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Volume 6, Issue 06, June 2017

www.feainformation.com www.feaiej.com www.feapublications.com

LSTC Recent Developments In LS-DYNA (Editor: Yanhua Zhao)

Improvement of Sandwich Structure Part Adaptivity in LS-DYNA

X. Zhu, H. Fan, L. Zhang and Y. Xiao - LSTC

New Inflator Models in LS-DYNA®

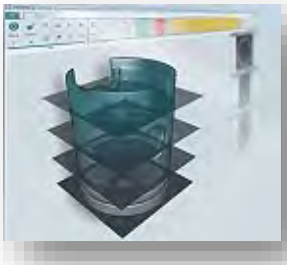
K.S Im, Z-C Zhang, G. Cook, Jr. - LSTC

ETA DYNAFORM Sales/Support

New Platinum Participant

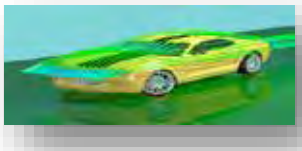
Finite Element Analysis Predictive Engineering

BETA CAE Systems RETOMO



Rescale & OSC

15th International LS-DYNA Conference Call For Papers



LSTC Livermore Software Technology Corp. DLFK DYNAMORE

FEA Information Inc.

A publishing company founded April 2000 – published monthly since October 2000.
The publication's focus is engineering technical solutions/information.
FEA Information Inc. publishes:

FEA Information Engineering Solutions

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BETA SIMULATION SOLUTIONS

MSC Materials Sciences Corporation ISO 9001:2008 CERTIFIED

eta

esi

JSOL

恒士达科技 Hengstar Tech.

Oasys The Software House of Arup

rescale

FINITE ELEMENT ANALYSIS Predictive Engineering

FEA Information News Sections

Articles – Blogs – News

Automotive News **Editor - Dilip Bhalsod**

Aerospace News **Editor - Marnie Azadian**

China FEA News –Events – Participants **Editor – Yahua Zhao**

Solutions

Participants	Distribution & Consulting	Cloud/On Demand/Subscription
ATD – Barrier - THUMS		

News Classes – Social Media **Editor - Aleta Hays**

Conferences – Events

LSTC Information & Apps **Editor - Yanhua Zhao**

Announcements

15th International LS-DYNA® Users Conference & Users Meeting
Call For Papers - Abstracts now being submitted!

Plenary Session - Keynote Address - Toyota Motor Corporation

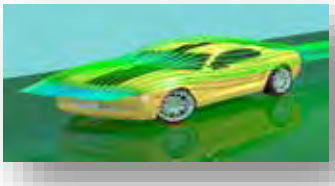
New platinum participant:
Predictive Engineering LS-DYNA Consulting Services
www.predictiveengineering.com

BETA CAE Systems announces the release of the new software RETOMO

All FEA Participants if you are not listed on the social media pages and would like your Twitter, Facebook, LinkedIn URL listed please send to:
mv@feainformation.com subject Social Media Link

Sincerely,
Marsha Victory Trent Eggleston
Marnie Azadian Suri Bala Dilip Bhalsod Yanhua Zhao Aleta Hays

15th International LS-DYNA® Users Conference & Users Meeting



June 10-12, 2018

Edward Hotel & Convention Center
Dearborn. MI. USA

Welcome:

The conference will host a forum for engineers, professors, students, consultants, industry leaders, and interested parties to exchange their ideas, and listen to the latest in industry and academic presentations..

The presenter (1) One Presenter of the accepted paper will receive a complimentary (no fee) conference registration, when they register using the "LSTC Conference" group registration code at the Edward Hotel.

Conference Dates:

Sunday	06/10/2018	Registration	Exhibition Area	Reception
Monday	06/11/2018	Registration	Exhibition Area	Banquet
Tuesday	06/12/2018	Registration	Exhibition Area	Closing
Wednesday/Thursday	06/13-14/2018	Training Classes		

Information:

Abstracts & papers papers@lstc.com
Participation, Registration conference@lstc.com

Abstract Submission on line:
Deadline: August 30, 2017
On line being processed by DYNAmore GmbH
www.dynamore.de/paper2018

Paper Submission: Deadline: February 14, 2018 FIRM

Notification and templates will be provided by DYNAmore
For any questions please write papers@lstc.com

Abstracts: www.dynamore.de/paper2018
Registration/Classes: www.ls-dynaconferences.com

Conference Call For Papers

- Acoustics
- Aerospace
- Automotive
  - Crashworthiness
  - Durability
  - NVH
- Ballistics and Penetration
- Biomechanics
- Civil Engineering
- Electromagnetics
- Fluid Dynamics
  - Compressible
  - ALE (Lagrangian, Eulerian)
  - CESE
  - Incompressible
- Granular Flow
- Heat Transfer
- Impact and Drop Testing
- Manufacturing Processes
- Material Parameter Identification
- Metal Forming
- Modeling Techniques
- Nuclear Power
- Occupant Safety
- Optimization
- Particle Method
  - Airbag Particle Method
  - Discrete Elements
  - Element Free Galerkin
  - Peradynamics
  - Smooth Particle Hydrodynamics
  - Smooth Particle Galerkin
- PrePost Processing
- Seismic Engineering
- Ship Building

BETA CAE Systems announces the release of the new software RETOMO

www.beta-cae.com/news/20170531_announcement_retomo.htm

Turn the key to 3D-modeling from CT-data of physical objects.

Grasp image data and turn them into tessellated models, ready to be driven to further analysis.

RETOMO addresses the need of contemporary industry to embed new approaches, such as Computer Tomography (CT) and the integration of its data into the CAE process.

This new software couples simulation and physical objects even for high-end complex, multi-material structures. RETOMO enables the correlation of CT with CAE and CAD data, by applying high-end methods to read, process, reduce, reconstruct, visualize CT images, and output them as tessellated models.

It incorporates functionality to import, interpret, analyze, and visualize industrial and scientific Computed Tomography (CT) data. Detailed tessellated models are generated, producing one or more files, one for each material, containing the FE-model in WaveFront format (*.obj), ready for pre-processing.

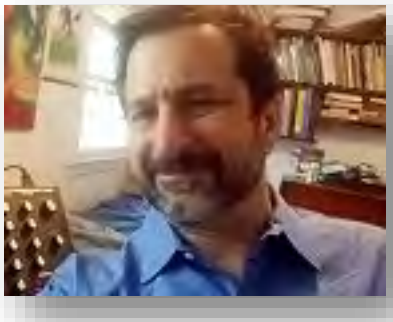
RETOMO has been designed to offer a minimal and intuitive interface having all tools and functions grouped together in such a way that the user can directly access to any of those as well as interact with the model during the analysis of the process.

It offers efficient capabilities for handling Multi-material objects. A solid transparent 3D volume rendering allows the clear visualization of materials, and supports the instantaneous changes in number of materials or inter-material thresholds. Multiple materials can also be handled simultaneously during the image segmentation.

RETOMO can generate separate meshes for all materials in the scan in a single pass. Powerful mesh processing tools allow users to proceed with mesh smoothing and simplification leading to more convenient model import and handling despite the number of datasets. Sophisticated algorithms allow users to work on big databases, without sacrificing the resulting quality.

CAE Blog update & Chris Mesibov awarded three patents

www.caeai.com/news/chris-mesibov-awarded-three-patents



June 7, 2017

CAE Associates' Senior Project Manager Chris Mesibov was recently awarded three patents for his work on optical amplifier control circuitry.

In modern telecommunications, fiber optical networks transmit tremendous amount of information of long distances via optical fibers using multiple wavelengths of laser light. Telecommunication carriers such as ATT and Verizon require optical amplifiers to restore the optical signal after long distances of transmission. The amplification process is purely optical, meaning there is no optical/electrical conversion of the transmitted information. The circuitry was required to monitor the optical power entering and exiting the optical amplifier and control the amplifier gain. This gain must be held constant under all conditions and must be adjusted quickly even in the case of an input power transient situation. In order to accomplish these goals the control electronics must overcome certain obstacles to ensure errors do not creep into the control process.

"It's a rare thrill when your work is recognized as completely unique by your peers," said Mesibov, "I hope that I can transfer the knowledge and perspectives that led me to this work to make CAE Associates' customers more successful.

The patents address optical amplifier control in the following areas:

1) Replicate photodetector current – The photodetector measures the optical power and this measurement is represented in the detector current and needed by multiple location in the circuitry.

2) Precisely amplify the current and turn it into a voltage – The integrated circuits used in this process must be accurate and not introduce any errors.

3) Match the performance of the input power detection and the output power detection - Achieving this ensures transient related gain errors are minimized.

https://www.caeai.com/blog June 2017

Emerging from the Dark Ages

By Nick Veikos, Eng.Sc.D. - President

Speeding Up Your Analysis – Part 2

By James Kosloski, M.S.M.E, Director of Engineering Services

DYNAFORM – Product & Support

www.eta.com

DYNAFORM is a simulation software solution, which allows organizations to bypass soft tooling, reducing overall tryout time, lowering costs, increasing productivity & providing complete confidence in die system design. It also allows for the evaluation of alternative and unconventional designs & materials.

DYNAFORM - By simulating every detail during the design stage, DYNAFORM ensures the highest quality formed part & most efficient manufacturing process possible.

DYNAFORM Modules:

Blank Size Engineering (BSE)

BSE is widely used for estimating blank size, along with blank nesting for maximum material usage, scrap & piece price. The plug-in is used to predict thinning, thickening & also to generate a forming limit diagram (FLD).

Formability Simulation (FS)

FS facilitates the rapid development & validation of single-station & progressive die designs. It uncovers hidden problem areas & enables designers to optimize designs based on accurate forming results.

Die Evaluation (D-Eval)

Since most tooling designs are done in a CAD environment, DYNAFORM's D-Eval Module was specially created to support and analyze CAD based tooling and engineering designs.

Die System Analysis (DSA)

DSA efficiently predicts many stamping related concerns within the die production line. It is used to analyze scrap shedding/removal, die structural integrity & sheet metal transferring/handling.

Optimization Platform

This module helps users to go beyond identifying problem areas, by incorporating design optimization to improve performance and quality - reducing wrinkling, thinning and tearing.

DYNAFORM – Product & Support

DYNAFORM Modules in NX

BSE-in-NX

BSE is a complete solution for accurately estimating blank size along with blank nesting for maximum material utilization, minimum scrap and piece costs—all within the familiar NX environment.

D-Eval-in-NX

Analyze CAD Based Die Designs in NX. DYNAFORM's D-Eval-in-NX Module was specially created to support and analyze CAD based tooling and engineering designs within the native NX environment.

TECHNICAL SUPPORT

Full Technical Support - etainfo@eta.com

Engineering Technology Associates, Inc.
1133 E Maple Rd, Suite 200
Troy, MI 48083 USA

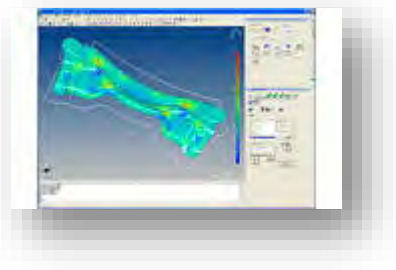
on line at https://www.eta.com/support/email-support

JSOL products – JSTAMPNV - JSTAMPLT

For the Complete List of Products sold visit: http://www.jstamp.jp/en/products/index.html

JSTAMP/NV: Integrated Press Forming Simulation System

JSTAMP/NV is an integrated forming simulation system for virtual tool shop where prototype to product manufacuring processes can be evaluated virtually. JSTAMP/NV meets the various industrial needs from automobile, electronics, iron and steel, etc. Main solvers of JSTAMP/NV are LS-DYNA, JOH/NIKE, and HYSTAMP. These solvers are being renewed actively. Next version you could meet the die face creator module with JSTAMP/NV.

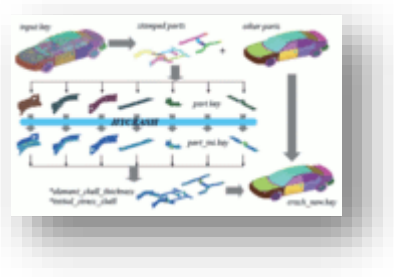


JSTAMP/LT: Inverse Press Forming Simulation System

JSTAMP/LT is an compact simulation system verifying design quality at the initial design stage. JSTAMP/LT gives advantages to determine initial blank line, trim line, and formability of the product designed before die tooling. JSTAMP/LT ensures high accuracy and extremely fast calculation in minutes with integration of the innovative inverse solver "HYSTAMP". Also, provides outstanding ease of use requiring no special training.

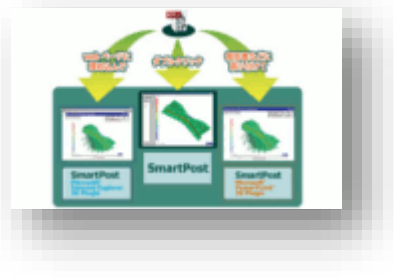
JSOL products – JSTAMPNV - JSTAMPLT

HYCRASH: **Solution for Coupling between Forming and Crash/Impact Simulations**



HYCRASH can make a input file considering forming effects from a general input file for crash/impact simulation without forming effects in LS-DYNA. Forming calculation is done automatically by HYSTAMP.

SmartPost: Compact 3D Viewer on Microsoft® PowerPoint® and Internet Explorer®



SmartPost is a free 3D viewer which can evaluate the result of JSTAMP/NV with 3D animation. Even if the PC does not have the license, not only animation but also the changing various sights or zooming is available. Microsoft® PowerPoint® and Internet Explorer® 3DPlugin are also provided.

LS-DYNA&JSTAMP Forum 2017 - Organizer: JSOL Corporation

Dates: Tuesday 31 October to Wednesday 1 November 2017.
Venue: Tokyo Conference Center Shinagawa (Tokyo, Japan)
URL: http://ls-dyna.jsol.co.jp/en/event/uf2017/

Terrabyte – Japan Products

The complete list can be found at www.terrabyte.co.jp/english/software/products.htm

FE analysis

- **LS-DYNA** is a general-purpose FE 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. The code's origins lie in highly nonlinear, transient dynamic FE analysis using explicit time integration.
- **ACS SASSI** is a state-of-the-art highly specialized finite element computer code for performing 3D nonlinear soil-structure interaction analyses for shallow, embedded, deeply embedded and buried structures under coherent and incoherent earthquake ground motions.
- **SASSI 2000** is a package of interrelated computer programs that can be used to solve a wide range of dynamic soil-structure interaction problems in two or three dimensions. It is currently an industry standard for solving soil-structure interaction problems.

EM Analysis: JMAG is a comprehensive software suite for electromechanical equipment design and development. Powerful simulation and analysis technologies provide a new standard in performance and quality for product design. INTEGRATED Engineering Software is the industry leader in Boundary Element Method CAE software. BEM provides the most accurate numerical field solutions for "large open regions".

Metal sheet: JSTAMP is an integrated forming simulation system for virtual tool shop based on IT environment. JSTAMP is widely used in many companies, mainly automobile companies and suppliers, electronics, and steel/iron companies in Japan.ges (BEM, FEM and FDTD).

Pre/Post: PreSys is an engineering simulation solution for FE model development. It offers an intuitive user interface with many streamlined functions, allowing fewer operation steps with a minimum amount of data entry. Multipurpose pre/post-processor for FE solver. It has tight interface with LS-DYNA. Users can obtain both load reduction for analysis work and model quality improvements.

Rescale and OSC Offer Supercomputing-as-a-Service

Rescale - June 13, 2017

Rescale has partnered with Ohio Supercomputer Center, a national center that drives research and development in computational science and the applications of supercomputing

Interview with Infrastructure Partner Ohio Supercomputer Center

Rescale has partnered with Ohio Supercomputer Center, a national center that drives research and development in computational science and the applications of supercomputing, since 2015. Under the partnership, Rescale allows joint customers to run over 200 pre-installed, pre-tuned HPC applications on OSC's specialized HPC infrastructure with zero setup or installation. Keep reading for a candid discussion with Alan Chalker, OSC's director of strategic programs, about the ways Rescale and OSC together enable specialized supercomputing on-demand.

Rescale: Can you start off by introducing yourself and describing your role at Ohio Supercomputer Center?

Alan Chalker: I'm Alan Chalker. I am director of strategic programs and the director of AweSim, which is our industrial engagement program. I'm responsible for all of our non-academic engagements. That includes engagement with the federal government, state government, nonprofit hospitals, and things like that.

Rescale: What should we know about OSC?

Alan Chalker: OSC was created in 1987 by the state of Ohio. The bill that created OSC, House Bill 171 signed on June 30, 1987, recognized OSC as an economic development asset for the state and therefore required engagement with both industry and academia. That's what sets us apart from many of the other centers—since day one, we have had a charter to serve both academics, who are the primary clients, but also industry. Because we're viewed by the state economic development entity as an attraction agent, we can serve companies outside of Ohio

.

Rescale and OSC Offer Supercomputing-as-a-Service:

By allowing companies outside of Ohio to use our center and see the cool things we're doing here, we raise awareness of Ohio as a good place to work and do business. Fundamentally, our goal is to provide infrastructure and computational services. We are not just providing a computer and saying "Have at it." We are very different than AWS because we provide a wide variety of products and services, including expertise, software, hardware, and software development tools.

The current three systems we have are Oakley, named after Annie Oakley; Ruby, after Ruby Dee; and Owens, after Jesse Owens—all named after famous Ohioans. Owens is an $8 million system we acquired late last year; it has 23,000 cores in it. It's the 202nd most powerful non-distributed computer in the world according to the TOP500 list. It has the latest generation of Intel processors, which are called Broadwell, and very high-speed InfiniBand interconnect. We're providing leading-edge capability that you can't get anywhere else.

Read Complete Information:
http://blog.rescale.com/?_ga=2.247425095.27047361.1497570257-592429713.1497570257

Oasys PRIMER Designed for LS-DYNA Models

The Oasys PRIMER pre-processor is designed to make preparation and modification of LS-DYNA models as fast and as simple as possible, improving user productivity and efficiency and reducing the time spent manipulating and developing models suitable for LS-DYNA.

Oasys 14.0 Software Suite

- Oasys 14.0 is the latest version of our Oasys Software Suite for pre- and post-processing of LS-DYNA models.
- Oasys 14 provides the user with a variety of new tools to help reduce the amount of time spent pre- and post-processing a model.

Oasys PRIMER

This new version of Oasys PRIMER includes a number of new features such as:

- Support for LS-DYNA R9.0 keywords
- Label locking ranges to "fix" specified ID's of entities
- New ways to select nodes/elements via path line/area
- New methods for fixing contact penetrations
- Output of contact information to Excel files
- Connections - auto remesh around spotwelds to create heat affected zone
- New ways to create and visualise mass and mass distributions
- Improved handling of parameters/parameter expressions including speed improvements for models containing many parameters
- New pedestrian tool for plotting/contouring HIC results, including area calculations
- New measure tool for contouring distances between parts
- Improvements to JavaScript tools, including the ability to write Excel files
- New meshing tools including a tet-mesher and improved ruled meshing
- Ability to access and investigate errors and warnings written to LS-DYNA output files
- New check dashboard to give overall "health" of your model
- For more information and the above new features, please see the detailed PDF.

Oasys PRIMER Designed for LS-DYNA Models

Oasys D3PLOT

This new version of Oasys D3PLOT includes a number of new features such as:

- "PRIMER" style object menus
- Simplification of capturing images of graphics windows and menus
- New colour-blind and greyscale friendly contour ramps
- Blanking can now be set per window
- Multiple on-plan integration point data can be plotted
- Additional support for Volume 3 features
- New streamlines plotting mode for visualising flow
- Reduced size PTF files can be generated
- Interactive definition of variables for returning to REPORTER
- For more information and the above new features, please see the detailed PDF.

Oasys T/HIS

- This new version of Oasys T/HIS includes a number of new features such as:
- Support for reading new data files
- New Javascript functionality for opening models and extracting data
- Support for Visual Studio Intellisense for writing Javascripts
- Simplification of capturing images of graphics windows and menus
- Improved Add(y), Div(y), Mul(y) and Sub(y) operations
- Interactive definition of variables for returning to REPORTER
- For more information and the above new features, please see the detailed PDF.

Oasys REPORTER

- This new version of Oasys REPORTER includes a number of new features such as:
- New US-NCAP Front FFB, Side MDB and Side Pole Impact templates
- New IIHS Side Impact (MDB) template
- New general LS-DYNA model and vehicle templates
- Library program output and text can now be mixed in table cells
- Rows and columns can now be added or deleted at any location in a table
- Cells in tables can now be merged
- Table cell borders can now be changed individually
- Data can now be returned to REPORTER from D3PLOT and T/HIS as variables

Predictive Engineering LS-DYNA Consulting Services

www.predictiveengineering.com/consulting/ls-dyna-consulting

LS-DYNA Consulting Services

LS-DYNA presents the greatest flexibility and power of any FEA based analysis software in the world. Its rate of innovation is truly amazing as it has expanded its capabilities over the last two decades into multi-physics from ALE, CFD (compressible and incompressible), frequency domain dynamics (PSD fatigue, modal frequency, rigid-body dynamics), NVH, electromagnetism, conjugate heat transfer, mesh free methods (EFG, SPH), discrete element method, complete fluid-structure, DEM-structure, SPH-structure capabilities and I'm sure I missed even more capabilities.

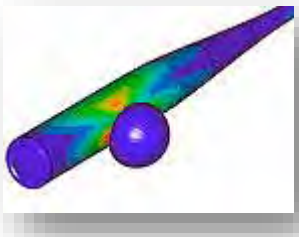
At Predictive Engineering, we pride ourselves in the ability to conceptualize complex structures and systems into accurate numerical models. Given the complexity of LS-DYNA, our experience gained over the course of 20+ years allows us to quickly provide our clients with the right balance between cost and accuracy.

Among the many LS-DYNA Case Studies are the following that represent just two of our more important projects and they provide a bit of insight into our ability to get you the right simulation results, quickly and economically. Visit our website for complete information.

LS-DYNA Nonlinear Analysis of Plastics, Elastomers and Foams

Analysis: LS-DYNA

Objective: This case study presents several consulting projects where LS-DYNA was used in the nonlinear analysis of plastics, elastomers and foams.



Baseball Bat Mechanics

Analysis: LS-DYNA

Objective: To understand the mechanics of aluminum bat/ball interaction. A FEA model was constructed of an aluminum bat based on geometric and material property data supplied by the client

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LSTC MI and California August Classes

Aleta Hays aleta@lstc.com

Specific class information can be read at www.lstc.com

Register ASAP to reserve your class space

Please note * designates first time being offered classes!

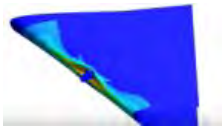
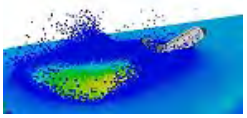
August			
1-2	Tue-Wed	CA	* Rubber, Foam, Viscoelastic Materials
3-4	Thur-Fri	CA	* Plasticity, Plastics, Visco-plastic Materials
8-9	Tue-Wed	MI*	SPG & Peridynamics Methods for Adv. Material Failure Analysis
8-9	Tue-Wed	CA*	* Fracture, Failure, Damage
10-11	Thur-Fri	CA	Composite LS-DYNA
14-15	Mon-Tue	CA	Implicit LS-DYNA
21-23	Mon-Wed	CA	ALE
24-25	Thur-Fri	CA	SPH
28	Mon	CA	Intro to LS-PrePost
Aug 29-Sep 1	Tue-Fri	CA	Intro to LS-DYNA

Aerospace & LS-DYNA

Aleta Hays aleta@lstc.com

Modern flight vehicles undergo severe conditions, such as differences in atmospheric pressure and temperature, or heavy structural load applied upon vehicle components.

Consequently, they are usually the products of various technologies including aerodynamics, avionics, materials science and propulsion. These technologies are collectively known as aerospace engineering.
Video

	**Bird Strike on an aircraft composite wing leading edge using LS-DYNA** **Husain Ansa**ri - www.youtube.com/watch?v=53vDJ4GSXl4 Bird numerical model created using SPH elements and null material with polynomial equation of state.
	**LS-DYNA Cargo Net Simulation during Airplane Crash Event.mov** **Predictive Engineering** - www.youtube.com/watch?v=k8ZVkFtNF9A LS-DYNA simulation of cargo net securing boxed-up cargo during an airplane crash event. The webbing, steel hardware and pallet were all successfully modeled and analyzed
	**Space shuttle landing - LS-DYNA discrete method (DEM)** **BeenuZz** - www.youtube.com/watch?v=Wr5B01NmgfU&list=PLXFT4P5W0f3-r_Rb3b3RkSj9oCOHvmWJb&index=3
	**September 11 Pentagon Attack Simulations Using LS-Dyna** **Mete A. Sozen, Sami A. Kilic and Christoph M. Hoffmann** www.cs.purdue.edu/homes/cmh/simulation/phase1/image1/10sep02.gif

Aerospace & LS-DYNA

LS-DYNA includes but is not limited to:

- Blade containment
- Bird strike (windshield, and engine blade)
- Failure analysis
- Ice Ingestion
- Debris containment
- Composite Modeling - (delamination and debonding)
- Landing Gear and Tire-Ground Interaction
- Engine Dynamics

Advanced Aerospace Materials:

- Fabrics and woven composites (such as Kevlar (R) and Zylon (R))
- Delamination/debonding of multi-ply composites
- Ice, Bird, Rubbers
- Temperature and Strain Rate dependency

Paper from LS-DYNA® Users Conferences -
Updated and additional papers: www.dynalook.com

The Use of LS-DYNA in the Columbia Accident Investigation and Return to Flight Activities
http://www.dynalook.com/international-conf-2004/03-1.pdf

A High Strain Rate Model with Failure for Ice in LS-DYNA
http://www.dynalook.com/international-conf-2006/11MaterialModeling.pdf

LS-DYNA® Aerospace Working Group (AWG) http://awg.lstc.com

The LS-DYNA® Aerospace Working Group (AWG) is a partnership of federal agencies, corporations, and universities working together to develop and publish aerospace test cases and modeling guidelines for finite element analyses with LS-DYNA®. The actions of the AWG serve to support the use, development, and reliability of LS-DYNA® for aerospace numerical analyses.

BOOKS –

	**Soil Structure Interaction Analysis by Finite Element Method** Soil-structure interaction is interdisciplinary field which involves structural and geotechnical engineering. In the conventional non-interaction analysis of building frame structural designer assumed that columns are resting on unyielding support.
	**Finite Element Method: Applications in Solids, Structures, and Heat Transfer** (Mechanical Engineering) 1st Edition, Kindle Edition The finite element method (FEM) is the dominant tool for numerical analysis in engineering, yet many engineers apply it without fully understanding all the principles. Learning the method can be challenging, but Mike Gosz has condensed the basic mathematics, concepts, and applications into a simple and easy-to-understand reference.
	**A FIRST COURSE IN THE FINITE ELEMENT METHOD** The book is written primarily as a basic learning tool for the undergraduate students in civil and mechanical engineering who are primarily interested in stress analysis and heat transfer. The text offers ideal preparation for students who want to apply the finite element method as a tool to solve practical physical problems.

www.eta.com

www.flotrend.com.tw

恒士达科技 Hengstar Tech.

www.hengstar.com

AutoCAE really customer focused

www.autocae.cn

ARUP

www.oasys-software.com/dyna

Dynawe

www.dynawe.com

AgileSim

www.agilesim.com.tw

PAN-i

www.pan-i.com

DLFK

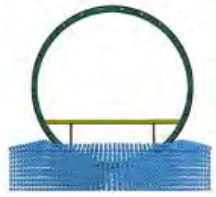
http://dalianfukun.com

FEA Information China - For Sign Up or to offer Articles Contact:
Editors: Yanhua Zhao - Yanhua@feainformation.com
Grace Su, Marsha Victory

YouTube Choices for the Month

Author: Marsha Victory mv@feainformation.com

My personal pics for this month

	**LS-DYNA Steel Profile Stamping Analysis - Video Tutorial** Ahmet OKUDAN - Published on Jun 10, 2017 www.youtube.com/watch?v=F5b5Uiw9aFs
	**LS-DYNA CFD : Flow through a funnel** LS-DYNA Multiphysics Published on Jun 2, 2017 www.youtube.com/watch?v=1ijUDN2yK4k
	**Numerical Simulations of a fuselage cross section drop test on water. The water was modeled with SPH method.** Ameen Topa - Published on Jun 2, 2017 https://www.youtube.com/watch?v=1CUhE6LmMZE
	**LS-DYNA - Thermal Stress Analysis** Sercan Devrim - Published on Jun 13, 2017 www.youtube.com/watch?v=apzGJdDEGGw

Website Month Showcase – Sites to Visit for Information

www.fujitsu.com/jp/solutions/business-technology/tc/sol/

www.infinite.nl/

http://www.dynamax-inc.com /

http://www.dynasplus.com/

http://www.beta-cae.com/

http://www.dynamore.de /

http://www.materials-sciences.com/

https://caeai.com/

http://www.eta.com/

http://www.lancemore.jp/index_en.html

LSTC Website Updates & News

www.lstc.com/download/manuals

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14th International LS-DYNA Conference 2016

Abstract Proceeding with papers included on memory stick

LS-DYNA Keyword Manual (Updated 01Jun2017)

Vol I
Vol II - Material Models
Vol III - Multi-Physics Solvers

Guest Article - Arthur B. Shapiro - Writing Code

To reach Art please send a note to agiac99@aol.com subject "Contact Art"

I spent my entire career as a code developer. I wrote engineering computer software. To be an expert in writing code, you first need an education in the discipline you are writing the software for plus training in mathematical numerical methods. You don't simply go to a 4 week "how to write computer code" class. However, you can start teaching the foundation in logical thinking on code creation to 5 year olds. For a thought exercise, write a sequence of instructions (i.e., code) on how to brush your teeth and give it to someone else to execute. An adult will start the code off by the statement "put toothpaste on the toothbrush". This will lead to a computational fault unless you started execution while being in the bathroom with the toothbrush and toothpaste clearly visible. A young child will say, "go to the bathroom" as the first execution statement.

I have spent the last several months evaluating training apps and materials. I experimented with Rheannon (turning 6 in August) to see what worked. I found nothing perfect. I wish I could merge some of the apps together to create the perfect learning environment. Here is my "best" list to start teaching code at the 5-6 year old level in the order they should be presented. This can of course be used for older children. They will just advance through each stage more quickly, or just jump to Swift Playgrounds and Lego Mindstorms.

(1) **Osmo Coding Kit on Amazon** and for iPad which is available through the Apple store. The best part is you write code by assembling tiles in front of the Ipad. The child has tactile feedback. Instead of building a Lego structure, the child uses tiles to build code to manipulate an environment. Each tile has an icon (e.g., move, jump, turn) so you don't need reading skills. The iPad camera sees the tiles and moves a figure on the iPad screen to reach an objective after you press the "start" tile. There are tiles for "loop" and "if-then-else" constructs.

(2) Lightbot Jr for iPad. The Osmo tiles are replaced by icons on the iPad screen. You drag and drop icons to assemble them into a code that moves a robot to an objective. No reading skills are needed. A shortcoming is that there are not enough practice exercises. My main reason for liking this app is that it is a stepping stone from the real world of Osmo physical tiles to the virtual world of writing code only on a computer.

(3) Rocket Cupcake. This is similar to Lightbot but has many exercises. The icons are dragged and dropped into a code window. The color of each icon changes as the code is executed in sequence. A red color indicates a bug and the code must be changed. A shortcoming is that there are too many popup windows requiring reading skills to navigate through them in order to get back to the programming environment. This is frustrating to a pre-reading child who will need help but should present no problem for older children.

(4) Tynker for iPad. Reading skills are now necessary. The icons have been replaced by words. Instead of an icon showing a figure jumping up, we now have a tile with the word "jump". The tiles are dragged and dropped into a code window. Again, we are moving a figure to reach an objective. A nice feature is that you can display the Swift code next to the assembled tiles. Swift is a real programming language.

(5) Swift Playgrounds for iPad. This is an Apple training app that uses the real programming language Swift. Swift is used to write real world application software. You write increasingly more complex Swift code as you progress through the training material: (1) learn to code 1: fundamentals of swift, (2) learn to code 2: beyond the basics, (3) learn to code 3, explore the universe.

We moved from the real world using the Osmo tactile tiles to write code that manipulates a figure in the virtual world of a computer screen, then wrote code in the virtual world of the computer (Lightbot, Rocket Cupcake, Tynker, Swift) to move a figure in virtual space, and now we should move back to the real world (i.e., write code on the computer to manipulate an object in the real world. Swift Playgrounds recently expanded its software to allow coding of Bluetooth-enabled robots. This includes Lego WeDo 2.0 which is appropriate for younger children (with parental help), Lego Mindstorms EV3, Sphero SPRK+, and Parrot drones.

AUTOMOTIVE NEWS & EVENTS

Editor: Dilip Bhalsod

The purpose of this section is to provide a place, for our automotive readers, to share news and events relative to their company and/or products.

The criteria for submitting information is as follows:

- It has to be public information
- Published on the Internet
- Be automotive informational, or human interest.
- We do not accept financial quarterly information

We would welcome the opportunity to share information about your company with our readership.

You may send Title to your information and the accompanying URL to agiac99@aol.com - Subject Line please use " Automotive News"

Submissions should be received by the 15th of each month, of the month you want your article placed

Submission publications is at the sole discretion of FEA Information Inc.

Chevrolet Bolt EV autonomous test vehicles

Chevrolet Bolt EV autonomous test vehicles are assembled at General Motors Orion Assembly in Orion Township, Michigan. (Photo by Jeffrey Sauger for General Motors)GM Produces First Round of Self-Driving Chevrolet Bolt EV Test Vehicles

First Company to Use Mass-Production Methods for Autonomous Vehicles Test Bolt EVs Feature Company's Latest Generation of AV Technology GM's Self-Driving Test Fleet Will Grow to 180

DETROIT — General Motors today announced that it completed production of 130 Chevrolet Bolt EV test vehicles equipped with its next generation of self-driving technology at its Orion Assembly Plant located in Orion Township, Michigan. The vehicles will join the more than 50 current-generation self-driving Bolt EVs already deployed in testing fleets in San Francisco; Scottsdale, Arizona; and metro Detroit.

"This production milestone brings us one step closer to making our vision of personal mobility a reality," said GM Chairman and CEO Mary Barra. "Expansion of our real-world test fleet will help ensure that our self-driving vehicles meet the same strict standards for safety and quality that we build into all of our vehicles."

GM became the first company to assemble self-driving test vehicles in a mass-production facility when its next generation of self-driving Chevrolet Bolt EV test vehicles began rolling off of the line at Orion Township in January.

The self-driving Chevrolet Bolt EVs feature GM's latest array of equipment, including LIDAR, cameras, sensors and other hardware designed to accelerate development of a safe and reliable fully autonomous vehicle.

"To achieve what we want from self-driving cars, we must deploy them at scale," said Cruise Automation CEO Kyle Vogt. "By developing the next-generation self-driving platform in San Francisco and manufacturing these cars in Michigan, we are creating the safest and most consistent conditions to bring our cars to the most challenging urban roads that we can find."

GM and Cruise Automation engineers have been testing Chevrolet Bolt EVs equipped with self-driving technology on public roads in San Francisco and Scottsdale, Arizona, since June 2016 and on public roads in Warren, Michigan, since January 2017.

General Motors Co. (NYSE: GM, TSX: GMM) and its partners produce vehicles in 30 countries, and the company has leadership positions in the world's largest and fastest-growing automotive markets. GM, its subsidiaries and joint venture entities sell vehicles under the Chevrolet, Cadillac, Baojun, Buick, GMC, Holden, Jiefang, Opel, Vauxhall and Wuling brands. More information on the company and its subsidiaries, including OnStar, a global leader in vehicle safety, security and information services, can be found at http://www.gm.com.

Kevin Kelly - kevin.m.kelly@gm.com
Patrick Sullivan - patrick.1.sullivan@gm.com

AEROSPACE NEWS & EVENTS

Editor: Marnie Azadian

The purpose of this section is to provide a place, for our aerospace readers, to share news and events relative to their company and/or products.

The criteria for submitting information is as follows:

- It has to be public information
- An internet URL
- Be technical, informational, or human interest.
- We do not accept financial quarterly information

We would welcome the opportunity to share information about your company with our readership.

You may send Title to your information and the accompanying URL to agiac99@aol.com - Subject Line please use "Aerospace News"

Submissions should be received by the 15th of each month, of the month you want your article placed. For example: We would need the title of the news or event by December 15th, 2015 to be featured in the December 2015 FEA newsletter.

Submission publications is at the sole discretion of FEA Information Inc.

New NASA Experiments, Research Headed to International Space Station

The SpaceX Dragon cargo craft lifted off from Launch Complex 39A at NASA's Kennedy Space Center in Florida at 5:07 p.m. June 3

About 6,000 pounds of research equipment, cargo and supplies are packed into the cargo craft that is now in Earth orbit and headed to the International Space Station. Credits: NASA TV

Major experiments that will look into the human body and out into the galaxy are on their way to the International Space Station aboard a SpaceX Dragon spacecraft following its 5:07 p.m. EDT launch aboard a Falcon 9 rocket.

The Dragon lifted off from Launch Complex 39A at NASA's Kennedy Space Center in Florida. About 6,000 pounds of research equipment, cargo and supplies are packed into the cargo craft that is now in Earth orbit and headed to the station.

NASA Television and the agency's website will provide live coverage of the rendezvous and capture beginning at 8:30 a.m. Monday, June 5. NASA astronauts Jack Fischer and Peggy Whitson will use the space station's robotic arm to capture SpaceX's Dragon when it arrives at the station.

Research materials flying inside the Dragon's pressurized area include an experiment studying fruit flies to better understand the effects on the heart of prolonged exposure to microgravity. Because they're small, age rapidly, and have a well-known genetic make-up, they are good models for heart function studies. This experiment could significantly advance understanding of how spaceflight affects the cardiovascular system and could aid in the development of countermeasures to help astronauts.

The Systemic Therapy of NELL-1 for osteoporosis investigation tests a new drug that can rebuild bone and block further bone loss, improving crew health. When people and animals spend extended periods of time in space, they experience bone density loss, or osteoporosis. In-flight countermeasures, such as exercise, prevent it from getting worse, but there isn't a therapy on Earth or in space that can restore bone. The results from this ISS National Laboratory-sponsored investigation build on previous research also supported by the National Institutes for Health and could lead to new drugs for treating bone density loss in millions of people on Earth.

Three payloads inside Dragon's unpressurized area will demonstrate new solar panel technologies, study the physics of neutron stars, and host an array of Earth-viewing instruments.

New NASA Experiments, Research Headed to International Space Station

This mission is SpaceX's eleventh cargo flight to the station under NASA's Commercial Resupply Services contract. Dragon's cargo will support dozens of the more than 250 science and research investigations during the station's Expeditions 52 and 53.

The Dragon spacecraft is scheduled to depart the space station in early July, returning with more than 3,400 pounds of science, hardware and crew supplies.

For more than 16 years, humans have lived and worked continuously aboard the International Space Station, advancing scientific knowledge and demonstrating new technologies, making research breakthroughs not possible on Earth that will enable long-duration human and robotic exploration into deep space. A global endeavor, more than 200 people from 18 countries have visited the unique microgravity laboratory that has hosted more than 1,900 research investigations from researchers in more than 95 countries.

First Flight Success for Gripen E

Defence and security company Saab today completed a successful first flight of the next generation smart fighter, Gripen E.

At 10:32 on Thursday June 15, Gripen E took off on its maiden flight, flown by a Saab test pilot. The aircraft (designation 39-8) left from Saab's airfield in Linköping, Sweden and flew over the eastern parts of Östergötland for 40 minutes. During the flight, the aircraft carried out a number of actions to demonstrate various test criteria including the retracting and extending of the landing gear.

"The flight was just as expected, with the aircraft performance matching the experience in our simulations. Its acceleration performance is impressive with smooth handling. Needless to say, I'm very happy to have piloted this maiden flight," says Marcus Wandt, Experimental Test Pilot, Saab.

"Today we have flown this world class fighter aircraft for the first time. We achieved it with the fully qualified software for the revolutionary avionics system. This is about giving our customers a smart fighter system with the future designed in from the start. The flight test activities will continue to build on this achievement with the programme on track to achieve the 2019 delivery schedule to our Swedish and Brazilian customers," says Jonas Hjelm, Senior Vice President and Head of Saab Business Area Aeronautics.

Saab serves the global market with world-leading products, services and solutions ranging from military defence to civil security. Saab has operations and employees on all continents and constantly develops, adopts and improves new technology to meet customers' changing needs.

BETA CAE Systems. www.beta-cae.com

BETA CAE Systems - ANSA

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 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

Solutions for:

Process Automation - Data Management – Meshing – Durability - Crash & Safety NVH - CFD - Thermal analysis - Optimization - Powertrain
Products made of composite materials - Analysis Tools -
Maritime and Offshore Design - Aerospace engineering - Biomechanics

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 compary 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.

ETA – Engineering Technology Associates **www.eta.com**

etainfo@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

Latest Release is ESI Visual-Environment 12.0

ESI Group **www.esi-group.com**

Visual-Environment is an integrative simulation platform for simulation tools operating either concurrently or standalone for various solver. Comprehensive and integrated solutions for meshing, pre/post processing, process automation and simulation data management are available within same environment enabling seamless execution and automation of tedious workflows. This very open and versatile environment simplifies the work of CAE engineers across the enterprise by facilitating collaboration and data sharing leading to increase of productivity.

Visual-Crash DYNA provides advanced preprocessing functionality for LS-DYNA users, e.g. fast iteration and rapid model revision processes, from data input to visualization for crashworthiness simulation and design. It ensures quick model browsing, advanced mesh editing capabilities and rapid graphical assembly of system models. Visual-Crash DYNA allows graphical creation, modification and deletion of LS-DYNA entities. It comprises tools for checking model quality and simulation parameters prior to launching calculations with the solver. These tools help in correcting errors and fine-tuning the model and simulation before submitting it to the solver, thus saving time and resources.
Several high productivity tools such as advanced dummy positioning, seat morphing, belt fitting and airbag folder are provided in **Visual-Safe,** a dedicated application to safety utilities.

Visual-Mesh is a complete meshing tool supporting CAD import, 1D/2D/3D meshing and editing for linear and quadratic meshes. It supports all meshing capabilities, like shell and solid automesh, batch meshing, topo mesh, layer mesh, etc. A convenient Meshing Process guides you to mesh the given CAD component or full vehicle automatically.

Visual-Viewer built on a multi-page/multi-plot environment, enables data grouping into pages and plots. The application allows creation of any number of pages with up to 16 windows on a single page. These windows can be plot, animation, video, model or drawing block windows. Visual-Viewer performs automated tasks and generates customized reports and thereby increasing engineers' productivity.

Latest Release is ESI Visual-Environment 12.0

ESI Group **www.esi-group.com**

Visual-Process provides a whole suite of generic templates based on LS-DYNA solver (et altera). It enables seamless and interactive process automation through customizable LS-DYNA based templates for automated CAE workflows.

All generic process templates are easily accessible within the unique framework of Visual-Environment and can be customized upon request and based on customer's needs.

Visual*DSS* is a framework for Simulation Data and Process Management which connects with Visual-Environment and supports product engineering teams, irrespective of their geographic location, to make correct and realistic decisions throughout the virtual prototyping phase. Visual*DSS* supports seamless connection with various CAD/PLM systems to extract the data required for building virtual tests as well as building and chaining several virtual tests upstream and downstream to achieve an integrated process. It enables the capture, storage and reuse of enterprise knowledge and best practices, as well as the automation of repetitive and cumbersome tasks in a virtual prototyping process, the propagation of engineering changes or design changes from one domain to another.

JSOL Corporation **www.jsol.co.jp/english/cae/**

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

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.

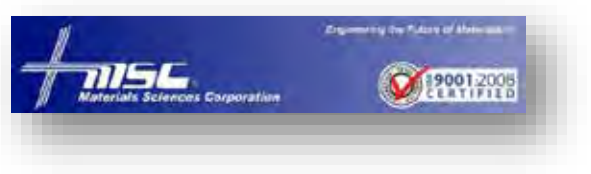
LS-OPT: LS-OPT is a standalone Design Optimization and Probabilistic Analysis package with an interface to LS-DYNA. The graphical preprocessor LS-OPTui facilitates definition of the design input and the creation of a command file while the postprocessor provides output such as approximation accuracy, optimization convergence, tradeoff curves, anthill plots and the relative importance of design variables.

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.



Material Sciences Corporation **info@materials-sciences.com**

Materials Sciences Corporation has provided engineering services to the composites industry since 1970. During this time, we have participated in numerous programs that demonstrate our ability to: perform advanced composite design, analysis and testing; provide overall program management; work in a team environment; and transition new product development to the military and commercial sectors. MSC's corporate mission has expanded beyond basic research and development now to include transitioning its proprietary technologies from the research lab into innovative new products. This commitment is demonstrated through increased staffing and a more than 3-fold expansion of facilities to allow in-house manufacturing and testing of advanced composite materials and structures

Materials Sciences Corporation (MSC) MAT161/162 - enhanced features have been added to the Dynamic Composite Simulator module of LS-DYNA.

This enhancement to LS-DYNA, known as MAT161/162, enables the most effective and accurate dynamic progressive failure modeling of composite structures to enable the most effective and accurate dynamic progressive failure modeling of composite structures currently available.

MSC/LS-DYNA Composite Software and Database -

Fact Sheet: http://www.materials-sciences.com/dyna-factsheet.pdf

- MSC and LSTC have joined forces in developing this powerful composite dynamic analysis code.
- For the first time, users will have the enhanced ability to simulate explicit dynamic engineering problems for composite structures.
- The integration of this module, known as 'MAT 161', into LS-DYNA allows users to account for progressive damage of various fiber, matrix and interply delamination failure modes.
- Implementing this code will result in the ability to optimize the design of composite structures, with significantly improved survivability under various blast and ballistic threats.

MSC's LS-DYNA module can be used to characterize a variety of composite structures in numerous applications—such as this composite hull under blast

Oasys Ltd. LS-DYNA Environment **www.oasys-software.com/dyna**

The Oasys Suite of software is exclusively written for LS-DYNA® and is used worldwide by many of the largest LS-DYNA® customers. The suite comprises of:

Oasys PRIMER

Key benefits:

- Pre-Processor created specifically for LS-DYNA®
- Compatible with the latest version of LS-DYNA®
- Maintains the integrity of data
- Over 6000 checks and warnings – many auto-fixable
- Specialist tools for occupant positioning, seatbelt fitting and seat squashing (including setting up pre-simulations)
- Many features for model modification, such as part replace
- Ability to position and depenetrate impactors at multiple locations and produce many input decks automatically (e.g. pedestrian impact, interior head impact)
- Contact penetration checking and fixing
- Connection feature for creation and management of connection entities.
- Support for Volume III keywords and large format/long labels
- Powerful scripting capabilities allowing the user to create custom features and processes

www.oasys-software.com/dyna

Oasys D3PLOT

Key benefits:

- Powerful 3D visualization post-processor created specifically for LS-DYNA®
- Fast, high quality graphics
- Easy, in-depth access to LS-DYNA® results
- Scripting capabilities allowing the user to speed up post-processing, as well as creating user defined data components

Oasys T/HIS

Key benefits:

- Graphical post-processor created specifically for LS-DYNA®
- Automatically reads all LS-DYNA® results
- Wide range of functions and injury criteria
- Easy handling of data from multiple models
- Scripting capabilities for fast post-processing

Oasys REPORTER

Key benefits:

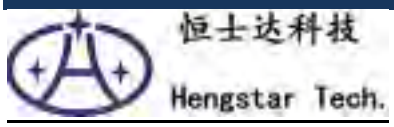
- Automatic report generation tool created specifically for LS-DYNA®
- Automatically post-process and summarize multiple analyses
- Built-in report templates for easy automatic post-processing of many standard impact tests

Predictive Engineering provides finite element analysis consulting services, software, training and support to a broad range of engineering companies across North America. We strive to exceed client expectations for accuracy, timeliness and knowledge transfer. Our process is both cost-effective and collaborative, ensuring all clients are reference clients.

Our mission is to be honest brokers of information in our consulting services and the software we represent.

Our History

Since 1995, Predictive Engineering has continually expanded its client base. Our clients include many large organizations and industry leaders such as SpaceX, Nike, General Electric, Navistar, FLIR Systems, Sierra Nevada Corp, Georgia-Pacific, Intel, Messier-Dowty and more. Over the years, Predictive Engineering has successfully completed more than 800 projects, and has set itself apart on its strong FEA, CFD and LS-DYNA consulting services.



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 in China, Hengstar Technology will continue to organize high level training courses, seminars, workshops, forums etc., and will also continue to support CAE events such as: China CAE Annual Conference; China Conference of Automotive Safety Technology; International Forum of Automotive Traffic Safety in China; LS-DYNA China users conference etc.

On Site Training: Hengstar Technology also provides customer customized training programs on-site at the company facility. Training is tailored for customer needs using LS-DYNA such as material test and input keyword preparing; CAE process automation with customized script program; Simulation result correlation with the test result; Special topics with new LS-DYNA features etc..

Distribution & Support: Hengstar distributes and supports LS-DYNA, LS-OPT, LS-Prepost, LS-TaSC, LSTC FEA Models; Hongsheng Lu, previously was directly employed by LSTC before opening his distributorship in China for LSTC software. Hongsheng visits LSTC often to keep update on the latest software features.

Hengstar also distributes and supports d3View; Genesis, Visual DOC, ELSDYNA; Visual-Crash Dyna, Visual-Process, Visual-Environment; EnkiBonnet; and DynaX & MadyX etc.

Consulting

As a consulting company, Hengstar focuses on LS-DYNA applications such as crash and safety, durability, bird strike, stamping, forging, concrete structures, drop analysis, blast response, penetration etc with using LS-DYNA's advanced methods: FEA, ALE, SPH, EFG, DEM, ICFD, EM, CSEC..

Lenovo www.lenovo.com

Lenovo is a USD39 billion personal and enterprise technology company, serving customers in more than 160 countries.

Dedicated to building exceptionally engineered PCs, mobile Internet devices and servers spanning entry through supercomputers, Lenovo has built its business on product innovation, a highly efficient global supply chain and strong strategic execution. The company develops, manufactures and markets reliable, high-quality, secure and easy-to-use technology products and services.

Lenovo acquired IBM's x86 server business in 2014. With this acquisition, Lenovo added award-winning System x enterprise server portfolio along with HPC and CAE expertise.

Canada	**Metal Forming Analysis Corp MFAC** galb@mfac.com www.mfac.com			
	LS-DYNA	LS-OPT	LS-PrePost	LS-TaSC
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	eta/DYNAFORM	INVENTIUM/PreSys		
Mexico	**COMPLX** Armando Toledo **www.complx.com.mx** / armando.toledo@complx.com.mx			
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United States	**CAE Associates Inc.** info@caeai.com www.caeai.com			
	ANSYS Products	CivilFem	Consulting ANSYS Consulting LS-DYNA	
United States	**DYNAMAX** sales@dynamax-inc.com www.dynamax-inc.com			
	LS-DYNA	LS-OPT	LS-PrePost	LS-TaSC
	LSTC Dummy Models		LSTC Barrier Models	

United States	**ESI Group N.A** info@esi-group.com www.esi-group.com			
	PAM-STAMP			
	QuikCAST	SYSWELD	PAM-COMPOSITES	CEM One
	VA One	CFD-ACE+	ProCAST	
		Weld Planner	Visual-Environment	IC.IDO

United States	**Engineering Technology Associates – ETA** etainfo@eta.com www.eta.com			
	INVENTIUM/PreSy	NISA	VPG	LS-DYNA
	LS-OPT	DYNAform		

United States	**Livermore Software Technology Corp** sales@lstc.com **LSTC** www.lstc.com			
	LS-DYNA	LS-OPT	LS-PrePost	LS-TaSC
	LSTC Dummy Models	LSTC Barrier Models	TOYOTA THUMS	

United States	**Predictive Engineering** george.laird@predictiveengineering.com www.predictiveengineering.com			
	FEMAP	NX Nastran	LS-DYNA	LS-OPT
	LS-PrePost	LS-TaSC	LSTC Dummy Models	
			LSTC Barrier Models	

France	**DynaS+**		v.lapoujade@dynasplus.com	
	www.dynasplus.com		Oasys Suite	
	LS-DYNA	LS-OPT	LS-PrePost	LS-TaSC
	DYNAFORM	VPG	MEDINA	
	LSTC Dummy Models		LSTC Barrier Models	

France	**DYNAmore France SAS**		sales@dynamore.eu	
	www.dynamore.eu			
	LS-DYNA, LS-PrePost	LS-OPT	Primer	DYNAFORM
	DSDM Products		LSTC Dummy Models	FEMZIP
	LSTC Barrier Models		DIGIMAT	

Germany	**CADFEM GmbH**		lsdyna@cadfem.de	
	www.cadfem.de			
	ANSYS	LS-DYNA	optiSLang	
	ESAComp	AnyBody		
	ANSYS/LS-DYNA			

Germany	**DYNAmore GmbH**		uli.franz@dynamore.de	
	www.dynamore.de			
	PRIMER	LS-DYNA	FTSS	VisualDoc
	LS-OPT	LS-PrePost	LS-TaSC	DYNAFORM
	Primer	FEMZIP	GENESIS	Oasys Suite
	TOYOTA THUMS		LSTC Dummy & Barrier Models	

The Netherlands	**Infinite Simulation Systems B.V**		j.mathijssen@infinite.nl	
	www.infinite.nl			
	ANSYS Products	CivilFem	CFX	Fluent
	LS-DYNA	LS-PrePost	LS-OPT	LS-TaSC

Russia	**STRELA**		info@dynarussia.com	
	LS-DYNA	LS-TaSC	LS-OPT	LS-PrePost
	LSTC Dummy Models		LSTC Barrier Models	

Spain	**DYNAmore France SAS**		sales@dynamore.eu		
	www.dynamore.eu				
	LS-DYNA, LS-OPT	LS-PrePost	Primer	DYNAFORM	
	DSDM Products		LSTC Dummy Models	FEMZIP	
	LSTC Barrier Models		DIGIMAT		
Sweden	**DYNAmore Nordic**		marcus.redhe@dynamore.se		
	www.dynamore.se		Oasys Suite		
	ANSA	µETA	LS-DYNA	LS-OPT	
	LS-PrePost	LS-TaSC	FastFORM	DYNAform	
	FormingSuite		LSTC Dummy Models		
			LSTC Barrier Models		
Switzerland	**DYNAmoreSwiss GmbH**		info@dynamore.ch		
	www.dynamore.ch				
	LS-DYNA		LS-OPT	LS-PrePost	
	LS-TaSC		LSTC Dummy Models &	Barrier Models	
UK	**Ove Arup & Partners**	dyna.sales@arup.com			
	www.oasys-software.com/dyna		TOYOTA THUMS		
	LS-DYNA		LS-OPT	LS-PrePost	
	LS-TaSC		PRIMER	D3PLOT	T/HIS
	REPORTER	SHELL	FEMZIP	HYCRASH	
	DIGIMAT	Simpleware	LSTC Dummy Models		
			LSTC Barrier Models		

China	**ETA – China**		lma@eta.com.cn	
	www.eta.com/cn			
	Inventium	VPG	DYNAFORM	NISA
	LS-DYNA	LS-OPT	LSTC Dummy Models	LS-PrePost
			LSTC Barrier Models	LS-TaSC
China	**Oasys Ltd. China**		de-long.ge@arup.com	
	www.oasys-software.com/dyna			
	PRIMER D3PLOT	HYCRASH	T/HIS REPORTER	SHELL
	LS-DYNA	LS-OPT	LSTC Dummy Models	LS-PrePost
	DIGIMAT	FEMZIP	LSTC Barrier Models	LS-TaSC
China	**Shanghai Hengstar Technology**		info@hengstar.com	
	www.hengstar.com			
	LS-DYNA	LS-TaSC	LSTC Barrier Models	D3VIEW
	LS-PrePOST	LS-OPT	LSTC Dummy Models	
	Genesis	VisualDoc		ELSDYNA
	Visual-Crahs DYNA	Visual-Proeces		DynaX & MadyX
	Enki Bonnet	Visual Environement		

India	**Oasys Ltd. India**		lavendra.singh@arup.com	
	www.oasys-software.com/dyna			
	PRIMER	D3PLOT	T/HIS	
			LS-OPT	LSTC Dummy Models	LS-PrePost
			LS-DYNA	LSTC Barrier Models	LS-TaSC

India	**CADFEM Eng. Svce**		info@cadfem.in	
	www.cadfem.in			
	ANSYS	VPS	ESAComp	optiSLang
	LS-DYNA	LS-OPT	LS-PrePost	

India	**Kaizenat Technologies Pvt. Ltd**		support@kaizenat.com	
	http://kaizenat.com /			
	LS-DYNA	LS-OPT	LSTC Dummy Models	LS-PrePost
	Complete LS-DYNA suite of products		LSTC Barrier Models	LS-TaSC

Japan	**CTC**	LS-dyna@ctc-g.co.jp		
	www.engineering-eye.com			
	LS-DYNA	LS-OPT	LS-PrePost	LS-TaSC
	LSTC Dummy Models	LSTC Barrier Models	CmWAVE	
Japan	**JSOL**			
	www.jsol.co.jp/english/cae		Oasys Suite	
	JSTAMP	HYCRASH	JMAG	
	LS-DYNA	LS-OPT	LS-PrePost	LS-TaSC
	LSTC Dummy Models	LSTC Barrier Models	TOYOTA THUMS	
Japan	**FUJITSU**			
	http://www.fujitsu.com/jp/solutions/business-technology/tc/sol/			
	LS-DYNA	LS-OPT	LS-PrePost	LS-TaSC
	LSTC Dummy Models	LSTC Barrier Models	CLOUD Services	
Japan	**LANCEMORE**	info@lancemore.jp		
	www.lancemore.jp/index_en.html			
	Consulting			
	LS-DYNA	LS-OPT	LS-PrePost	LS-TaSC
	LSTC Dummy Models	LSTC Barrier Models		
Japan	**Terrabyte**	**English:**		
	www.terrabyte.co.jp	www.terrabyte.co.jp/english/index.htm		
	Consulting			
	LS-DYNA	LS-OPT	LS-PrePost	LS-TaSC
	LSTC Dummy Models	LSTC Barrier Models	AnyBody	

Korea	**THEME**	wschung7@gmail.com		
	www.lsdyna.co.kr		Oasys Suite	
	LS-DYNA	LS-OPT	LS-PrePost	LS-TaSC
	LSTC Dummy Models	LSTC Barrier Models	eta/VPG	Planets
	eta/DYNAFORM	FormingSuite	Simblow	TrueGRID
	JSTAMP/NV	Scan IP	Scan FE	Scan CAD
	FEMZIP			

Korea	**KOSTECH**	young@kostech.co.kr		
	www.kostech.co.kr			
	LS-DYNA	LS-OPT	LS-PrePost	LS-TaSC
	LSTC Dummy Models	LSTC Barrier Models	eta/VPG	FCM
	eta/DYNAFORM	DIGIMAT	Simuform	Simpack
	AxStream	TrueGrid	FEMZIP	

Taiwan **AgileSim Technology Corp.**

www.agilesim.com.tw

LS-DYNA	LS-OPT	LS-PrePost	LS-TaSC
LSTC Dummy Models	LSTC Barrier Models	eta/VPG	FCM

Taiwan **Flotrend**

www.flotrend.com.tw

LS-DYNA	LS-OPT	LS-PrePost	LS-TaSC
LSTC Dummy Models	LSTC Barrier Models	eta/VPG	FCM

Taiwan **SiMWARE Inc..**

www.simware.com.tw

LS-DYNA	LS-OPT	LS-PrePost	LS-TaSC
LSTC Dummy Models	LSTC Barrier Models	eta/VPG	FCM

Contact: JSOL Corporation Engineering Technology Division cae-info@sci.jsol.co.jp

Cloud computing services
for
JSOL Corporation LS-DYNA users in Japan

JSOL Corporation is cooperating with chosen cloud computing services

JSOL Corporation, a Japanese LS-DYNA distributor for Japanese LS-DYNA customers.

LS-DYNA customers in industries / academia / consultancies are facing increased needs for additional LS-DYNA cores

In calculations of optimization, robustness, statistical analysis, we find that an increase in cores of LS-DYNA are needed, for short term extra projects or cores.

JSOL Corporation is cooperating with some cloud computing services for JSOL's LS-DYNA users and willing to provide short term license.

This service is offered to customers using Cloud License fee schedule, the additional fee is less epensive than purchasing yearly license.

The following services are available (only in Japanese). HPC OnLine:

NEC Solution Innovators, Ltd.
http://jpn.nec.com/manufacture/machinery/hpc_online/

Focus
Foundation for Computational Science
http://www.j-focus.or.jp

Platform Computation Cloud
CreDist.Inc.

PLEXUS CAE
Information Services International-Dentsu, Ltd. (ISID) https://portal.plexusplm.com/plexus-cae/

SCSK Corporation
http://www.scsk.jp/product/keyword/keyword07.html

Rescale Cloud Simulation Platform

www.rescale.com

Rescale: Cloud Simulation Platform

The Power of Simulation Innovation
We believe in the power of innovation. Engineering and science designs and ideas are limitless. So why should your hardware and software be limited? You shouldn't have to choose between expanding your simulations or saving time and budget.

Using the power of cloud technology combined with LS-DYNA allows you to:
· Accelerate complex simulations and fully explore the design space
· Optimize the analysis process with hourly software and hardware resources
· Leverage agile IT resources to provide flexibility and scalability

True On-Demand, Global Infrastructure
Teams are no longer in one location, country, or even continent. However, company data centers are often in one place, and everyone must connect in, regardless of office. For engineers across different regions, this can cause connection issues, wasted time, and product delays.

Rescale has strategic/technology partnerships with infrastructure and software providers to offer the following:
· Largest global hardware footprint – GPUs, Xeon Phi, InfiniBand
· Customizable configurations to meet every simulation demand
· Worldwide resource access provides industry-leading tools to every team
· Pay-per-use business model means you only pay for the resources you use
· True on-demand resources – no more queues

ScaleX Enterprise: Transform IT, Empower Engineers, Unleash Innovation
The ScaleX Enterprise simulation platform provides scalability and flexibility to companies while offering enterprise IT and management teams the opportunity to expand and empower their organizations.

ScaleX Enterprise allows enterprise companies to stay at the leading edge of computing technology while maximizing product design and accelerating the time to market by providing:

- Collaboration tools
- Administrative control
- API/Scheduler integration
- On-premise HPC integration

Industry-Leading Security

Rescale has built proprietary, industry-leading security solutions into the platform, meeting the needs of customers in the most demanding and competitive industries and markets.

- Manage engineering teams with user authentication and administrative controls
- Data is secure every step of the way with end-to-end data encryption
- Jobs run on isolated, kernel-encrypted, private clusters
- Data centers include biometric entry authentication
- Platforms routinely submit to independent external security audits

Rescale maintains key relationships to provide LS-DYNA on demand on a global scale. If you have a need to accelerate the simulation process and be an innovative leader, contact Rescale or the following partners to begin running LS-DYNA on Rescale's industry-leading cloud simulation platform.

LSTC - DYNAmore GmbH JSOL Corporation

Rescale, Inc. - 1-855-737-2253 (1-855-RESCALE) - info@rescale.com

944 Market St. #300, San Francisco, CA 94102 USA

ESI Cloud Based Virtual Engineering Solutions

www.esi-group.com

ESI Cloud offers designers and engineers cloud-based computer aided engineering (CAE) solutions across physics and engineering disciplines.

ESI Cloud combines ESI's industry tested virtual engineering solutions integrated onto ESI's Cloud Platform with browser based modeling,

With ESI Cloud users can choose from two basic usage models:

- An end-to-end SaaS model: Where modeling, multi-physics solving, results visualization and collaboration are conducted in the cloud through a web browser.
- A Hybrid model: Where modeling is done on desktop with solve, visualization and collaboration done in the cloud through a web browser.

Virtual Performance Solution:

ESI Cloud offers ESI's flagship Virtual Performance Solution (VPS) for multi-domain performance simulation as a hybrid offering on its cloud platform. With this offering, users can harness the power of Virtual Performance Solution, leading multi-domain CAE solution for virtual engineering of crash, safety, comfort, NVH (noise, vibration and harshness), acoustics, stiffness and durability.

In this hybrid model, users utilize VPS on their desktop for modeling including geometry, meshing and simulation set up. ESI Cloud is then used for high performance computing with an integrated visualization and real time collaboration offering through a web browser.

The benefits of VPS hybrid on ESI Cloud include:

- Running large concurrent simulations on demand
- On demand access to scalable and secured cloud HPC resources
- Three tiered security strategy for your data
- Visualization of large simulation data sets
- Real-time browser based visualization and collaboration
- Time and cost reduction for data transfer between cloud and desktop environments
- Support, consulting and training services with ESI's engineering teams

ESI Cloud Based Virtual Engineering Solutions

www.esi-group.com

VPS On Demand

ESI Cloud features the Virtual Performance Solution (VPS) enabling engineers to analyze and test products, components, parts or material used in different engineering domains including crash and high velocity impact, occupant safety, NVH and interior acoustics, static and dynamic load cases. The solution enables VPS users to overcome hardware limitations and to drastically reduce their simulation time by running on demand very large concurrent simulations that take advantage of the flexible nature of cloud computing.

Key solution capabilities:

- Access to various physics for multi-domain optimization
- Flexible hybrid model from desktop to cloud computing
- On demand provisioning of hardware resources
- Distributed parallel processing using MPI (Message Passing Interface) protocol
- Distributed parallel computing with 10 Gb/s high speed interconnects

Result visualization

ESI Cloud deploys both client-side and server-side rendering technologies. This enables the full interactivity needed during the simulation workflow along with the ability to handle large data generated for 3D result visualization in the browser, removing the need for time consuming data transfers. Additionally ESI Cloud visualization engine enables the comparisons of different results through a multiple window user interface design.

Key result visualization capabilities:

- CPU or GPU based client and server side rendering
- Mobility with desktop like performance through the browser
- 2D/3D VPS contour plots and animations
- Custom multi-window system for 2D plots and 3D contours
- Zooming, panning, rotating, and sectioning of multiple windows

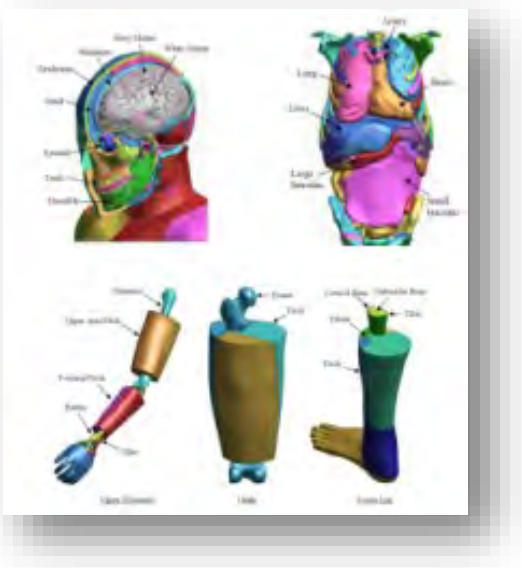
Collaboration

To enable real time multi-user and multi company collaboration, ESI Cloud offers extensive synchronous and asynchronous collaboration capabilities. Several users can view the same project, interact with the same model results, pass control from one to another. Any markups, discussions or annotations can be archived for future reference or be assigned as tasks to other members of the team.

Key collaboration capabilities:

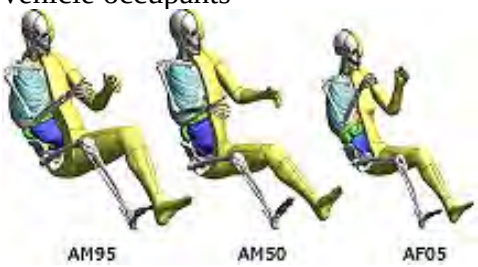
- Data, workflow or project asynchronous collaboration
- Multi-user, browser based collaboration for CAD, geometry, mesh and results models
- Real-time design review with notes, annotations and images archiving and retrieval
- Email invite to non ESI Cloud users for real time collaboration

TOYOTA - Total Human Model for Safety – THUMS

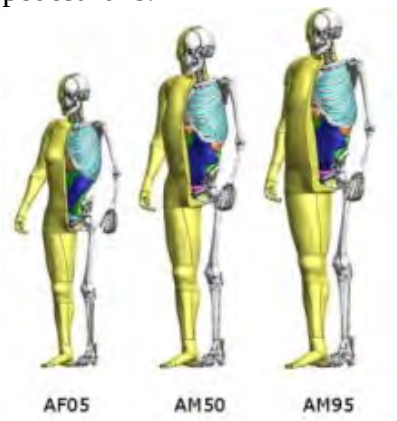


The Total Human Model for Safety, or THUMS®, is a joint development of Toyota Motor Corporation and Toyota Central R&D Labs. Unlike dummy models, which are simplified representation of humans, THUMS represents actual humans in detail, including the outer shape, but also bones, muscles, ligaments, tendons, and internal organs. Therefore, THUMS can be used in automotive crash simulations to identify safety problems and find their solutions.

Each of the different sized models is available as sitting model to represent vehicle occupants



and as standing model to represent pedestrians.



The internal organs were modeled based on high resolution CT-scans.

THUMS is limited to civilian use and may under no circumstances be used in military applications.

LSTC is the US distributor for THUMS. Commercial and academic licenses are available.

For information please contact: THUMS@lstc.com

THUMS®, is a registered trademark of Toyota Central R&D Labs.

LSTC – Dummy Models

LSTC Crash Test Dummies (ATD)

Meeting the need of their LS-DYNA users for an affordable crash test dummy (ATD), LSTC offers the LSTC developed dummies at no cost to LS-DYNA users.

LSTC continues development on the LSTC Dummy models with the help and support of their customers. Some of the models are joint developments with their partners.

e-mail to: atds@lstc.com

Models completed and available (in at least an alpha version)

- Hybrid III Rigid-FE Adults
- Hybrid III 50th percentile FAST
- Hybrid III 5th percentile detailed
- Hybrid III 50th percentile detailed
- Hybrid III 50th percentile standing
- EuroSID 2
- EuroSID 2re
- SID-IIs Revision D
- USSID
- Free Motion Headform
- Pedestrian Legform Impactors

Models In Development

- Hybrid III 95th percentile detailed
- Hybrid III 3-year-old
- Hybrid II
- WorldSID 50th percentile
- THOR NT FAST
- Ejection Mitigation Headform

Planned Models

- FAA Hybrid III
- FAST version of THOR NT
- FAST version of EuroSID 2
- FAST version of EuroSID 2re
- Pedestrian Headforms
- Q-Series Child Dummies
- FLEX-PLI

LSTC – Barrier Models

Meeting the need of their LS-DYNA users for affordable barrier models, LSTC offers the LSTC developed barrier models at no cost to LS-DYNA users.

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

- ODB modeled with shell elements
- ODB modeled with solid elements
- ODB modeled with a combination of shell and solid elements

- MDB according to FMVSS 214 modeled with shell elements
- MDB according to FMVSS 214 modeled with solid elements
- MDB according to ECE R-95 modeled with shell elements
- AE-MDB modeled with shell elements

- IIHS MDB modeled with shell elements
- IIHS MDB modeled with solid elements
- RCAR bumper barrier

- RMDB modeled with shell and solid elements

e-mail to: atds@lstc.com.

Conference – Events – Users Meetings

Keep up to date on upcoming

Conferences

Meetings

Events

if you have a new event to be listed please send to agiac99@aol.com

Conference/Events/User Forums

Oct. 23rd-25th	**3rd China LS-DYNA User's conference** Shanghai, China	http://www.lsdyna.cn
Oct 31st – Nov 1st	**LS-DYNA&JSTAMP Forum 2017** Tokyo, Japan	http://ls-dyna.jsol.co.jp/en/event/uf/

LS-DYNA & JSTAMP Forum 2017 in Tokyo, Japan

http://ls-dyna.jsol.co.jp/en/event/uf2017/

Welcome to the LS-DYNA & JSTAMP Forum 2017

JSOL Corporation holds an annual LS-DYNA & JSTAMP Forum to provide our users a wide range of information including the latest simulation technologies and case studies and also to offer the opportunity for information exchange among our users.

This year the venue of the LS-DYNA & JSTAMP Forum 2017 moves from Nagoya to Tokyo. It will be held at Tokyo Conference Center Shinagawa, from Tuesday 31 October to Wednesday 1 November 2017. Our engineers will showcase the latest simulation technologies and poster sessions will be held. We welcome any inquiry, consultation and discussion about your day-to-day work.

We encourage our users to take advantage of this once a year opportunity. We look forward to your attendance in the event.

JSOL Corporation - Engineering Technology Division

LS-DYNA&JSTAMP Forum 2017 - Organizer: JSOL Corporation

Dates: Tuesday 31 October to Wednesday 1 November 2017.

Venue: Tokyo Conference Center Shinagawa (Tokyo, Japan)

ESI Group User Forums

www.esi-group.com

ESI User Forums

26 Sep 2017 - 27 Sep 2017
ESI Forum in North America 2017
Birmingham, Michigan, United States

26 Sep 2017 - 27 Sep 2017
VPS User Conference 2017
Czech Republic

17 Oct 2017 - 19 Oct 2017
5th OpenFOAM User Conference 2017
Frankfurt/Main, Germany

7 Nov 2017 - 9 Nov 2017
ESI Forum in Germany 2017
Weimar, Germany

15 Nov 2017 - 16 Nov 2017
PUCA FORUM 2017
Hilton Hotel Tokyo, Japan

22 Nov 2017
ESI Forum in India 2017
Pune, India

2017 3rd China LS-DYNA User's conference Oct. 23rd-25th, Shanghai, China

Yanhua Zhao & China Conference Team - chinaconf@lstc.com

The 3rd China LS-DYNA conference will echo the success of the well-participated 1st and 2nd China User's Conference, in 2013 and 2015.

Accompanied by the rapid growth of CAE applications in China, LS-DYNA is highly recognized as one of the most widely used finite element analysis software by Chinese users.

China is gaining momentum and recognition in Finite Element Analysis. In the past years, the continuing expansion of application areas has been gaining more users in automotive, die and mold, aerospace and aeronautics industries in China.

In China LS-DYNA is fast becoming the software of choice, by all engineers, students, professors and consulting companies. It is recognized that LS-DYNA, LS-PrePost, LS-OPT and the LSTC ATD and Barrier Models, developed by LSTC, are setting standards for the finite element simulation industry. At the conference LSTC software new features will be introduced and helpful techniques will be shared.

The conference will be attended by experienced users from different industries, LSTC technical support engineers and software developers. Additionally, it will be attended by academic researchers, hardware vendors and software vendors.

With the popularity and attendance of the 1st and 2nd conference and demand from users it has been decided that the conference will be held regularly. One of the goals is to serve as a convenient platform for people in this field to exchange their ideas, share their findings and explore new software functions.

Hosts: Livermore Software Technology Corp. & Dalian Fukun Technology Development Corp.
Date: Oct. 23rd -25th, 2017
Location: InterContinental Shanghai Pudong, Shanghai, China
Website: http://www.lsdyna.cn
Contact: chinaconf@lstc.com

Training and Social Media Section

Aleta Hays

Training

Classes

Webinars

On Site – On Line

We will be adding to this section monthly – if you have a new event to be listed please send to Aleta ayh225@aol.com and cc Anthony agiac99@aol.com

Participant's Training Classes

Webinars

Info Days

Class Directory

Participant Class Directory

Arup **(corporate)**	www.oasys-software.com/dyna/en/training
BETA CAE Systems **(corporate)**	www.beta-cae.com/training.htm
DYNAmore **(corporate)**	www.dynamore.de/en/training/seminars
ESI-Group **(corporate)**	https://myesi.esi-group.com/trainings/schedules
ETA **(corporate)**	www.eta.com/support2/training-calendar
KOSTECH	www.kostech.co.kr/
LSTC - (corporate)	www.lstc.com/training
LS-DYNA OnLine - (Al Tabiei)	www.LSDYNA-ONLINE.COM

ARUP Visit the website for complete listings/changes/locations

www.oasys-software.com/dyna/en/training

Arup offers a wide range of training for new and existing users of the Oasys LS-DYNA Environment software who are seeking to improve their understanding and application of these powerful analysis tools. New users will benefit from our introductory courses and can quickly become effective in other areas of application through the range of courses on offer. The courses will also provide existing users with knowledge of how to use the latest features in Oasys and LS-DYNA.

BETA CAE SYSTEMS Visit the website for complete listings/changes/locations

www.beta-cae.com/training.htm

Basic and advanced training courses can be scheduled upon request. A variety of standard or tailored training schedules, per product or per discipline, are being offered to meet customers needs.

A number of recommended training courses offered are described below. The list is not exhaustive and more courses can be designed according to your needs.
Please, contact ansa@beta-cae.com for further details.

Recommended Training Courses (Complete information on website)

- SPDRM
- ANSA / μETA Basics
- ANSA / μETA for CFD
- ANSA / μETA for Crash & Safety simulation
- ANSA / μETA for Durability simulation
- ANSA / μETA for NVH analyses
- Multi-Body Dynamics
- Laminated Composites
- Morphing and Optimization
- Automation
- Additional special sessions

Author: Christian Frech christian.frech@dynamore.de

DYNAmore Visit the website for complete overview and registration

www.dynamore.de/seminars

Seminar dates offered by DYNAmore – July 2017

Download full seminar brochure (pdf): www.dynamore.de/seminars2017

Selection of trainings from July

Introduction	
Introduction to LS-DYNA	11-13 July
Basics/Theory	
Element Types and Nonlinear Aspects	14 July
Metal Forming/Process Simulation	
Applied Forming Simulation with eta/DYNAFORM	3-4 July
Introduction to Sheet Metal Forming with OpenForm	5 July
Hot Forming with LS-DYNA	6-7 July
Optimization	
Structural Optimization with GENESIS	18-19 July

Information days (free of charge)

Verification and Validation	17 July
LS-DYNA for Civil Engineering Applications	20 July

Support/Webinar series (free of charge) – Registration via www.dynamore.de

Support day: Occupant Safety	21 July

If not otherwise stated, the event location is Stuttgart, Germany. Other event locations are:
G = Gothenburg, Sweden; L = Linköping, Sweden V = Versailles, France; T = Turin, Italy, Sb = Salzburg, Austria

We hope that our offer will meet your needs and are looking forward to welcoming you at one of the events.

Among the many classes held during the year are the following:

September

11-12	LS-DYNA ALE/Euler
18-19	Intro LS-OPT – Funcunality & Standard
20	LS-DYNA Discrete Element Method
25-17	Intro to LS-DYNA Explicit

October

09	Intro to LS-DYNA Implicit
10	LS-DYNA Implicit - Advanced
16-17	LS-DYNA CFD Incompressible - ICFD
18	LS-DYNA CFD Compressible - CESE
19-20	LS-DYNA Electromagnetism - EM

https://myesi.esi-group.com/trainings/schedules

Basic OpenFOAM training for application engineers
13 Jul 2017 to 14 Jul 2017

Basic PAM-STAMP
19 Jul 2017 to 20 Jul 2017

Basic OpenFOAM training for application engineers
10 Aug 2017 to 11 Aug 2017

PAM-DIEMAKER for CATIA V5
16 Aug 2017 to 18 Aug 2017

Basic PAM-STAMP
16 Aug 2017 to 17 Aug 2017

Introduction to ProCAST
22 Aug 2017 to 24 Aug 2017

VPS Explicit - PAM-CRASH I - Grundlagen (Basics)
5 Sep 2017 to 7 Sep 2017

Please visit the website for complete information on all the classes and locations

https://myesi.esi-group.com/trainings/schedules

KOrea Simulation TECHnology Co., Ltd. Training

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August

***Concrete and Geomaterial Modelling in LS-DYNA**

Date: August 17~18

Lecturer: Dr. Len Schwer(We invited him as a guest speaker)

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Date	Location	Class	Instructor(s)
June			
1-2	CA	User Materials in LS-DYNA (UMAT)	A. Tabiei
1-2	MI	Contact	S. Bala
9	MI	Material Characteristics for Metals Plastics and Polymers - Test Data to Material Model	S. Bala
15-16	MI	Introduction to Metal Forming	L. Zhang / Q Yan
19	MI	Intro to LS-PrePost	P. Ho / Q. Yan
20-23	MI	Intro to LS-DYNA	J. Reid
July			
10-11	MI	Occupant Simulation	S. Guha
24	MI	Intro to LS-PrePost	P. Ho / Q. Yan
25-29	MI	Intro to LS-DYNA	A. Tabiei

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August			
1-2	CA	Rubber, Foam & Viscoelastic Materials	A. Tabiei
3-4	CA	Plasticity, Plastics, Visco-plastic Materials	A. Tabiei
8-9	CA	Fracture, Failure, Damage	A. Tabiei
10-11	CA	Composite LS-DYNA	A. Tabiei
14-15	CA	Implicit LS-DYNA	A. Tabiei
21-23	CA	ALE/Eulerian & FSI Interaction in LS-DYNA	M. Souli
24-25	CA	Smoothed Particle Hydrodynamics (SPH)	M. Souli
28	CA	Intro to LS-PrePost	P. Ho / Q. Yan
Aug29-Sep1	CA	Intro to LS-DYNA	A. Nair
September			
12-13	MI	Airbag Modeling	A. Nair
13	CA	Material Characteristics for Metals, Plastics, and Polymers - Test Data to Material Model	S. Bala
14-15	CA	Contact	S. Bala
October			
10-13	MI	Optimization and Probalistic Analysis using LS-OPT	A. Basudhar
16	MI	Intro to LS-PrePost	P. Ho / Q. Yan
17-20	MI	Intro to LS-DYNA	A. Nair
17-18	CA	NVH and Frequency Domain Analysis	Y. Huang
November			
6	CA	Intro to LS-PrePost	P. Ho / Q. Yan
7-10	CA	Intro to LS-DYNA	A. Nair
13-14	CA	LS-DYNA Advanced	S. Bala
Nov 30-Dec 1	CA	Advanced Metal Forming	L. Zhang / X.Zhu
December			
11	MI	Intro to LS-PrePost	P. Ho / Q. Yan
12-15	MI	Intro to LS-DYNA	A. Nair

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Composite Materials In LS-DYNA

This course will allow first time LS-DYNA users to use composite materials. The most important elements to start using all the composite material models in LS-DYNA will be presented in the 8 hours.

Foam & Viscoelastic Materials in LS-DYNA

Objective of the course: Learn about several foam material models in LS-DYNA to solve engineering problems. Detailed descriptions are given of the data required to use such material in analysis. Examples are used to illustrate the points made in the lectures

Plasticity, Plastics, and Viscoplastics Materials in LS-DYNA

Objective of the course: Learn about several plasticity based material models in LS-DYNA to solve engineering problems. Detailed descriptions are given of the data required to use such material in analysis. Examples are used to illustrate the points made in the lectures.

Rubber Materials in LS-DYNA

Objective of the course: Learn about several rubber material models in LS-DYNA to solve engineering problems. Detailed descriptions are given of the data required to use such material in analysis. Examples are used to illustrate the points made in the lectures.

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LS-DYNA Resource Links

LS-DYNA Multiphysics YouTube Facundo Del Pin

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Software lets engineers run crash tests inside computers rather than on roads. It also allows them to compare the performance of different designs early in the process while cars are still on the drawing board, saving money and injuries.

www.computerhistory.org/makesoftware/exhibit/

Dag Spicer - Senior Curator

Dag Spicer is CHM's "Chief Content Officer", and is responsible for creating the intellectual frameworks and interpretive schema of the Museum's various programs and exhibitions

LSTC Recent Developments, Features, Updates, News, Presentations

Editor: Yanhua Zhao

Improvement of Sandwich Structure Part Adaptivity in LS-DYNA
Xinhai Zhu, Houfu Fan, Li Zhang and Yuzhong Xiao - LSTC

New Inflator Models in LS-DYNA®
Kyoung-Su Im, Zeng-Chan Zhang, and Grant O. Cook, Jr. - LSTC

Previously Presented: **For a copy write to yanhua@feainformation.com**

May

Improvement of Mesh Fusion in LS-DYNA
Houfu Fan, Xinhai Zhu, Li Zhang and Yuzhong Xiao - LSTC
Representative Volume Element (RVE) analysis using LS-DYNA
C.T. Wu, W. Hu LSTC

April

New features of 3D adaptivity in LS-DYNA -
W. Hu LSTC
New Feature: Defining Hardening Curve in LS-DYNA® -
X. Zhu, L. Zhang, Y. Xiao

March

Improvements toOne-Step Simulation in LS-DYNA
Xinhai Zhu, Houfu Fan, Li Zhang,

February

LS-DYNA Smooth Particle Galerkin (SPG) Method
C.T. Wu, Y. Guo, W. Hu - LSTC

January

Lancing features in LS-DYNA
Quanqing Yan, Li Zhang, Yuzhong Xiao, Xinhai Zhu, Philip Ho - LSTC

December

Thermal Coupling Method Between SPH Particles and Solid Elements
in LS-DYNA
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Introduction to second order Lagrangian elements in LS-DYNA
Hailong Teng - Livermore Software Technology Corp.

October

*An Introduction to *CONSTRAINED_BEAM_IN_SOLID*
Hao Chen - Livermore Software Technology Corp

September:

Introduction to the new framework for User Subroutine Development of LS-DYNA
Zhidong Han and Brian Wainscott

*New Features in *ELEMENT_LANCING*
Xinhai Zhu, Li Zhang, Yuzhong Xiao

August :

Equivalent Radiated Power calculation with LS-DYNA
Yun Huang, Zhe Cui - Livermore Software Technology Corporation

July:

Recent Developments for Laminates and TSHELL Forming
Xinhai Zhu, Li Zhang, Yuzhong Xiao - LSTC

Improvement of Sandwich Structure Part Adaptivity in LS-DYNA

Xinhai Zhu, Houfu Fan, Li Zhang and Yuzhong Xiao
LSTC

INTRODUCTION

Mesh adaptivity on sandwich structure part has been implemented in LS-DYNA® for a while. However, the original implementation can only handle sandwich structure part with one layer of solid element, and its usage has been very limited. In this work, the original implementation is successfully extended to multilayer solids, and this feature can be activated with a newly added parameter IFSAND in the keyword *CONTROL_ADAPTIVE.

It is demonstrated through a benchmark example that mesh adaptivity on sandwich structure part works very well, and it can provide more detailed fringe contour resolution, for example, at rounded punch corners, while keeping the computational cost at an acceptable level.

Adaptive Mesh Fission for Sandwich Structure Part

A sandwich structure part consists of two layers of shells each at top and bottom and a core of solid elements in between. As adaptive mesh fission for shells are quite mature in LS-DYNA, the key for the adaptivity of sandwich structure part is the mesh fission scheme for the solid, which is accomplished by making use of the corresponding adaptive mesh of the shells. For instance, if the two shells are discretized into quadrilateral elements and the solid into hexahedral ones, the solid can be adaptively refined by sweeping the corresponding top and bottom adaptive shell through the thickness direction, as shown in Figure 1. If the shells are discretized into triangular elements and the solids are discretized into wedge elements, then the shells can be adaptively refined as more triangular elements and solids refined as more wedge elements (not shown in the Figure).

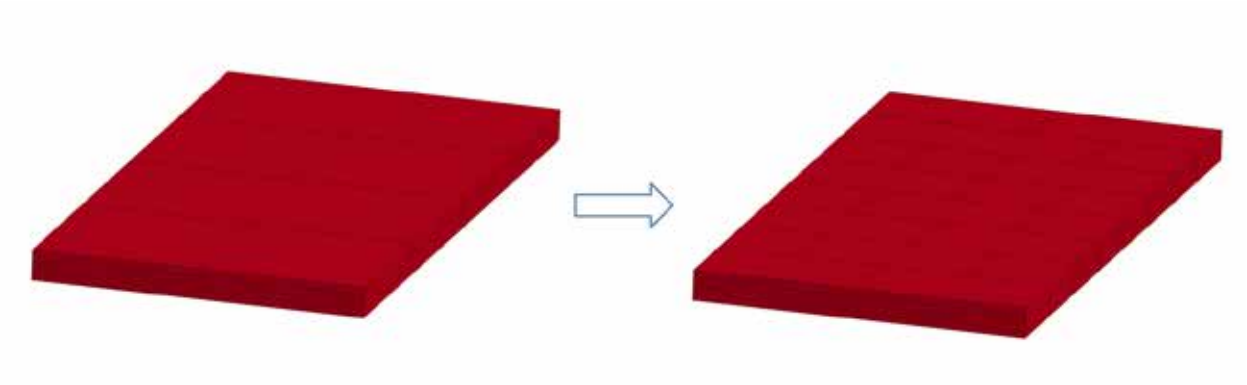


Figure 1. Mesh Fission for Sandwich Structure Part: 32 hexahedral elements are refined to 128 of the same type, as a sweeping of the top and bottom adaptive shell elements through the thickness. The number of layers of the solids always remains the same.

Activating the New Feature

The mesh adaptivity for multilayer solid core of sandwich structure part can be activated by using a new option in the existing keyword *CONTROL_ADAPTIVE, as shown in the following keyword:

```
*CONTROL_ADAPTIVE
$  ADPFREQ    ADPTOL    ADPOPT    MAXLVL    TBIRTH    TDEATH    LCADP    IOFLAG
    0.50      4.0       1         4         0.0        .0006      0        1
$  ADPSIZE    ADPASS    IREFLG    ADPENE    ADPTH     MEMORY    ORIENT   MAXEL
    1.5       1         0         8.000     0.0
$  IADPN90    IADPGH    NCFREQ    IADPCL    ADPCTL    CBIRTH    CDEATH   LCLVL
      -1
$  CNLA                                                                  IFSAND
                                                                           1
```

In the keyword, the common adaptive parameters directly apply to the adaptivity of the sandwich structure part. For instance, ADPFREQ defines adaptive fission frequency, ADPTOL defines the fission tolerance and ADPOPT defines the fission option. When the option **IFSAND** is set to be 1, the feature is invoked. Adaptive fusion feature is not yet available for the sandwich structure part.

Numerical Example and Discussion

To test the new feature, a number of simulations were carried out using the NUMISHEET ’96 S-rail Benchmark, as shown in Figure 2. For each case, a forming process is first conducted without adaptive mesh refinement, followed by a corresponding one with adaptive mesh fission.

In the first case, the solid is discretized into one layer of hexahedral elements and the shells are discretized into quadrilateral elements, respectively. The contours of the effective plastic strains at the end of the forming processes with and without adaptive mesh fission are shown in Figure 3. Although the difference of the maximum effective plastic strains in the solid are very small (0.5330 without mesh fission and 0.5469 with fission), the contours with adaptive fission is clearly more localized around the corner areas. This is as expected, given that the newly generated small elements around the comer areas shall provide higher resolutions to the local fringe contours.

In the second case, we would like to consider the solid discretized into multiple (in this case, three) layers of hexahedral elements. The contours of the effective plastic strains at the end of the forming processes with and without adaptive mesh fission are shown in Figure 4. The maximum effective plastic strains are 0.8348 without mesh fission and 0.9159 with fission. Again the one with adaptive mesh fission is more localized at the corner area. Compared to the result obtained from the first case, the current one provides a more detailed gradient in the thickness direction. In fact, the maximum plastic strains are much higher for the 3 layer cases than those for the one layer cases. It is believed that the multiple layer models provide better result in that the nodes of the solid are not completely restricted by the nodes of the shells on the sandwich, as opposed to

the one layer solid model that inevitably imposes extra constrains to the solid nodes, which is less realistic.

In the third case, the shells are discretized into triangle elements and the solid is discretized into wedge elements, so as to show that the hexahedron is not the only option for the solid in sandwich structure part. The resulting effective plastic strains for the case with and without adaptive mesh fission are shown in Figure 5. The contour results present similar localization trend as those in the previous two cases.

To have a better comparison on the maximum effective plastic strains in the solid obtained from the three different cases, the maximum values are summarized in Table 1. One can see that the maximum effective plastic strain neither relies much on the type of the element, nor does it depend much on whether the adaptivity is on or off. In fact, it seems that the number of layers in the thickness direction mainly determines the maximum magnitude of the effective plastic strain. Specifically in the current examples, the maximum values for one layer of element (Hexahedral or Wedge) are around 0.55, while those for three layers of element are higher than 0.83. However, this does not necessarily mean adaptivity is not important in the simulation. The local distribution patterns of the contours are very different, especially in the corner areas, which is usually the locations of great importance. In all respect, the multi-layer core of solid elements feature, as well as the mesh adaptivity option, are both of great significance in the forming simulation of the sandwich structure part.

To uncover the underlying reason why the effective plastic strain resulting from three layers of solid elements is larger, the two cross sections of the solids from the corresponding sandwich structure parts are plotted in Figure 6. Assume that the two sandwich structure parts are subjected to the same pure bending force, which yields a linear distribution of the effective plastic strain along the thickness direction. As can be seen from Figure 6, the Gauss integration point (red dot) corresponding the maximum effective plastic strain of the three layer model is in general closer to the surface, leading to a higher value even though the deformations of the two models are exactly the same.

CONCLUSION:

A new feature of mesh adaptivity for sandwich structure part is successfully implemented and available for use. The new feature supports the adaptive fission of the solid with multiple layers, as compared to the original restriction that allows only one layer of solid elements. This improvement not only provides more detailed information through more layer of elements in the thickness direction, it also provides more freedom to the material within the solid, i.e., nodes of the solid are no longer solely attached to the shells. On the other hand, the adaptive mesh refinement feature serves to provide better resolution of the simulation results in local area of interest while keeping the computational cost to an acceptable level.

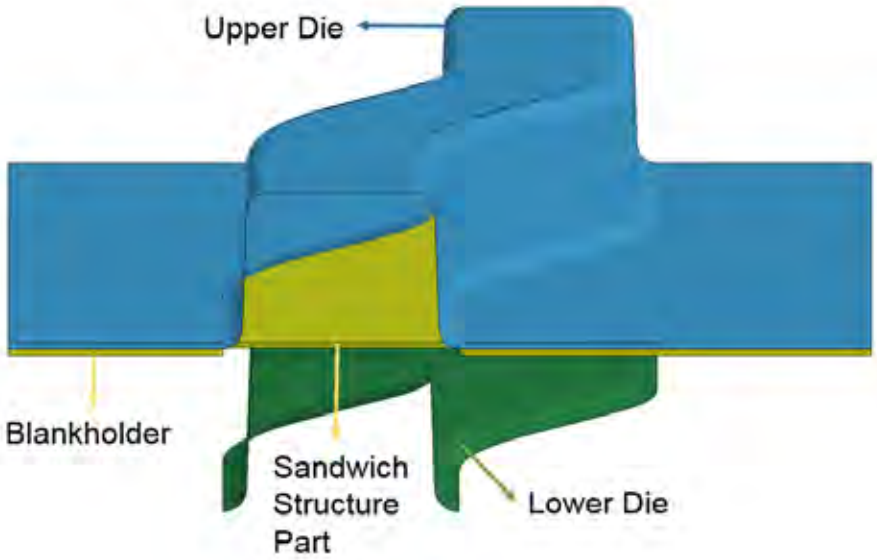
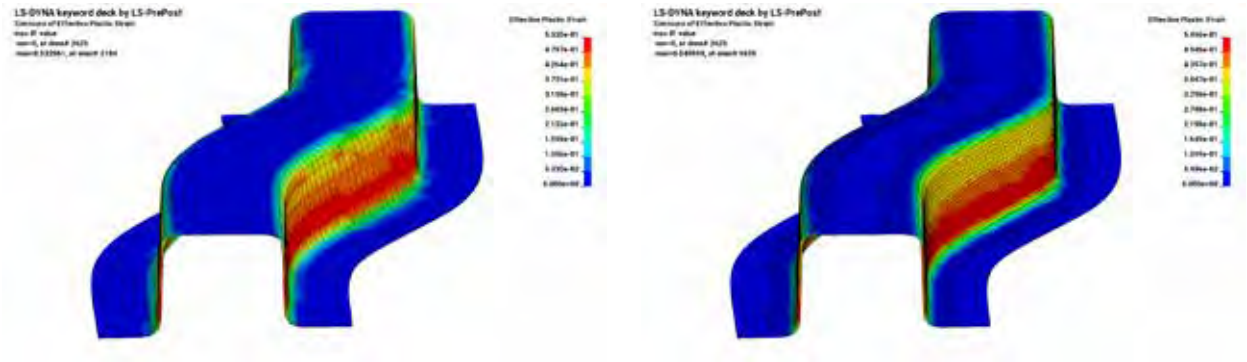
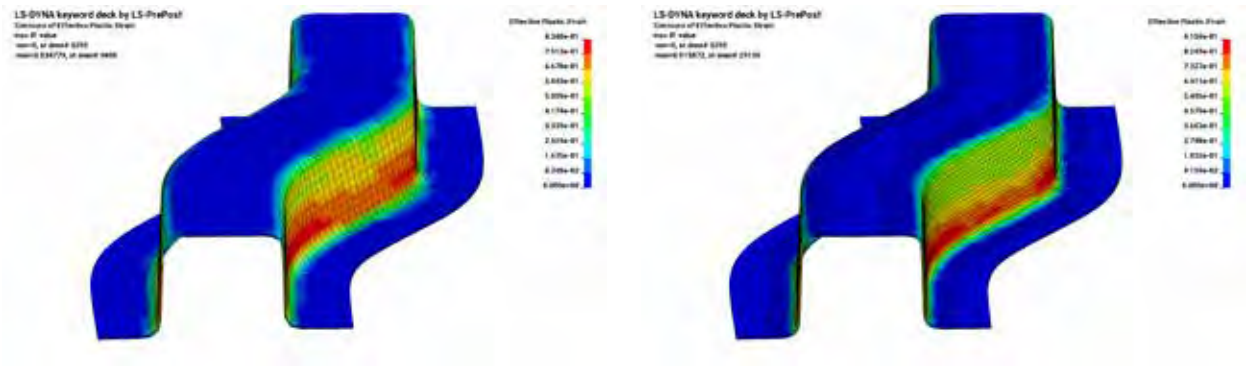


Figure 2. NUMISHEET ’96 Benchmark: The upper/lower die and blankholder are rigid; the sandwich structure part consists of one upper, one lower shell and the solid in between. Several forming processes are performed, with different discretization schemes.



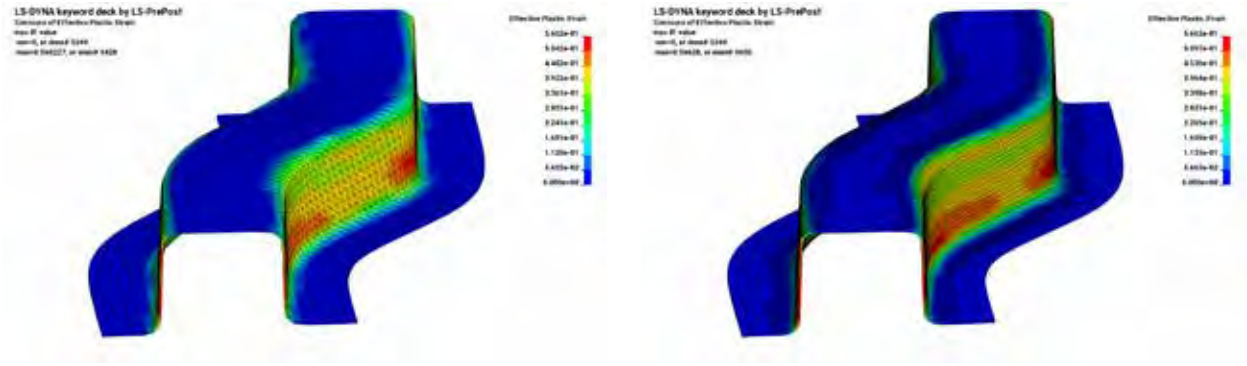
(a) No Fission (b) With Fission

Figure 3. Effective plastic strains of the solid at the end of the forming processes, with and without adaptive fission. The solid is discretized into one layer of hexahedral elements.



(a) No Fission (b) With Fission

Figure 4. Effective plastic strains of the solid at the end of the forming processes, with and without adaptive fission. The solid is discretized into three layers of hexahedral elements.



(a) No Fission (b) With Fission

Figure 5. Effective plastic strains of the solid at the end of the forming processes, with and without adaptive fission. The solid is discretized into one layer of wedge elements.

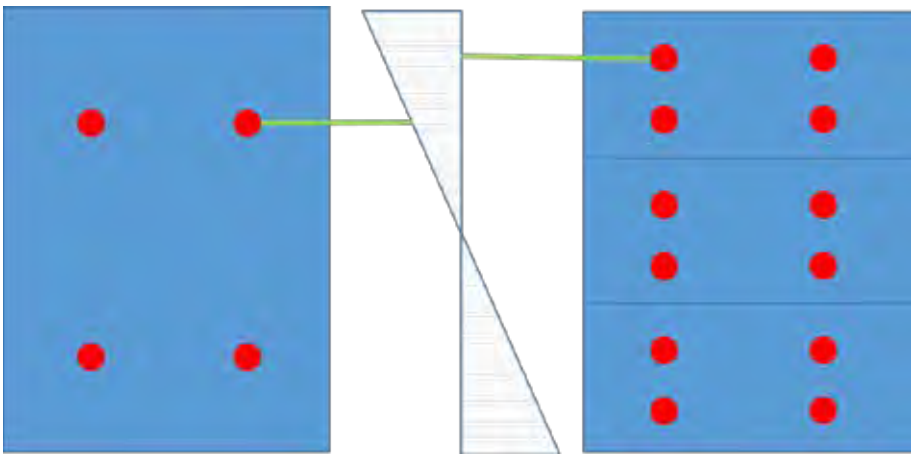


Figure 6. Schematic of the solid cross sections with one and three layers of elements, the dots (red online) denote the locations of Gauss integration points. The two sandwich structure parts are subjected to the same pure bending force. One can easily tell that the one with three layers of elements shall present higher effective plastic strain, simply because the corresponding Gauss integration point is closer to the surface.

	Hex, 1Layer	Hex, 3Layers	Wedge, 1Layer
No Fission	0.5330	0.8348	0.5602
With Fission	0.5496	0.9159	0.5663

Table 1. Comparisons of the final maxinum effective plastic strains for the solid meshes of different cases, with and without mesh fission.

ACKNOWLEDGEMENT:

The feature in this article was requested by BMW. Their valuable feedback during the development is highly appreciated.

REVISION INFORMATION:

Sandwich Structure Part Adaptivity feature is available starting in Revision 116282.

New Inflator Models in LS-DYNA®

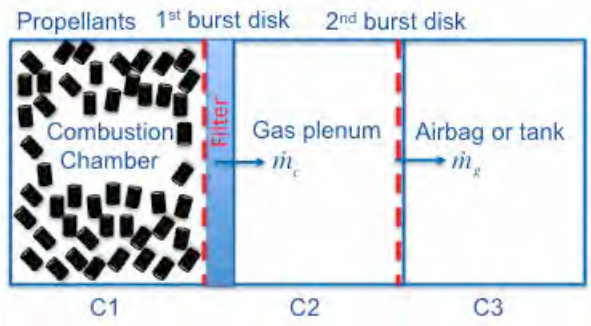
Kyoung-Su Im, Zeng-Chan Zhang, and Grant O. Cook, Jr.
Livermore Software Technology Corp., Livermore, CA 94551, USA

Abstract

Three new inflator models for the airbag simulation are developed, i.e., i) the pyrotechnic, ii) the cold flow hybrid, and iii) the heated flow hybrid models. In order to obtain the combustion product gas compositions and the combustion temperature, a PEP (Cruise,1973) program which is the propellant equilibrium combustion code is also provided. The inflating process is modeled by applying basic conservation laws: the continuity, the energy, and the species transport equations. Unlike other inflator models, here the combustion temperature in these new models is obtained by solving an implicit equation constructed via the thermodynamic relation after the total energy equation is solved. Thus, the new models will be more physical and can provide more accurate results. For user's convenience, three output formats are supported for LS-DYNA's ALE, CPM, and CESE solvers to continue the airbag simulations.

Introduction

The modeling zones of the pyrotechnic inflator generally consist of the propellant, combustion chamber, gas plenum, and discharge tank. Propellant grains including igniting material are contained and confined to the combustion chamber, which is completely sealed from the rest of the inflator by a thin rupture disk, so that the pressure of the combustion chamber is maintained until it reaches a desired value. Once the propellant is ignited, pressure and temperature will increase rapidly due to combusting propellant grains, and this is followed by the rupture disk opening because of high pressure in the combustion chamber. Then, the filter screen between the combustion chamber and the gas plenum will capture the condensed phase slag, and this also cools the hot gas by permeating through the wide surface area heat sink. When the combustion gas fills in the gas plenum and the pressure in it exceeds a certain specified value, another rupture disk opens and the product gases exhaust into the discharge tank. Since the pressure, temperature and mass flow rate in the discharge tank caused by the performance of the inflator characteristics are the crucial factor in designing an airbag, it is very important for the inflator simulation models to provide accurate information concerning the propellant combustion process.



The schmatics of each zone in inflator model.

Model Descriptions

Available Inflator models:

- Pyrotechnic inflator (PI) model: basic model (gas is generated purely by propellant).
- Cold flow hybrid inflator (CFHI) model: inert gas stored in the gas chamber.

- Heated flow hybrid inflator (HFHI) model: the detailed reaction mechanism (currently only gaseous phase) required.

Basic Assumptions:

- Inflator is divided into several different discrete computational zones: combustion chamber, gas plenum, diffusers, and tank.
- In each zone, the gas and condensed phases are well mixed. Gas phase species are treated as ideal gas while the condensed phase species are incompressible.
- Gas and condensed phases are composed of multiple species with temperature dependent thermodynamics properties. For example, the specific heat for species *k* is a function of temperature only, given in terms of a polynomial as,

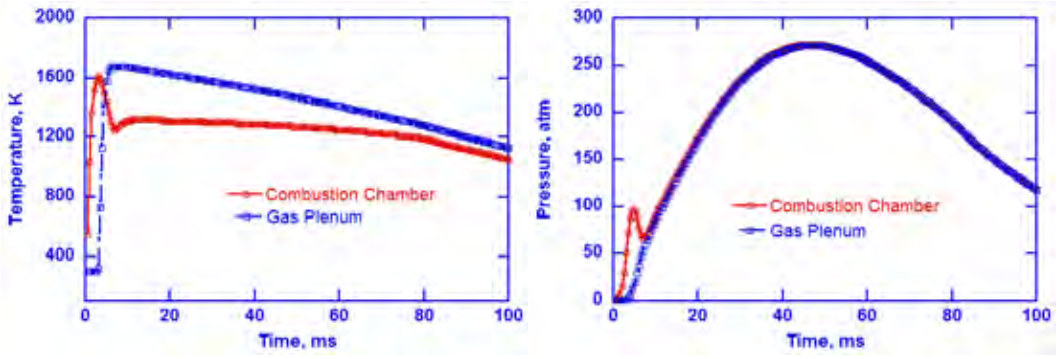
$$\frac{C_{pk}^0}{R} = a_{1k} + a_{2k}T_k + a_{3k}T_k^2 + a_{4k}T_k^3 + a_{5k}T_k^4, \quad C_{vk}^0 = C_{pk}^0 - R_k$$

- The burning rate of the propellant grain is approximated as a function of chamber pressure in time and is converted into the equilibrium compositions. Such compositions can be determined by either an equilibrium code or the stoichiometric combustion reaction.
- The mass flow rates from zone to zone are determined by the gas dynamic formula based on the isentropic flow assumption.

Calculations:

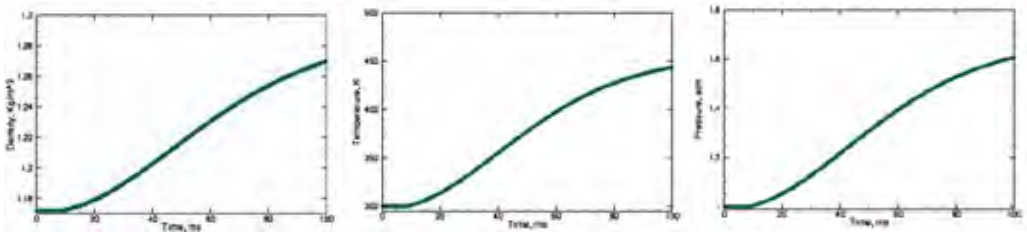
- In each zone, based on its initial conditions, the continuity, energy, and species transport equations are solved to find the species mass, total energy, chamber pressure, and chamber temperature. (see Fig. a) & b) for example)
- For HFHI model, a detailed mechanism of elementary reaction systems is required in order to compute the species production.

Fig. a) Combustion & Gas Plenum



(a) Temperature (b) Pressure

b) Discharge Tank



(a) Density (b) Temperature (c) Pressure

How to use:

1. Prepare the chemistry input file (*.inp) and thermodynamics data files (therminf.dat) for participating combustion species in the calculation.
2. Select the inflator model to run.
3. Specify the number of zones (currently, 3 zones only).
4. Set initial conditions for each zone (including the propellant card).
   a) The combustion chamber: initial conditions, propellant product composition, and chamber compositions.
   b) If the HFHI model is selected, make sure that the elementary reactions are included in the chemistry input file.
4. Run the code to get the load curve for flow properties.
5. Calibrate the input parameters using experimental data such as the combustion pressure and tank pressure curves.
6. Finally, use the necessary load curves and parameters to continue the airbag simulation

Remarks:

- The species compositions can be determined by either an equilibrium code or the stoichiometric combustion reaction.
- An LSTC variant of the PEP equilibrium code is provided as a separate code option from LS-DYNA to calculate the combustion species compositions (i.e. mole fractions) and the flame temperature.
- To obtain the accurate input values for the airbag simulation, the pressure curve must be calibrated through a tank test. If possible, it is recommended to conduct pressure curve calibration in the combustion chamber as well.

References:

1. Butler, P. B., Kang, J., and Krier, H., *Prog. Energy Combust. Sci.*, *19*:365-382 (1993).
2. Schmitt, R. G., Butler, P. B., and Jon, J. F., *Combustion Sci. and Tech.*, 122:1-6, 305-330 (1997).
3. Seo, Y.-D. Chung. S. H., and Yoh, J. J., *Fuel, doi:10.1016/j.fuel.2010.12.042* (2011).
4. O'Loughlin, J. P. and Stevens H. O., "Heated Gas Inflator", US Patent0290108 (2006).
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