioengineering industries. LS-DYNA is optimized for shared and distributed memory Unix, Linux, and Windows based, platforms, and it is fully QA'd by LSTC. The code's origins lie in highly nonlinear, transient dynamic finite element analysis using explicit time integration.

LS-PrePost

An advanced pre and post-processor that is delivered free with LS-DYNA. The user interface is designed to be both efficient and intuitive. LS-PrePost runs on Windows, Linux, and Macs utilizing OpenGL graphics to achieve fast rendering and XY plotting.

LS-TaSC™

A Topology and Shape Computation tool. Developed for engineering analysts who need to optimize structures, LS-TaSC works with both the implicit and explicit solvers of LS-DYNA. LS-TaSC handles topology optimization of large non-linear problems, involving dynamic loads and contact conditions.

LSTC Dummy Models

Anthropomorphic Test Devices (ATDs), as known as "crash test dummies", are life-size mannequins equipped with sensors that measure forces, moments, displacements, and accelerations.

LSTC Barrier Models

LSTC offers several Offset Deformable Barrier (ODB) and Movable Deformable Barrier (MDB) model

Oasys Primer

A model editor for preparation of LS-DYNA input decks. - Oasys D3Plot is a 3D visualization package for post-processing LS-DYNA analyses using OpenGL® (SGI) graphics.

Oasys PRIMER

Offers model creation, editing and error removal, together with many specialist functions for rapid generation of error-free models. Oasys also offers post-processing software for in-depth analysis of results and automatic report generation.

Oasys D3Plot

A 3D visualization package for post-processing LS-DYNA analyses using OpenGL® (SGI) graphics.

Participant Solutions
Shanghai Hengstar

www.hengstar.com

Center of Excellence

Hengstar Technology is the first LS-DYNA training center of excellence in China. As part of its expanding commitment to helping CAE Engineers, Hengstar Technology will continue to organize high level training courses and seminars in 2012.

The lectures/training are taught by senior engineers and experts mainly from LSTC, Carhs, OEMs, and other consulting groups.

On Site Training

Hengstar also provides customer customized training programs on-site at the company facility. Training is tailored for company needs using LS-DYNA or the additional software products by LSTC.

Distribution & Support

Hengstar Distributes and supports LS-DYNA, LS-OPT, LS-PrePost, LS-TaSC. Hongsheng Lu, previously was directly employed by LSTC before opening his distributorship in China for LSTC software. He travels to LSTC often to keep current on the latest software features and support to continue to grow Hengstar as a CAE consulting group.

North America
Distribution & Consulting

Canada

Metal Forming Analysis Corp MFAC
galb@mfac.com

www.mfac.com

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*LS-PrePost *LS-TaSC
*DYNAFORM *VPG
*INVENTIUM/PreSys
*LSTC Dummy Models
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*PAM-RTM *PAM-CEM
*VA One *CFD-ACE+
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*Visual-Environment
*Visual-Process
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Gompute

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www.gompute.com

*LS-DYNA Cloud Service
*Additional software
*Additional Services

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United States

CAE Analysis

info@caeai.com

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*ANSYS Products
*CivilFem
*Consulting ANSYS
*Consulting LS-DYNA

United States

Predictive Engineering

george.laird@predictiveengineering.com
www.predictiveengineering.com

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Distribution – Consulting

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*LSTC Barrier Models

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*AnyBody
*VPS
*FTI FormingSuite

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Netherlands

Infinte

j.mathijssen@infinite.nl

www.infinite.nl

*ANSYS Products
*CivilFem
*CFX
*Fluent
*LS-DYNA

Germany

GNS

mbox@gns-mbh.com

www.gns-mbh.com

*Animator
*Generator
*Indeed
*OpenForm

Asia Pacific
Distribution – Consulting

Italy

EnginSoft SpA

info@enginsoft.it

www.enginsoft.it

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*Flowmaster
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*ESAComp
*AdvantEdge
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marcus.redhe@dynamore.se

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GRIDCORE

info@gridcore.com

*LS-DYNA Cloud Service
*Additional software
*Additional Services

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Ove Arup & Partners

dyna.sales@arup.com

www.oasys-software.com/dyna

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lma@eta.com.cn

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*NISA
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China

Oasys Ltd. China
(software house of Arup)

Stephen.zhao@arup.com

www.oasys-software.com/dyna

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Japan

Fujitsu

http://jp.fujitsu.com/solutions/hpc/app/lsdyna

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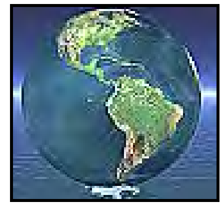
Cloud Services including LS-DYNA



Japan	Fujitsu www.fujitsu.com
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Vincent LAPOUJADE

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France

AS+, A French LS-DYNA distributor since 2008, is pleased to announce that as of January 1,st 2012 we have transferred our finite element activities to a new dedicated entity : DynAS+.

Since the founding within AS+ of our engineering department around transient dynamic (and more specifically LS-DYNA software), our expertise has continuously been strengthened to be used today by an increasingly significant number of customers across France. Our new entity is dedicated to LSTC's

LS-DYNA LS-PrePost LS-OPT LS-TaSC LSTC ATD/Barrier Models

Our primary goal is to concentrate our knowledge and expertise to constantly satisfy our customers, improve our visibility and promote and support more effectively LS-DYNA on the French territory. .

Contact: Vincent LAPoujade
v.lapoujade@dynasplus.com

You will find additional information on our distributor, training, support activities and associated consulting services on our new website: www.dynasplus.com.

Vincent LAPOUJADE (technical manager of AS+ and expert in technical support of LS-DYNA) and his entire team are proud to now be able to sell, support, consult and offer training under DynAS+

We remain at your disposal to answer any questions by mail : v.lapoujade@dynasplus.com

Training Germany
CADFEM GmbH

The Complete Courses Offered Can Be Found At: www.cadfem.de
Please check the site for accuracy and changes.
Among the many course offering are the following:

Introduction to simulation with ANSYS Workbench
January 10, 2012
February 21, 2012
March 13, 2012

Introduction to explicit structural mechanics with ANSYS-LS-DYNA and LSTC's LS-DYNA
February 08, 2012
May 09, 2012

Material Modeling with LS-DYNA
March 06, 2012

Modeling joints with LS-DYNA
March 02, 2012

Introduction to simulation of joint and muscle forces with AnyBody
April 25, 2012

Efficient coupling of AnyBody with ANSYS workbench
April 27, 2012

Additional Courses are offered – please check the website for upcoming dates for:

FTI Forming Suite
DIGIMAT
DIFFPACK

Individual Training:

Take advantage of the expertise of our specialists and get to know how simulation processes in your company can be arranged in an optimal way.

Let us combine your expert knowledge in your particular company questions with our experience in handling with ANSYS and ANSYS Workbench. In an individual training we can develop efficient solution approaches hand in hand and we help you to use our software effectively.

Training Germany
DYNAmore

The Complete Courses Offered Can Be Found At: www.dynamore.de/en

eta/DYNAFORM Stuttgart, Jan. 23

Thermal Stuttgart, Jan. 25

Intro LS-DYNA Stuttgart, Feb. 1

Intro Material Stuttgart, Feb. 3

Material Modeling Stuttgart, Feb. 6

Identification LS-OPT Stuttgart, Feb. 8

Material Failure Stuttgart, Feb. 9:

Training United States
Livermore Software
Technology Corp

The Complete Courses Offered Can Be Found At: www.lstc.com

Please check the site for accuracy and changes.
Among the many course offering are the following:

Implicit Analysis with LS-DYNA
MI
January 16-17, 2012

Introduction to LS-PrePost (no charge)
CA
January 30, 2012

Introduction to LS-DYNA
CA
January 31 - February 3, 2012

NVH and Frequency Domain Analysis with LS-DYNA
CA
February 7-8, 2012

ALE/Eulerian & Fluid/Structure Interaction in LS-DYNA
CA
February 20-22, 2012

Smoothed Particle Hydrodynamics (SPH) in LS-DYNA and Element-Free Galerkin (EFG)
CA
February 23-24, 2012

Training Sweden
DYNAmore Nordic

The Complete Courses Offered Can Be Found At: www.dynamore.se

Please check the site for accuracy and changes.
Among the many course offering are the following:

LS-PrePost 3, introduction
March 12, 2012
Anders Jernberg Fars Hatt,
Kungälv

LS-DYNA, introductory course
March 13, 2012
Dr. Jimmy Forsberg Fars Hatt,
Kungälv

ANSA & Metapost, Introductory course
March 20, 2012
David Karlsson
Linköping

ANSA CFD Meshing
March 22, 2012
David Karlsson
Linköping

LS-DYNA, implicit analysis
March 27, 2012
Dr. Thomas Borrvall
Linköping

LS-DYNA, Simulation of sheet metal forming processes
April 17, 2012
Dr. Mikael Schill
Linköping

LS-DYNA, Material modelling
April 24, 2012
Dr. Thomas Borrvall
Linköping

Training France
Alliance Plus (AS+)

The complete Training Courses offered can be found at www.asplus.fr/ls-dyna
Please check the site for accuracy and changes.

LS-DYNA Explicit/Implicit solver – Special University Training session (to be held in Toulouse)
15-18/02 – Special University Price
(date to be confirmed)

Other regular courses (in Paris) ...

LS-DYNA Introduction Explicit Solver
10-12/09

LS-DYNA Introduction Implicit Solver
24/09

LS-DYNA Unified Introduction Implicit & Explicit Solver
16-19/01, 18-21/06 & 12-15/11

LS-OPT & LS-TaSC Introduction
21-22/03 & 24-25/10

Switch to LS-DYNA
2-3/04 & 10-11/10

Switch from Ls-PrePost 2.X to 3.X
4/04 & 26/09 & 28/11

LS-DYNA Advanced Implicit Solver
25/09

LS-DYNA ALE / FSI
19-20/03 & 22-23/10

LS-DYNA SPH
21-22/05 & 8-9/10

LS-PrePost 3.0 – Advanced meshing capabilities
5/04 & 27/09 & 29/11

LS-DYNA User Options
23-24/05

LS-DYNA – Plasticity, Damage & Failure – By Paul DU BOIS
26-27/11
(date may be changed in Q1)

LS-DYNA – Polymeric materials – By Paul DU BOIS
12-13/12

LS-DYNA – Geo-material modeling
14-15/12

Training United States
Engineering Technology
Associates

The Complete Courses Offered Can Be Found At: www.eta.com

Please check the site for accuracy and changes.
Among the many course offering are the following:

Introduction to DYNAFORM
February 07-08, 2012

Introduction to PreSys
February 14, 2012

Introduction to LS-DYNA
February 21-22, 2012

Training United States
CAE Associates

The Complete Courses Offered Can Be Found At: www.caeai.com

Please check the site for accuracy and changes.
Among the many course offering are the following:

ANSYS Training, CFD and FEA Consultants Serving CT, NJ, NY, MA, NH , VT

Feb 28, 2012 2 days
Introduction to Fatigue & Fracture Analysis
Middlebury, CT

Mar 05, 2012 1 day
ANSYS DesignModeler
Middlebury, CT

Mar 06, 2012 2 days
Introduction to ANSYS Mechanical (Workbench)
Middlebury, CT

Apr 12, 2012 2 days
Introduction to CivilFEM
Middlebury, CT

Apr 16, 2012 3 days
Introduction to ANSYS Mechanical APDL Part I (Traditional GUI
Middlebury, CT

Apr 19, 2012 2 days
Introduction to ANSYS Mechanical APDL Part II (Traditional GUI)
Middlebury, CT

May 14, 2012 1 day
ANSYS Workbench Meshing for CFD
Middlebury, CT

May 15, 2012 2 days
Introduction to CFX
Middlebury, CT

Jun 11, 2012 1 day
ANSYS DesignModeler
Middlebury, CT

Jun 16, 2012 2 days
Introduction to ANSYS Mechanical (Workbench)
Middlebury, CT

Training China
Hengstar Technology

The Complete Courses Offered Can Be Found at www.hengstar.com

2012	2	3	4	5	6	7	8	9	10	11	12
An Introduction to LS-DYNA(High Level)											
Concrete & Geomaterial Modeling with LS-DYNA											
Pedestrian Safety and Bonnet Design with LS-DYNA											
Crashworthiness Theory and Technology											
LS-DYNA MPP, Airbag Simulation with LS-DYNA											
Introduction of LS-OPT which is Based on LS-DYNA											
Passive Safety and Restraint Systems Design											
Crashworthiness Simulation with LS-DYNA											
Passive Safety Simulation with LS-DYNA											
Crashworthy Car Body Development - Design, Simulation and Optimization											

France
Alyotech Technologies

For course location visit www.alyotech.fr

LS-DYNA Introduction
- Feb 01-03
- March 14-16
- April 03-05
- June 04-06
- Sept 10-12
- Oct 01-03
- Nov 12-14
- Dec 03-05

LS-DYNA Thermal
- Sept 13-14

LS-DYNA Implicit
- March 19-20
- May 21-23
- Sept 17-19
- Nov 19-21

LS-PrePost – Meshing
- March 22
- May 24
- Sept 27
- Nov 26

LS-PrePost – New Interface
- March 23
- May 25
- Sept 28
- Nov 27

LS-OPT Introduction
- February 27-28
- June 18-19
- Dec 10-11

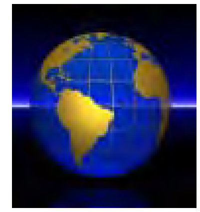
LS-TaSC – Topology Optimization
- February 29
- June 20
- Dec 12

Material Modeling & User Defined Material in LS-DYNA
- July 10-11

Crash & Impact Modeling
- April 02-05

FSI & ALE in LS-DYNA
- March 15-16

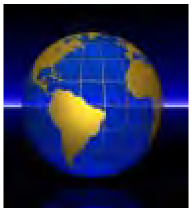
LS-DYNA Composite
- July 12-13



PARTICIPANTS

2012 Start Dates

05/08 Sweden	**Gompute User Meeting 2012** www.simdi.se
06/03 US	**LSTC - 12th Int'l LS-DYNA® Users Conference** www.ls-dynaconferences.com
06/25 Germany	**GNS -7th OpenFOAM® Workshop** www.openfoamworkshop.org/2012/OFW7.html
10/09 Germany	**DYNAmore The LS-DYNA Forum 2012** www.dynamore.de
10/24 Germany	**30th CADFEM Users´ Meeting** www.usersmeeting.com/en
2013 06/03 Germany	**9th European LS-DYNA Users Conference** www.arup.com



Worldwide Conferences – Events 2012

Courtesy Postings

start date	Conference - Event
02/21 US	SAE 2012 Hybrid Vehicle Technology Symposium www.sae.org/events/training/symposia/hybrid /
03/12 US	Aerospace & Defense Supplier Summit www.bciaerospace.com/seattle
04/03 Germany	Automotive CAE Grand Challenge 2012 www.carhs.de/grand-challenge
04/16 Belgium	11th Int'l Conf. - Computer Applications/Information Tech. -Maritime Ind. www.compit.info/
May 15 US	2012 SIMULIA Customer Conference www.3ds.com/company/events/scc-2012/overview/
05/21 Germany	Nastran Users Meeting http://pages.mscsoftware.com/NastranUserMeeting2012-Home.html
06/12 US	Seventh M.I.T. Conference www.seventhmitconference.org/

Press Release – News
ESI's Casting Simulation Suite

Complete information can be read at - www.esi-group.com

Latest release of ESI's Casting Simulation Suite: ESI's foundry simulation solution is now extended by Salsa 3D, a gating and running design tool

The new collaborative engineering environment, including Visual-Cast, allows interoperability and chaining between casting software and other simulation disciplines.

Paris, France – 10 January, 2012 – ESI Group, pioneer and world-leading solution provider in virtual prototyping for manufacturing industries, announces the latest release of ESI's Casting Simulation Suite, composed of ProCAST & QuikCAST. The suite provides a predictive evaluation of the entire casting process, including filling and solidification defects, microstructural changes and part distortion. It enables rapid visualization of the effects of design changes for cast parts, to aid in making the right decisions from an early stage of the manufacturing process. Virtual Prototyping enables foundries to shrink product development costs, reduce time to market, and increase product quality.

This new release includes a complete and new user environment, with a modeler that drastically reduces the preparation time thanks to a new methodology, new interface and enhanced automatic assembly. Also, the first release of the new pre-processor, Visual-Cast, provides set-up of process conditions straight onto the CAD topology, instead of onto the meshing. This gives the possibility of adapting the model to the simulation needs without resetting the process definition. This version of the Casting Simulation Suite also provides an advisor to assist in computing the mechanical properties of aluminum after age hardening treatment for parts like wheels, suspension components, cylinder heads and engine blocks. This tool has been originally developed by Rio Tinto Alcan, and by Michel Garat in particular.

New microstructure models are now available; for example for Ni-Resist and Compacted Graphite Iron, materials mostly used in the automotive industry.

To ensure sound castings, major functionalities like core gassing, oxide particles tracing and prediction of burn-on and mold penetration have been implemented.

In addition, users will benefit from the results of global research projects on light-weight materials and superalloys that will lead to improvements in centrifugal casting modeling and in the prediction of micro-porosity.

To further complement of the capabilities of its Casting Simulation Suite, ESI now distributes a filling system design tool. CTIF (Centre Technique des Industries de la Fonderie), a French casting research center, and ESI Group have signed an agreement for the exclusive distribution, support and development of

SALSA 3D . The tool developed by CTIF calculates efficient filling systems for pressure die casting, following experimental and fundamental rules.

SALSA 3D helps calculate and size gating and running systems for the High Pressure Die Casting process. It assists in designing gates, runners and overflows by controlling the maximum gate velocity and thickness based on the available pressure machine. This potentially delivers significantly increased yield and reduced die development time and the filling system can be validated using ProCAST or QuikCAST.

SALSA 3D will be integrated gradually into the ESI Casting Simulation Suite, with the aim of offering a software combination that helps maximize productivity, reduce development time and improve the quality of parts.

For more information, please visit: www.esi-group.com/casting

About ESI Group
ESI is a pioneer and world-leading solution provider in virtual prototyping for manufacturing industries that takes into account the physics of materials. ESI has developed an extensive suite of coherent, industry-oriented applications to realistically simulate a product's behavior during testing, to fine-tune manufacturing processes in accordance with desired product performance, and to evaluate the environment's impact on performance. ESI's solutions fit into a single collaborative and open environment for End-to-End Virtual Prototyping, thus eliminating the need for physical prototypes during product development. The company employs about 850 high-level specialists worldwide covering more than 30 countries. ESI Group is listed in compartment C of NYSE Euronext Paris.

Press Release – News
Ford Sollers Plant - Russia

ST. PETERSBURG, Russian Federation, January 17, 2012 – The 500,000th vehicle rolled off the production line today at the Ford Sollers plant in Vsevolozhsk, near St. Petersburg, Russia. It marked a double celebration as the milestone car was a Ford Focus Wagon – the very first all-new Focus Wagon to be built at the plant.

"It's great that the half-millionth Ford car to be built in Russia is the first all-new Ford Focus Wagon, the very latest model to our vehicle range," said Ted Cannis, President and CEO, Ford Sollers.

"Since the first Ford car came off the production line here in Vsevolozhsk in 2002, the Ford brand has undergone enormous change in Russia. Our sales volume has increased five-fold since 2002, and we at Ford Sollers are determined to build upon that success in the years ahead."

Adil Shirinov, Executive Director and Chief Operating Officer, Ford Sollers, said: "This 500,000th car is important for the team here at the Vsevolozhsk plant and all Ford Sollers employees, the St. Petersburg area, and for our customers in Russia. Ford is today recognized by Russian customers for its safety, craftsmanship, distinctive design, driving dynamics, affordability and – increasingly – for its outstanding technology, and this all-new Ford Focus Wagon has it all."

Also watching the 500,000th car off the line – a top-of-the-line 2.0-litre, candy red Ford Focus Titanium Wagon – were Valery Serdyukov, Governor of the St. Petersburg region, and Alexander Sobolenko, Head of the Vsevolozhsk Municipal Region.

The plant in Vsevolozhsk was the first complete-manufacturing, non-domestic automotive plant in Russia when it was opened by Ford in 2002. It is now one of three plants operated by Ford Sollers. Over 2,700 employees currently work at the plant. Each day, the plant produces around 300 cars in each of two shifts. The Russian plant produces the Ford Focus in all three body styles: five-door, four-door and wagon. Since 2009, Vsevolozhsk also has built the four-door Ford Mondeo.

History of production Vsevolozhsk:

- July, 2002 – Start of Ford Focus production
- 2003 – Focus became the best-selling car manufactured in Russia by a non-domestic manufacturer; a status it retained for seven years
- 2006 – 100,000th Russian-built Ford Focus built in Vsevolozhsk
- October, 2007 – 200,000th Ford Focus rolled off the production line
- March, 2009 – Start of Mondeo production.
- June, 2009 – The number of Russian-built Focus cars reached 300,000
- March, 2011 – The 400,000th Ford Focus was produced in Vsevolozhsk
- July 2011 – All-new Ford Focus four-door and five-door production begins

•January 17, 2012 – 500,000th car built, and the start of Ford Focus Wagon production.

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About Ford Sollers

The Ford Sollers joint venture started operation on October 1, 2011, and is responsible for the production, import and distribution of all Ford brand products, including vehicles, parts and accessories, in Russia. The Ford Sollers joint venture includes vehicle production facilities in Vsevolozhsk (St.Petersburg region), and in Naberezhnye Chelny and in the special economic zone of Alabuga in the the Republic of Tatarstan. Ford Sollers also will manufacture engines and operate a stamping facility that will provide a higher level of local parts content for Ford vehicles built in Russia. It also plans to establish research and development activities.