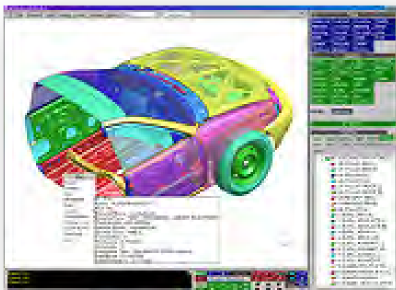
fea INFORMATION
Engineering Solutions
Volume 5, Issue 09, September 2016

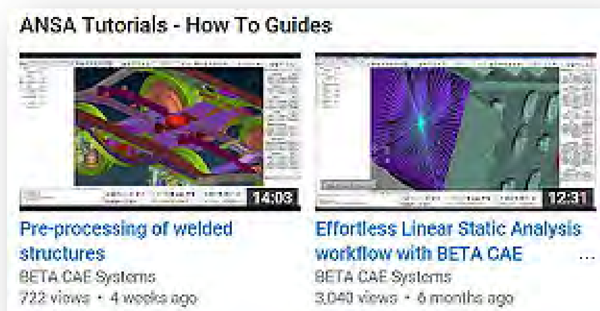
OAYSIS PRIMER



ESI
EP Tender

HYBRID III
5th Model

ANSA Tutorials



CRAY - Expanding the Envelope for LS-DYNA Blade Off Simulations

The Truck Whisperer

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
- FEA Information Engineering Journal
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Livermore Software Technology, Corp. (LSTC) Developer of LS-DYNA One Code Methodology.

LS-DYNA provides fully integrated, strongly coupled, solvers for extensive multiphysics capabilities. Integrated, at no additional cost. Optimized for shared and distributed memory for Unix, Linux, & Windows Based platforms.

DYNAmore GmbH – LSTC's Master Distributor in the EU

DYNAmore is dedicated to sales, support, training engineers with LS-DYNA to solve non-linear mechanical problems numerically. Employs 85 engineers in Europe. Co-develops the LSTC software and provide engineering services.

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- **Hobart Sea Trials 2016LS-DYNA Resources**

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LS-DYNA Recent Developments, Features, Updates – Editor – Yanhua Zhao

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

Announcements

TWITTER: We will soon be set up with DYNAmore to "tweet"

I guess this is my first two pre-tweets, prior to twitter tweets, coming soon:

"With the papers from Detroit 2016 we have now more than 1900 technical papers, located at dynalook. www.dynalook.com

"LSTC just released an updated version of the detailed Hybrid III 5th model

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Francois-Henry will be presenting

A Global, Distributed Ordering Library **- Authors: Cleve Ashcraft and Francois-Henry Rouet**

The SIAM Workshop on Combinatorial Scientific Computing Albuquerque, NM

Sincerely,

Marsha Victory Trent Eggleston

Marnie Azadian Suri Bala Dilip Bhalsod Yanhua Zhao

Publication - SPH and ALE formulations for sloshing tank analysis

"SPH and ALE formulations for sloshing tank analysis"

The International Journal of Multiphysics, Volume 9 Number 3 2015

http://multi-science.atypon.com/doi/10.1260/1750-9548.9.3.209

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2. Jason Wang, Jingxiao Xu, LSTC, Livermore Software Technology Corp. Livermore CA 94550, USA

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Abstract: Design of fuel tanks requires the knowledge of hydrodynamic pressure distribution on the structure. These can be very useful for engineers and designers to define appropriate material properties and shell thickness of the structure to be resistant under sloshing or hydrodynamic loading. Data presented in current tank design codes as Eurocode, are based on simplified assumptions for the geometry and material tank properties. For complex material data and complex tank geometry, numerical simulations need to performed in order to reduce experimental tests that are costly and take longer time to setup. Different formulations have been used for sloshing tank analysis, including ALE (Arbitrary Lagrangian Eulerian) and SPH (Smooth Particle Hydrodynamic). The ALE formulation uses a moving mesh with a mesh velocity defined trough the structure motion. In this paper the mathematical and numerical implementation of the FEM and SPH formulations for sloshing problem are described. From different simulations, it has been observed that for the SPH method to provide similar results as ALE formulation, the SPH meshing, or SPH particle spacing needs to be finer than ALE mesh. To validate the statement, we perform a simulation of a sloshing analysis inside a partially filled tank. For this simple, the particle spacing of SPH method needs to be at least two times finer than ALE mesh. A contact algorithm is performed at the fluid structure interface and SPH particles. In the paper the efficiency and usefulness of two methods, often used in numerical simulations, are compared.

Sections: Introduction, ALE Formulation, SPH Formulation, Constitutive Material Models For Water, Numerical Simulations, Conclusion

Engineering Advantage - September 6, 2016 By: Patrick Cunningham

Static and Dynamic Friction – Where the Rubber Meets the Road

By: Patrick Cunningham

I was recently reminded first hand of the important distinction between sticking and sliding frictional contact. I was in a bicycle race on a speedy descent when two riders in front of me rubbed shoulders and hit the pavement. If you have ever seen footage of bicycle racers crashing, you have a pretty good idea what happened next as I and my fellow racers frantically attempted to avoid the ensuing pile up. (Picture above)

So there I was, flying down the road doing everything I could to slow down and squeeze through a rapidly narrowing avenue of escape. It is commonly known among bike racers that locking up your back wheel is bad news because controlling the bike becomes much more challenging. What is less commonly known is the reason why this occurs. Not all bike racers are engineers after all.

When your wheel is rolling on the pavement there is no relative movement between the tire and the road at the point of contact. This is considered a sticking contact interface where the static coefficient of friction is in play. The tangential force on the tire which decelerates you during braking is the static coefficient of friction multiplied by the normal force from the combined weight of you and your bicycle.

When your wheel locks up there is relative movement between the tire and the road and the contact transitions from sticking to sliding. Sliding friction coefficients are typically less than their static counterparts. This is bad news when you need to decelerate because the tangential force that is slowing you down is reduced as well.

Despite the fact that these crashes occur in a few short seconds it feels like you are moving in slow motion and I found myself thinking about how I would model this effect using finite elements. No really, it was better than obsessing about road rash. Frictional contact modeling is fairly common in today's world and can play an important role in a design and assembly process. In a press fit scenario you are often trying to evaluate the amount of force required to complete an assembly process. If you are relying on the static coefficient of friction alone you may be overestimating the force required. Frictional contact can also make the system response path-dependent, such that the sequence in which the loads are applied can affect the end result.

Both static and sliding friction coefficients can depend on many different variables including materials, surface finish, temperature, normal pressure, sliding distance, and relative velocity. In order to simulate the friction forces correctly, some finite element codes, like ANSYS®, allow the engineer to explicitly characterize the these dependencies. This can be in tabular form, via common models, such as exponential decay, or through user-defined friction routines. Other codes simply use a constant value, yielding results which are either too conservative, or not conservative enough. For example, in Figure 1 below, a tabular definition of frictional force as a function of sliding distance is defined in a static analysis. To relate to my bike racing analogy, the friction between the tire and the road dips as sliding occurs and then drops again when the tire wears away and I am sliding directly on the wheel. As illustrated in the picture above, it's something I strongly suggest you avoid.

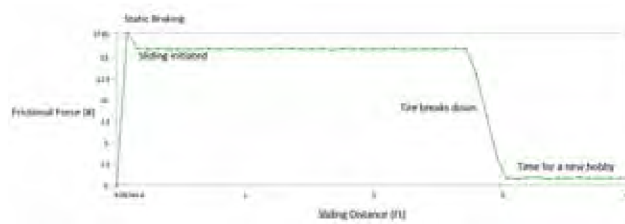


Figure 1 – Friction Coefficient as a Function of Sliding Distance

As you would expect, knowing the values of the friction coefficients is very important. Unless you can evaluate them through testing you will likely have to rely on a textbook number for starters. When that is the case it is always a good idea to evaluate the sensitivity of the response to the coefficient used. This can done in tools like ANSYS® where the friction coefficients can be defined as input parameters as part of a sensitivity or optimization study.

If you are using other options to model friction, I would welcome a discussion on the topic. Don't be a "stickler" and feel free to comment. I might even share the end of my bike race story.

September – Recent Changes LS-DYNA Support Site

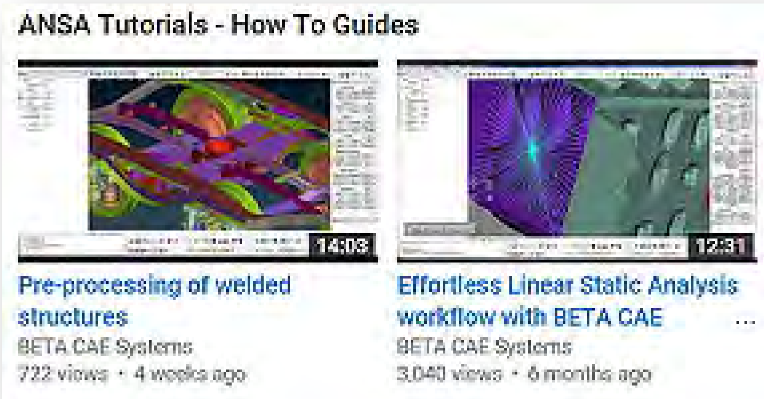
www.dynasupport.com

At this site you will find new releases, ongoing developments and answers to basic and advanced questions that might occur while using LS-DYNA.

Recent Changes
History Variables for Certain Material Models
Sep 15, 2016

LS-DYNA R9.0.1 (R9.109912) released
Aug 30, 2016

LS-DYNA R7.1.3 (R7.107967) released
Jul 14, 2016



YOUTUBE

www.youtube.com/user/betacae

BETA CAE Open Meeting NA
October 11, 2016, The Inn at St. John's
Plymouth, MI, USA
hosted by BETA CAE Systems USA

BETA CAE Open Meeting Japan
November 8, 2016, Nagoya, Japan
hosted by TOP CAE Corp.

BETA CAE Open Meeting Beijing China
November 22, 2016
Beijing, China - hosted by Beijing E&G Software

BETA CAE Open Meeting Shanghai China
November 25, 2016
Shanghai, China
hosted by Shanghai Turing Info. Tech.

7th BETA CAE International Conference

30 May - 1 June, 2017

Thessaloniki, Greece

SPONSORED EVENTS: BETA CAE Systems participation

German LS-DYNA forum 2016 –
Oct. 10-12 2014, Bamberg, Germany:

NAFEMS Simulation-Based Optimization
October 12-13, Manchester, UK

2016 International CAE conference
October 17-18, Parma, Italy

FFT Acoustic Simulation conference & ACTRAN Users' meeting 2014
October 11-13, Brussels, Belgium

SIMULIA RUM Benelux
November 9-10, Antwerp, Belgium

SIMULIA RUM Germany
November 10-11, Darmstadt, Germany

NAFEMS A Guide to High-Fidelity CFD for Industry
November 16, Stratfort-upon-Avon, UK

SIMVEC - Simulation und Erprobung in der Fahrzeugentwicklung
Nov. 22-23, Baden Baden, Germany

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DYNAmore 14th German LS-DYNA Forum

Author: Nils Karajan nik@dynamore.de Conference Contact: forum@dynamore.de

14th GERMAN LS-DYNA® FORUM 2016

October 10 - 12 2016, Bamberg, Germany

Agenda published - www.dynamore.de/forum2016-e

The agenda of the 14th German LS-DYNA Forum offers more than 100 technical presentations by users from various industries, who will share their experiences with LS-DYNA and LS-OPT. Moreover, software developers from LSTC and DYNAmore provide insight into the potential applications of their latest implementations. The Forum is rounded off with six workshops covering popular topics.

It is notable that the modeling of fiber reinforced plastics play again an important role this year. In particular, to close the gap between process and serviceability simulations, DYNAmore is developing the new mapping tool "Envyo", which is already used in a number of presentations. Furthermore, the classic applications of short-duration dynamics are still of growing interest. Also well represented are the applications with respect to function and component simulation, which can be computed with the implicit features of LS-DYNA.

Following this, the 14th German LS-DYNA Forum offers an ideal platform to exchange your experiences and insights with other users across the LS-DYNA product range as well as the associated CAE process chains. But have a look for yourself.

In addition to the Forum, we also offer 11 English-spoken seminars on LS-DYNA and LS-OPT where conference participants will receive a 10% discount on the seminar fees. In the morning before the Forum there will be a free-of-charge workshop on integrative simulation of fiber-reinforced plastics.

Venue

Welcome Kongresshotel Bamberg
Mußstraße 7, 96047 Bamberg, Germany
Hotel room booking please use this link

Conference Agenda

www.dynamore.de/forum16-inv-e

Conference language - German and English

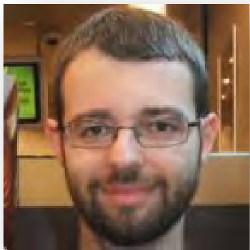
Participation Fees

Industry: € 580 - Academic: € 410
All prices excluding VAT.

Exhibiting and sponsoring - Please contact us.

Registration and Contact -

Registration form: online
Registration form: **pdf**
DYNAmore GmbH,
Conference Contact: forum@dynamore.de



Research scientist at Livermore Software Technology Corp.

Fields of interest are Applied Mathematics and High-Performance Computing.

Join Francois-Henry Rouet on October 10th – 12th:

The SIAM Workshop on Combinatorial Scientific Computing
Albuquerque, NM

Francois-Henry will be presenting
A Global, Distributed Ordering Library
Authors: Cleve Ashcraft and Francois-Henry Rouet

Previous Presentation ***Using low-rank approximation techniques for engineering problems.***
Presented by Francois Henry Rouet

Authors: Julie Anton, Cleve Ashcraft, Pierre L'Eplattenier, Roger Grimes, Francois-Henry Rouet, Clément Weisbecker, LSTC

7th International Conference on Computational Methods, Berkeley, CA, August 1-4

Abstract: Matrices that appear in the boundary element methods and finite element methods are often structured (or low-rank, or data-sparse). This means that they exhibit rank-deficient blocks, typically the blocks corresponding to far range interactions in the physical space. Identifying and compressing these low-rank blocks, e.g., using SVD or a rank-revealing factorization, is the key to reducing the storage and computational requirements of many matrix operations, such as performing matrix-vector products, computing eigenvalues, and solving linear systems. In this talk, we focus on the latter, for both dense and sparse matrices. For sparse matrices, the low-rank property is usually not found in the input matrix but at intermediate steps of the factorization algorithms used to solve linear systems.

Many different techniques, referred to as low-rank representations, have been proposed in the literature. Among others, the Hierarchically Semi-Separable (HSS) matrices and Block Low-Rank representations have been widely studied and have recently been implemented in parallel solvers. However very few comparison results can be found in the literature; usually they are restricted to model problems, or to comparing a single low-rank algorithm against a non-low-rank one. Our goal is to compare the performance of the HSS and BLR approaches for dense and sparse matrices arising from engineering applications.

The matrices that we consider for this presentation all arise from implicit simulations performed with LS-DYNA for real world applications. We will compare the HSS and BLR techniques using multiple high-performance implementations. The HSS-based solver we use is the STRUMPACK code, that can be used as a preconditioner or as a direct solver for both dense and sparse problems. For BLR we use MUMPS, a sparse direct solver that has recently gained Block Low-Rank features, as well as a BLR code developed at LSTC.

TOPCRUNCH Bench Marks

www.topcrunch.org

The TopCrunch project was initiated to track the aggregate performance trends of high performance computer systems and engineering software. Instead of using a synthetic benchmark, actual engineering software applications are used with real data and are run on high performance computer systems.

Vendor/Submitter ARD/ARD Corporation

Computer Interconnect; ARD C51601T72IR21-25/QDR Infini

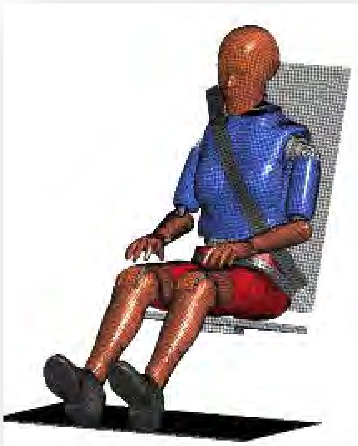
Processor i7-5960X

#Nodes x #Processors per Node x #Cores Per Processor = Total #CPU 8 x 1 x 8 = **64**

Time (Sec) 9859

Benchmark Problem Car2car

Hybrid III 5th model - Update



LSTC just released an updated version of the detailed Hybrid III 5th model.

atds@lstc.com

The release

Includes calibrations for the standard:

- Thorax,
- Neck-Flexion,
- Neck Extension,
- Knee and Head-Drop Tests.

The downloadable package contains:

- model documentation, which can be followed for all "Injury Channel Plotting".
  - The documentation contains also calibration results and plots.
- A sled model in which the same dummy has been positioned together with seat-belt routed over it is also included in the package. This sled model was tested using the LS-Dyna Release Version R_901.

Best regards and Thank you for your interest in our products,

LSTC Models Team

Recommendations:

It is recommend to upgrade to this latest release for use with this dummy model.

Please go through the README file in the package first.

To download the model, please visit:

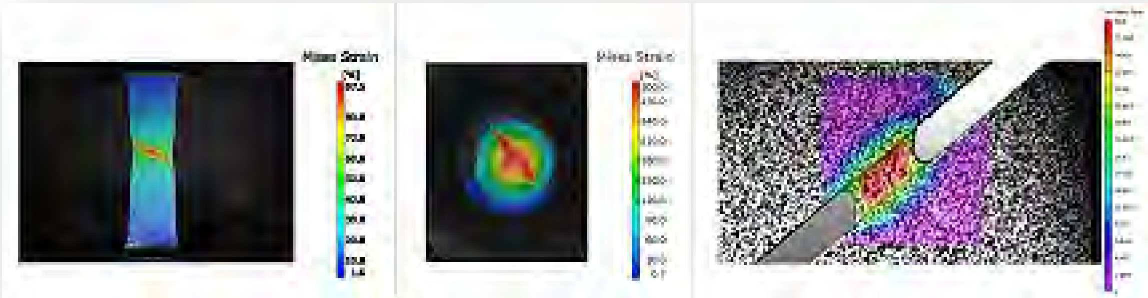
http://www.lstc.com/download/dummy_and_barrier_models

If you need help with access or have questions or comments about this model, please contact atds@lstc.com

If you have subscribed to LSTC_models_news. Change E-mail Subscriptions here: http://listserv.lstc.com/mailman/listinfo/lstc_models_news

DatapointLabs to Offer TestPaks® for GISSMO

Marcia Swan – DatapointLabs www.knowmats.com/Post/View/162



Tensile, biaxial, and grooved shear tests for GISSMO failure modeling

DatapointLabs to Offer TestPaks® for GISSMO

The GISSMO damage model available in *MAT_ADD_EROSION of LS-DYNA provides the ability to add material damage and failure to constitutive material models such as MAT_024, which do not contain this capability. The model is a phenomenological formulation that allows for an incremental description of damage accumulation, including softening and failure for a variety of metallic materials.

TestPaks for GISSMO are provided as a collaboration between DatapointLabs and Dr. Paul Du Bois and include all the specimen preparations, tests, and post-processing of data. An LS-DYNA GISSMO material file is provided.

Order the LS-DYNA GISSMO Failure Model TestPak from our online Test Catalog. [www.datapointlabs.com/Catalog.asp] [www.datapointlabs.com/TestPakDetails.asp?TestPakId=223]

Look for us if you'll be attending one of these events, or contact us to set up an appointment to meet with one of our representatives on site.

- **Digimat** Users' Meeting 2016, October 4-6, 2016; Lisbon, Portugal.
- **CADFEM ANSYS** Simulation Conference, October 5-7, 2016; Nuremberg, Germany. Attend our presentation, - Booth #26 among the conference sponsors.
- **International CAE Conference**, October 17-18, 2016; Parma, Italy.
- **Western Pennsylvania ANSYS Users Group,** October 21, 2016; Canonsburg, PA USA. Presentation: "Testing, Modeling and Validation for Plastics Simulation in ANSYS."

CRAY - Expanding the Envelope for LS-DYNA Blade Off Simulations

By Greg Clifford - September 12, 2016 Copyright to Cray

Fan blade off containment

Cray® XC™ supercomputer and the finite element application LS-DYNA®.

When a fan or compressor blade fails in an airplane jet engine, it's a potentially deadly event. Failed blades release high-energy fragments that can perforate the engine case, damage fuel tanks and cause catastrophic failures. Because of this extreme danger, the Federal Aviation Administration requires that engine cases be capable of containing blade fragments. In turn, it makes "fan blade off containment" a critical design requirement for the aerospace industry.

Of course, improving fan blade off containment simulation also makes for a compute challenge for users of Cray® XC™ supercomputer and the finite element application LS-DYNA®. So a team from Cray and Livermore Software Technology Corporation (LSTC) got together recently to study how to achieve these improvements.

Fan blade off containment simulation is technically challenging and computationally intensive. For example, a large 80-million-element simulation using LS-DYNA version R7.1.2 takes more than a month to complete. But ideally, time-to-solution on this type of simulation should be less than a day.

First, the team needed to make improvements to the most computationally expensive part of the simulation — surface-to-surface erosion contact. To optimize the surface-to-surface process, they used the CrayPAT™ analysis tool to identify the most time-consuming subroutines. The resulting improvements included a 30 percent reduction in memory required for storing erosion contact surfaces, removal of redundant erosion calculations and faster exterior surface calculation.

Next, they needed to test the improvements. To do this, they first compared the performance of the simulation between LS-DYNA R8.0.0 and the earlier LS-DYNA R7.1.2 on a medium-size model of 26.5 million nodal points and 24 million solid elements. Then, they analyzed the MPI communication patterns and load balance among the MPI processes. Based on these results they identified the compute bottlenecks and made code changes to improve performance. And finally, they carried out the 80-million-element simulation using the enhanced LS-DYNA version R8.0.0 on the XC system.

So what kind of results did they see?

For the comparison test, the team focused on simulation performance during the collision phase (where the released blade collides with the engine case and the other two rotating blades), modeling these processes using surface-to-surface erosion contact. The team found that at 256 cores, the total elapsed time on LS-DYNA R8.0.0 was only about 1.9 times faster than LS-DYNA R7.1.2. But as core count increased, the speedup increased. At 2,048 cores, version R8.0.0 was about 2.7 times faster.

The team then analyzed the LS-DYNA wall time based on its functionality to determine where the speedup came from. Their analysis showed the speedup came from the "contact" and "miscellaneous" functions which were direct outcomes of the code optimizations.

Next, the team used Profiler, the Cray MPI profiling tool, to determine how much time was spent on MPI communication and which MPI calls dominated MPI time. Profiler revealed that total MPI time decreased as core count increased at lower core counts (256 to 1,024). The trend reversed at higher core counts of 1,024 to 2,048. This result revealed that MPI time is dominated by MPI synchronization time in the simulation and indicates load imbalance. Because of load imbalance, the parallel scaling of fan blade off simulation of the medium-size model is limited to 1,024 cores. However, for larger models, which are desired for future simulations, fan blade off simulations can scale to over 16,000 cores.

For their final test, the team ran a large model of the fan blade off simulation using 82 million nodal points and 80.6 million solid elements. With the earlier LS-DYNA version, the large model took more than a month using 16,384 cores on the Cray XC system. Using the optimized LS-DYNA R8.0.0 the simulation took only 21 hours — or 34 times faster than R7.1.2.

Read a white paper about the fan blade off containment tests. This free white paper details the use of LS-DYNA, a finite element program made by LSTC, on a Cray® XC40™ supercomputer to simulate fan blade off containment. In a real-life simulation, an explosive charge is fired to release the turbine blade, leaving very little visible detail in the engine.

LS-DYNA's simulation visualization allows engineers to strip away part of the structure to see those details, and alter their design if necessary.

http://web.cray.com/LS-DYNA-Aerospace-Simulation-White-Paper

ESI Virtual Performance Solutions

Excerpt – Full article and pdf is located at: www.esi-group.com

"Using Virtual Performance Solution has enabled us to virtually validate our crash scenario for the generator's fuel tank and to demonstrate that our trailer brings more energy absorption capacity. Integrating ESI's latest water management module for tank sloshing in our model has been particularly efficient to accurately model the content of the tank and get more realistic results"

Jean-Baptiste Segard, Founder and CEO - EP Tender

EP Tender Generators approved for launch after testing with ESI Virtual Performance Solution

Challenge

EP Tender offers electric mobile energy modules (fuelpowered electric generators) for electric cars. Users rent the small trailers on which these generators are mounted. EP Tender aimed to address safety concerns and to assure compliance of their trailers with all regulatory requirements, without building and testing physical prototypes.

Story

In an effort to reduce CO2 emissions, new technical solutions are emerging, such as enhanced batteries or plug-in hybrid electric vehicles (PHEV). Only 2% of automotive trips exceed 200 km, yet when choosing a vehicle consumers consistently value extended range over reduced cost, for fear of running out of energy and getting stranded. As a result, for electric vehicles to gain significant market share against internal combustion engine vehicles, supplemental energy must be made available for those times when it is needed.

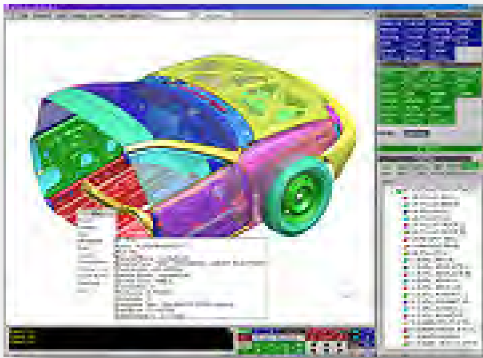
Benefits

EP Tender defined a rear crash scenario within their design specification and succeeded in validating the performance of their generator using ESI Virtual Performance Solution (VPS). They were even able to further improve the design, without the expense of creating and testing multiple physical prototypes.

Excerpt – Full article and pdf is located at: www.esi-group.com

Oasys PRIMER

www.oasys-software.com/dyna/en/software/primer.shtml



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.

Our priority with Oasys PRIMER is to provide complete support for every LS-DYNA keyword. The user can be assured that every model read in and written out will lose no data.

Main features:

- Full support for LS-DYNA version R8.0
- Connections function for defining various connections (e.g. spotwelds, bolts) including a Autoweld function that does not require an input file
- Quick-pick menu for on-screen manipulation of entity display characteristics
- Quick-pick menu for on-screen editing of LS-DYNA keywords
- Easy access to part data through the Part Tree navigation menu, and Part Table
- Cross reference viewer menu for tracking how different entities refer to each other
- Airbag Folding including mesh-independent airbag folding
- Seatbelt fitting including automatic seatbelt re-fitting after dummy re-positioning
- Mechanisms
- Keyboard shortcut keys for most of the common functions
- Simple meshing capability.
- Full support for LS-DYNA parameters
- Background image and image/model alignment function

Oasys PRIMER is designed specifically for pre-processing with LS-DYNA. Therefore the user interface is clear, simple and tailored towards LS-DYNA - without any compromises.

All of the common keywords can be created, modified and graphically visualised to help users understand exactly what a model contains and how the various entities are inter-related.

Connection Definition

The Connections function within Oasys PRIMER allows the user to quickly and easily create spotwelds and bolted connections. These can be created manually, using a spotweld file, or automatically using the Autoweld option.

The Connection Table allows the user to review the status of the various connections within a model and make modifications.

Once created the data is stored along with the keyword file allowing the connections to be easily updated. The connection data can also be written out as a separate file for use with other models.

Part Tree & Part Table

The Part Table functions in Oasys PRIMER allows the user to quickly review or modify properties such as thickness, element type, material type, yield stress, or density of an individual part or a whole series of part.

The Part Tree enables users to quickly navigate around their models, giving a visual display of the parts that are in each include file and allowing the user to move parts between include files with a simple click-drag function.

Error Checking

Oasys PRIMER has a large range of checking functions. These include basic mesh quality checks, and over 3000 LS-DYNA specific checks to help reduce the amount of time taken to get a new model up and running.

The Check Window and Error Tree Viewer allows users to clearly see any errors within a model and quickly locate the items that are causing the errors.

Occupant Set-Up

- There are a number of functions available within Oasys PRIMER to aid with setting up and positioning occupant dummies within a model. These include:
- •Dummy Positioning
- •Mechanism that allows seat position to be quickly adjusted
- •Seat Foam Compression which allow users to pre-compress seat foam
- •Seatbelt Fitting which allows users to easily fit a seatbelt to a dummy and automatically re-fit the belt if the dummy is repositioned

Airbag Folding

The Airbag Folding function in Oasys PRIMER allows users to define the folding pattern for 2D and3D airbag.

It includes a range of fold types such as thick, thin, tuck, spiral and scrunch. It also includes distortion and penetration checking to ensure the quality of the final folded airbag.

Once created the folding pattern data is stored along with the keyword file allowing any updates to be easily carried out.

ETA Engineering - Innovation Starts Here.

www.eta.com/eta-engineering

Computer Aided Engineering (CAE) Services,
Product Design,
Product Development Services,
On-site Support

Innovation Starts Here. For over 30 years, ETA has been an Innovation Leader in the area of engineering consulting services. It is one of the largest and fastest growing engineering service suppliers in the world, offering Computer Aided Engineering (CAE) Services, Product Design, Product Development Services, as well as On-site Support. ETA offers expertise in all aspects of structural design and analysis and has been a true leader in implementing optimization into the product development process.

The ETA team specializes in design optimization, stress analysis, crash, NVH, durability and safety analysis using the latest advanced software and technology available. With a vast amount of experience in the field, ETA can apply its innovative techniques and expertise at the component, sub-system or full system level and serves a wide variety of industries.

ETA has unique expertise in:

- Full Vehicle, Component and Sub-System Development Programs
- Components--Interior, Body, Chassis
- Product Development
- Mass Reduction
- Performance Improvement
- Advanced Crash & Occupant Safety Analysis
- Pre-production Performance--Crash, NVH and Durability
- Concept, Development and Verification (load and fatigue life)
- Metal Forming Applications & Manufacturing Process Simulation
- Manufacturing Process Improvements

Services

- ACP Process
- Full Vehicle Development
- CAE/FE Analysis
- Design Optimization
- On-Site Support

Core Competencies

- ACP Process
- Product Design
- Product Development
- CAE Analysis

LS-DYNA & JSTAMP Forum 2016 – November 8&9

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

Organizer: JSOL Corporation
Dates: Tuesday 8 November to Wednesday 9 November 2016.
Venue: NAGOYA TOKYU HOTEL (Aichi, Japan)
URL: http://ls-dyna.jsol.co.jp/en/event/uf/

Welcome to the LS-DYNA & JSTAMP Forum 2016

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 2016 moves from Tokyo to Nagoya. It will be held at NAGOYA TOKYU HOTEL, from Tuesday 8 November to Wednesday 9 November 2016. 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

Among The Keynote – Special and Sessions speakers:

Tuesday, 8 November, 2016
Prof. Frederic Barlat
The Graduate Institute of Ferrous Technology, Pohang University of Science and Technology
Advanced constitutive modeling and application to sheet forming process simulations

Tuesday, 8 November, 2016
Mr. Toshihiko Kuwabara
Professor, Division of Advanced Mechanical Systems Engineering, Institute of Engineering, Tokyo University of Agriculture and Technology
Advanced Material Testing Methods for enhancing high-precision metal forming simulations
.
Wednesday, 9 November, 2016
Dr. Yuichi Kitagawa
General Manager, Advanced CAE Div. Safety CAE Technology Development Dept., Toyota Motor Corporation
Development of THUMS Version 4 Child Models

Wednesday, 9 November, 2016
Dr. David J. Benson
Livermore Software Technology Corporation
Recent Development in LS-DYNA

AUTOMOTIVE NEWS & EVENTS

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.

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2016 Chicago Auto Show (CAS) - 2017 Tacoma TRD Pro Reveal 003 - September 06, 2016

The Truck Whisperer - Mike Sweers and His Sweat Equity in Tundra and Tacoma

Chief Engineer Mike Sweers (left) and Toyota Division Group Vice President and General Manager Bill Fay pose with the 2017 Toyota Tacoma TRD Pro after its reveal at the Chicago Auto Show, Feb. 11, 2016.

Photo: Joe Wilssens

At the Toyota Technical Center in York Township, Mich., Mike Sweers serves as the chief engineer for both the Tundra and Tacoma. Take a ride to Southeastern Michigan to find out a little more about the life of a chief engineer and what goes into making Toyota trucks the toughest on the road.

Exactly what do you do?

A chief engineer's responsibility is really the vehicle from the start to the finish of its life cycle. What I mean by that is as we start with the vehicle concept, looking at what the customer wants, needs, desires, and how that vehicle fits into their daily life and how we – as Akio Toyoda would say – make our customer smile. So that involves collecting data from Product Planning, Marketing and other groups.

We meet with evaluation groups so we can understand how a customer would use the vehicle in the segment. Since I'm in charge of trucks, it's how would a full-sized truck customer use this truck instead of a compact truck customer. What do they do with them? From a daily driver, to weekends, to the guy who goes out and races his truck in the desert or rock climbs. How do we fit each one of those customers' needs? Or do we pick a specific portion of that segment and focus our product on them?

From there we have to work out the investment, figure out the business case for the vehicle and get it approved by the board of directors. So before we can ever start designing the vehicle, we go through all these steps.

So when it starts, you have nothing really?

It depends. If it's a brand new concept vehicle or a brand new segment, it's different. We have to understand what we're trying to sell. Trucks are a very well established segment. And how you treat that segment or how you break into that segment may be completely different. For Tundra, it's more of what we call a niche truck. The opposite of that is Tacoma. We are the leader in that segment. And how we approach each vehicle is a little different. We can be a little polarizing, a little daring on Tundra because it's a niche vehicle. With Tacoma, we need to make sure we are satisfying that segment so we remain the leader in that segment itself. So we're looking at the demographics, making sure we're meeting our customers' needs. For me, I'm a truck guy, so I have a personal interest in it because I always drive trucks. So it's very important to me that I have a product that we're putting out that I'm excited to drive as well.

So what is the difference between a Tundra customer and an F-150 customer?

A Tundra customer is really buying the truck because they know that truck is going to last. It has the lowest cost of ownership. It has the highest residual value in the market. And that supports the fact that the customer will get a high-quality product. In the full-sized segment, the number one reason is capability, "What can I tow? What can I haul?" But it's also kind of a reflection of the owner itself. Tundra owners are saying, "I bought the best. I can do whatever my neighbor's F-150 can do, but I know it's going to last forever."

Do sales factor into how you approach these things?

Sales factor in all the time. At the end of the day, we have to sell our product. We're going up against the best-selling vehicle in the country, but how we do it is with QDR, styling, by making sure we're meeting our customers' requirements for wants needs and desire.

What is the design process like?

As we move into design, we get into daily activities with the engineers. How are we going to put the vehicle together? What combinations go together? We work with TEMA production engineering. We work with purchasing every day, cost planning every day. We need to make sure we're hitting design targets. And we're still working with styling, and the goal is that the initial sketch everyone agreed to is what we want to hit. So trying to find new ways of manufacturing and making sure we can still build the product.

Then we go into tooling. Once we move into tooling, we go to the plant and ask if they can build it. The last thing we want to do is give them something that is not easily built or can't be built repeatedly. That affects our quality. Or a big area we have to be cautious of, especially with the plants in Baja and Texas that are running full capacity, is that we're not creating ergonomic issues for the line operator. We don't want anyone to get hurt putting our vehicles together.

It's a big team effort. But if we consider ourselves an orchestra, my role is the conductor: getting people from all parts of the company to talk together. Everybody does their job, but I need to make sure everyone is doing their job with consideration of everyone else's job.

What's important to doing your job well?

To me, the key to being a good chief engineer is to be a customer. So if I have to change the oil, can I get to the oil filter without running oil all over the place? We had a van when my kids were young and I had to make everyone go inside when I'd change the oil on it because it was a 90-minute affair and an hour of that was cleaning up the oil. It would infuriate me, and that's something I think about. Even when we go down to the plant, one thing I tell our engineers is, "If you wouldn't want to do that job for eight hours a day, then don't ask somebody else to do that job."

AEROSPACE NEWS & EVENTS

Marnie Azadian

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.

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- 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 Marnie Azadian at 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.

Hobart Sea Trials 2016

(Source: Air Warfare Destroyer Alliance; undated, 2016©)

Hobart, the first of Australia's three new Air Warfare Destroyers, left the shipyard in Adelaide today to begin her initial Builder Sea Trials. The second ship is due to be launched in December, and the third is about half-built. (AWDA photo©)

This September, the Air Warfare Destroyer Project enters an exciting new phase with Hobart commencing its first series of sea trials, Builder's Sea Trials. This phase will demonstrate the functionality of the ship's propulsion, maneuvering, auxiliary, control and navigation systems.

Following Builder's Sea Trials, in early 2017 Hobart will undertake Category 5 (CAT5) trials to test and demonstrate the ship's more advanced systems and the combat system performance.

Hobart will conduct Builder's Sea Trials off the coast of South Australia over several days in September. Throughout this period the ship will be operated under the command of a civilian Master and crew, augmented by specialists from the Alliance and key equipment suppliers who will perform the system testing and trials.

Before the ship is put to sea, the AWD Alliance will conduct a comprehensive assessment to ensure the safety of the ship, embarked personnel, the environment and other seafarers. This assessment is defined as the Alliance Sea Trials Release Process and has three major steps; the Sea Worthiness Assessment, Ship Sea Trials Release and Sea Readiness Confirmation.

During Builder's Sea Trials, whilst the ship is at sea, a dedicated shore support team will remain in constant communications with the Ship's Master to assist the ship and ensure the success of the trials.

In the lead up to Builder Sea Trials the AWD Alliance continues to complete a number of important alongside dock trials - testing the ships systems before it departs to sea for the first time. Tests include Inclining Trials, measuring the ship's stability and vertical centre of gravity, and Bollard Trials, testing the ship's propulsion system

LS-DYNA Resource Links

LS-DYNA Multiphysics YouTube Facundo Del Pin

https://www.youtube.com/user/980LsDyna

FAQ LSTC Jim Day

ftp.lstc.com/outgoing/support/FAQ

LS-DYNA Support Site

www.dynasupport.com

LS-OPT & LS-TaSC

www.lsoptsupport.com

LS-DYNA EXAMPLES

www.dynaexamples.com

LS-DYNA CONFERENCE PUBLICATIONS

www.dynalook.com

ATD –DUMMY MODELS

www.dummymodels.com

LSTC ATD MODELS

www.lstc.com/models www.lstc.com/products/models/mailinglist

AEROSPACE WORKING GROUP

http://awg.lstc.com/tiki/tiki-index.php

Participant's Training Classes

Webinars

Info Days

Class Directory

Participant Class Directory

Arup (corporate)	www.oasys-software.com/dyna/en/training
BETA CAE Systems S.A. (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
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

To enrol on any of these courses please email Dyna Support at dyna.support@arup.com.

Date	Training Class
Scheduled on request	Oasys PRIMER - An Introduction
Scheduled on request	Oasys PRIMER - Automatic Assembly of Multiple Crash Cases
Scheduled on request	Oasys PRIMER - Spotwelds and Connections
Scheduled on request	Oasys PRIMER - Seat and Dummy Positioning
Scheduled on request	Oasys PRIMER & D3PLOT - An Introduction to JavaScripting

BETA CAE 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.gr 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: Nils Karajan nik@dynamore.de

DYNAmore Visit the website for complete listings / changes / locations
www.dynamore.de/seminars

Selection of trainings as well as free-of-charge information & support days in September – November 2016

Download full seminar brochure (pdf): www.dynamore.de/seminars-2016

Trainings

Introduction to LS-PrePost	12 Sept / 24 Oct. / 21 Nov.
Introduction to LS-DYNA	13-15 Sept. / 25-27 Oct. / 25-27 Oct. (T) / 22-24. Nov.
Damage and Failure Modeling	13-14 Sept. (L) / 16-17 Nov.
User Materials in LS-DYNA	16 Sept.
LS-OPT – Optimization and Robustness	20-22 Sept. (V) / 18-20 Oct. / 22-24 Nov. (T)
Joining Techniques in LS-DYNA	22-23 Sept. / 15-16 Nov. (G)
Introduction to Passive Safety	26-27 Sept.
Implicit Analysis with LS-DYNA	29-30 Sept. / 7.-8. Nov (V)
EM - Electromagnetism in LS-DYNA	4 Oct.
ICFD – Incompressible Fluid Solver in LS-DYNA	5-6 Oct.
Contact Definitions in LS-DYNA	6 Oct. (G) / 28 Oct.
CESE – Compressible Fluid Solver in LS-DYNA	7 Oct.
Simulating Short Duration Events	13-14 Oct.
Blast Modelling in LS-DYNA	17-18 Oct.
Penetration Modelling in LS-DYNA	19-20 Oct.
Explosives Modelling in LS-DYNA	21 Oct.
Applied Forming Simulation with eta/DYNAFORM	7-8 Nov.
Metal Forming Simulation with LS-DYNA	9-11 Nov.
Modelling Metallic Materials	14-15 Nov.
Introduction to Welding Simulation	18 Nov.

Information days and webinars (free of charge)

Information day: Welding and Heat Treatment	27 Sept. (A)

Support days (free of charge)

LS-DYNA	15 Sept. / 14 Oct. / 18 Nov.

If not otherwise stated, the event location is Stuttgart, Germany. Other event locations are:

G = Göteborg, Sweden; V = Versailles, France; A = Aachen, Germany;
L = Linköping, Sweden; T = Turin, Italy,

If the offered seminars do not fully suit your needs, we are pleased to meet your individual requirements by arranging tailored on-site training courses on your company premises.

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

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

Latest Release is ESI Visual-Environment 12.0

Weld Distortion Engineering - Shrinkage Method
14 Sep 2016 to 16 Sep 2016

Introduction to ProCAST
20 Sep 2016 to 22 Sep 2016

Basic PAM-STAMP
21 Sep 2016 to 22 Sep 2016

High frequency automotive interior acoustics
29 Sep 2016 to 30 Sep 2016

VA One: Coupled FEA/SEA Training
12 Oct 2016 to 13 Oct 2016

Basic PAM-STAMP
19 Oct 2016 to 20 Oct 2016

A One: SEA Training
24 Oct 2016 to 25 Oct 2016

Basudhar	Optimization, Probabilistic Design Using LS-OPT (3.5 days)	MI	Oct 25-28
Yan / Ho	Intro to LS-PrePost	CA	Oct 31
Tabiei	Intro to LS-DYNA	CA	Nov 1-4
Y Huang	NVH and Frequency Domain Analysis with LS-DYNA	CA	Nov 7-8
Tabiei	Adv Impact	MI	Dec 8-9
Yan / Ho	Intro to LS-PrePost	MI	Dec 12
Tabiei	Intro to LS-DYNA	MI	Dec 13-16

LS-DYNA On Line

Visit the website for complete listings/changes/locations

www.LSDYNA-ONLINE.COM

For Information contact: courses@lsdyna-online.com or 513-3319139

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.

BETA CAE Systems S.A. **www.beta-cae.gr**

BETA CAE Systems S.A.– 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 S.A.– µETA

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

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

CRAY

www.cray.com

THE CRAY® XC™ SERIES: ADAPTIVE SUPERCOMPUTING ARCHITECTURE

The Cray® XC™ series delivers on Cray's commitment to an adaptive supercomputing architecture that provides both extreme scalability and sustained performance. The flexibility of the Cray XC platform ensures that users can precisely configure the machines that will meet their specific requirements today, and remain confident they can upgrade and enhance their systems to address the demands of the future.

Cray® XC40™ and XC40-AC™ supercomputers are enabled by a robust Intel® Xeon® processor road map, Aries high performance interconnect and flexible Dragonfly network topology, providing low latency and scalable global bandwidth to satisfy the most challenging multi-petaflops applications.

While the extreme-scaling Cray XC40 supercomputer is a transverse air-flow liquid-cooled architecture, the Cray XC40-AC air-cooled model provides slightly smaller and less dense supercomputing cabinets with no requirement for liquid coolants or extra blower cabinets. A reduced network topology lowers costs, and the system is compatible with the compute technology, OS, ISV and software stack support of high-end XC40 systems.

MAXIMIZE PRODUCTIVITY WITH CRAY CS SERIES SUPERCOMPUTERS

Understanding the need for nimble, reliable and cost-effective high performance computing (HPC), we developed the Cray® CS™ cluster supercomputer series. These systems are industry-standards-based, highly customizable, and expressly designed to handle the broadest range of medium- to large-scale simulation and data analytics workloads.

All CS components have been carefully selected, optimized and integrated to create a powerful HPC environment. Flexible node configurations featuring the latest processor and interconnect technologies mean you can tailor a system to your specific need — from an all-purpose cluster to one suited for shared memory, large memory or accelerator-based tasks.

Innovations in packaging, power, cooling and density translate to superior energy efficiency and compelling price/performance. Expertly engineered system management software instantly boosts your productivity by simplifying system administration and maintenance.

Maximize your productivity with flexible, high-performing Cray CS series cluster supercomputers.

CRAY **www.cray.com**

CRAY® SONEXION® SCALE-OUT LUSTRE®STORAGE SYSTEM

Brought to you by Cray, the world's leading experts in parallel storage solutions for HPC and technical enterprise, the Cray® Sonexion® 2000 system provides a Lustre®-ready solution for popular x86 Linux® clusters and supercomputers through Cray Cluster Connect™. As a leader in open systems and parallel file systems, Cray builds on open source Lustre to unlock any industry-standard x86 Linux compute cluster using InfiniBand™ or 10/40 GbE utilizing proven Cray storage architectures.

The Cray Sonexion 2000 system provides 50 percent more performance and capacity than the Sonexion 1600 system in the same footprint.

Simplify

- Through its fully-integrated and pre-configured design, Cray Sonexion storage gets customers deployed faster and reduces the total number of components to manage.
- The Sonexion system's compact design reduces the total hardware footprint of petascale systems by 50 percent over component-based solutions.

Scale

- Performance scales from 7.5 GB/s to 1.7 TB/s in a single file system.
- Capacity scales in modular increments; the Sonexion 2000 system stores over two usable petabytes in a single rack. Fewer drives and components reduce capital costs as capacity grows.

Protect

- New software-based GridRAID offers higher levels of data protection and up to 3.5 times faster rebuild times than traditional RAID6 and MD-RAID storage.
- Cray ensures quality, reliability and stability at scale through exhaustive thermal and real-world stress testing, system hardening and availability, and tight hardware and software integration.

OPEN ARCHIVE AND TIERED STORAGE SYSTEM FOR BIG DATA AND SUPERCOMPUTING

Cray Tiered Adaptive Storage (TAS), powered by Versity, is designed to meet the expansive data preservation and access needs driven by big data, where data needs to migrate fluidly from high performance storage to deep tape archives, while always being accessible to users.

CRAY www.cray.com

With Cray TAS you can:

- Deploy tiered storage and archives faster
- Feel confident preserving and protecting data into the future, using Linux®
- Simplify managing data using familiar tools for years to come

CRAY® URIKA-XA™ EXTREME ANALYTICS PLATFORM

Pre-integrated, open platform for high performance analytics delivers valuable business insights now and into the future

The flexible, multi-use Cray® Urika-XA™ extreme analytics platform addresses perhaps the most critical obstacle in data analytics today — limitation. Analytics problems are getting more varied and complex but the available solution technologies have significant constraints. Traditional analytics appliances lock you into a single approach and building a custom solution in-house is so difficult and time consuming that the business value derived from analytics fails to materialize.

In contrast, the Urika-XA platform is open, high performing and cost effective, serving a wide range of analytics tools with varying computing demands in a single environment. Pre-integrated with the Apache Hadoop® and Apache Spark™ frameworks, the Urika-XA system combines the benefits of a turnkey analytics appliance with a flexible, open platform that you can modify for future analytics workloads. This single-platform consolidation of workloads reduces your analytics footprint and total cost of ownership.

Based on pioneering work combining high-performance analytics and supercomputing technologies, the Urika-XA platform features next-generation capabilities. Optimized for compute-heavy, memory-centric analytics, it incorporates innovative use of memory-storage hierarchies and fast interconnects, which translates to excellent performance at scale on current as well as emerging analytics applications.

Additionally, the enterprise-ready Urika-XA platform eases the system management burden with a single point of support, standards-based software stack and compliance with enterprise standards so you can focus on extracting valuable business insights, not on managing your environment.

CRAY **www.cray.com**

THE URIKA-GD™ GRAPH DISCOVERY APPLIANCE IS A PURPOSE-BUILT SOLUTION FOR BIG DATA RELATIONSHIP ANALYTICS.

The Urika-GD™ appliance enables enterprises to:

- Discover unknown and hidden relationships and patterns in big data
- Build a relationship warehouse, supporting inferencing/deduction, pattern-based queries and intuitive visualization
- Perform real-time analytics on the largest and most complex graph problems

The Urika-GD system is a high performance graph appliance with a large shared memory and massively multithreaded custom processor designed for graph processing and scalable I/O.

With its industry-standard, open-source software stack enabling reuse of existing skill sets and no lock in, the Urika-GD appliance is easy to adopt.

The Urika-GD appliance complements an existing data warehouse or Hadoop® cluster by offloading graph workloads and interoperating within the existing enterprise analytics workflow.

Realize rapid time to powerful new insights.

DatapointLabs **www.datapointlabs.com**

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

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

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

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

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

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

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.

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
The Software House of Arup

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

恒士达科技
Hengstar Tech.

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 focus 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** www.mfac.com	galb@mfac.com
	LS-DYNA LSTC Dummy Models eta/DYNAFORM	LS-OPT LSTC Barrier Models INVENTIUM/PreSys	LS-PrePost eta/VPG	LS-TaSC

Mexico	**COMPLX** **www.complx.com.mx** /	Armando Toledo armando.toledo@complx.com.mx
	LS-DYNA LS-OPT	LS-PrePost LS-TAsc Barrier/Dummy Models
United States	**CAE Associates Inc.** www.caeai.com	info@caeai.com
	ANSYS Products CivilFem	Consulting ANSYS Consulting LS-DYNA
United States	**DYNAMAX** www.dynamax-inc.com	sales@dynamax-inc.com
	LS-DYNA LS-OPT LSTC Dummy Models	LS-PrePost LS-TaSC 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

Italy	**EnginSoft SpA**		info@enginsoft.it	
	www.enginsoft.it			
	ANSYS	MAGMA	Flowmaster	FORGE
	CADfix	LS-DYNA	Dynaform	Sculptor
	ESAComp	AnyBody	FTI Software	
	AdvantEdge	Straus7	LMS Virtual.Lab	ModeFRONTIER

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

www.apic.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 to the increase use of LS-DYNA more and more in recent years.

In calculations of optimization, robustness, statistical analysis, larger amount of LS-DYNA license in short term are required.

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

This service is offered to the customers by the additional price to existence on-premises license, which is relatively inexpensive 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/

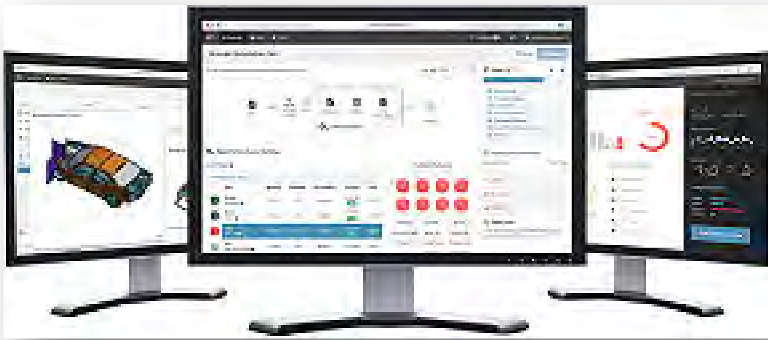
Focus
Foundation for Computational Science
http://www.j-focus.or.jp

Platform Computation Cloud
CreDist.Inc.
http://www.credist.co.jp /

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

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

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.

Rescale Cloud Simulation Platform

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/software-solutions/cloud-solutions/esi-cloud

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/software-solutions/cloud-solutions/esi-cloud

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

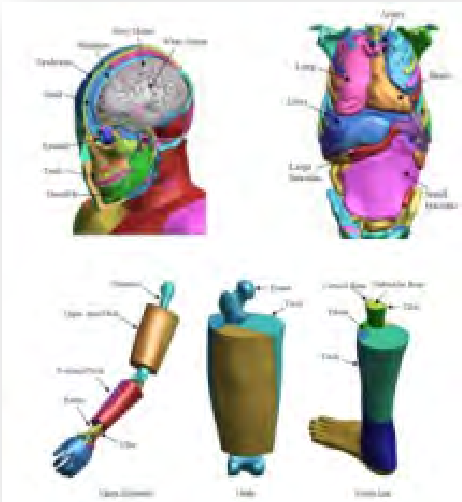
Collaboration

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

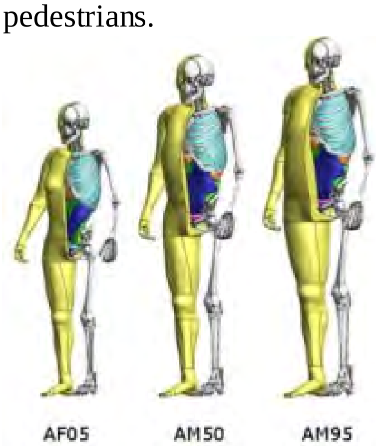
TOYOTA - Total Human Model for Safety – THUMS



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.

FACEBOOK

BETA CAE SYSTEMS SA | CADFEM | Cray Inc.

ESI Group | Lenovo

TWITTER

BETA CAE SYSTEMS SA | Cray Inc. | ESI Group

ETA | CADFEM | Lenovo

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Introduction to the new Framework for User Subroutine Development of LS-DYNA

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Abstract

A new framework has been introduced to LS-DYNA since the recent release R9.0. It allows all the LS-DYNA user subroutines to be complied into an independent dynamic library and loaded on demand. Multiple dynamic libraries can be loaded simultaneously. Conflicts resulting from multiple implementations of the same material models can be resolved through rules specified in the keyword file during run time. The new framework is completely backward compatible with the current user subroutines, without any changes to the existing source code. In the present paper, it is shown how to build, load and debug the dynamic library of the user subroutines. The rules are introduced for the case that multiple dynamic libraries are loaded.

Introduction

LS-DYNA is a general-purpose finite element program for multi-physics analysis. It has been widely used in many industries for several decades. LS-DYNA consists of a single executable and supports various state-of-the-art parallelization technologies. In addition, users have created their own customized versions of LS-DYNA through user subroutines to extend the applications of LS-DYNA. User subroutines support many features, including

- User material models (*MAT_USER_DEFINED_MATERIAL_MODELS)
- User thermal material models (*MAT_THERMAL_USER_DEFINED)
- User equations of state (*EOS_USER_DEFINED)
- User solid elements (*SECTION_SOLID)
- User shell elements (*SECTION_SHELL)
- Various utility subroutines, such as material failure criteria, load and boundary conditions, and outputs.

Of these, the user material models have been the most widely used. Within LS-DYNA, ten material IDs are reserved for user material models from the very beginning, i.e. UMAT41-UMAT50. Indeed, there have been numerous material models developed successfully. Many of them have also been adopted and included in the LS-DYNA releases. In recent years, a common request among LS-DYNA users is to allow the concurrent use of one user material ID from multiple model developers. This request is beyond the capability of the original development framework which was defined tens of years ago, which allows only one implementation of each user subroutine to be compiled and linked into the LS-DYNA executable.

A new framework for user subroutines has been introduced into the recent release, R9.0. It has a distinguishing feature: that LS-DYNA is completely decoupled from the user subroutines. It makes the use of the user subroutines more flexible

- One LS-DYNA executable is needed. No more customized executables.
- The LS-DYNA executable runs well with all features. No user subroutines are required if they are not used in the input deck.
- The LS-DYNA executable can load one single dynamic library during runtime if one set of user subroutines are implemented. It works as the original development framework and no rules are required.
- The LS-DYNA executable can load multiple dynamic libraries in which multiple implementations of the same user subroutines are allowed. The rules can be specified in the input deck to define how they are applied to different parts.

This feature is enabled with three new keywords which are documented in the R9 manuals. Keyword *MODULE_PATH specifies the path where the dynamic libraries are stored. Keyword *MODULE_LOAD specifies the file name of the library to be loaded. Keyword *MODULE_USE defines the rules on how to apply the loaded dynamic libraries to the corresponding parts in the model. These three keywords can be repeated as many times as necessary. This feature is still under development and currently supported by the Linux MPP executables. It requires a MODULE-enabled executable to support these three MODULE keywords.

In general, this feature supports all user subroutines, including the user material models, elements, utilities and so on. In the present paper, it is demonstrated through the use of the user material models only. Interested users may refer to the LS-DYNA manuals for more details.

Compilation of the user subroutines

The new framework provides a user subroutine package. All the source files are identical to those provided for the original framework. It allows the existing user subroutines to be reused without any changes. The only difference is in the build script, “Makefile”, in which all compiler settings are specified as variables, for an example a MPP package with the Intel compiler, as:

```
MY_FLAG = -fPIC -O2 -safe_cray_ptr -xSSE2 -align array16byte ......
FC = /opt/platform_mpi/bin/mpif90
LD = /opt/platform_mpi/bin/mpif90 -shared -nofor_main
export MPI_F77 := /opt/intel/composer_xe_2013.5.192/bin/intel64/ifort

MY_TARGET = demo.so
MY_OBJS = dyn21.o dyn21b.o init_dyn21.o ......
MY_INC = nlqparm define.inc define2.inc ......
```

where

MY_FLAG defines the compiler flags. It should not be changed in most cases.

FC and LD specify the MPI compiler and linker respectively which should match the MPI installation.

MPI_F77 specifies the Intel Fortran compiler which should match the compiler installation.

MY_TARGET defines the output file name of the dynamic library. It can be changed accordingly.

Once done, run "make" in the same folder and the dynamic library will be built and saved as "demo.so" which is specified in "MY_TARGET". This dynamic library can be tested by running the MODULE-enabled LS-DYNA executable with the sample input deck provided in Appendix A.

The user can make the changes to the source files provided in the user subroutine package, or add more source files by changing the variable "MY_OBJS" in "Makefile".

The compiler flags defined in "MY_FLAG" are set for building the release version of the user subroutines. The option "-O2" may be replaced with "-g -O0" to build the source code for debug. The LS-DYNA executable can be started within a debugger, for example, "gdb", as

```
gdb mppdyna
```

It needs to be pointed out that the dynamic library is not loaded until the LS-DYNA executable is executed. So the breakpoints within the dynamic library may not be set in some systems. If so, the following option needs to be set within "gdb",

```
set breakpoint pending on
```

which indicates that all pending breakpoints should automatically set when the dynamic library is loaded. Then the breakpoint can set for the dynamic library before the LS-DYNA is started, for example,

```
break umat41
```

The MODULE Feature

The MODULE-enabled LS-DYNA executable does not need any dynamic libraries to run a regular job, if no user subroutine is used in the model. It can be used as a standard release version of the LS-DYNA executable.

If one dynamic library is required, only the keyword *MODULE_LOAD needs to be added to the input deck. As shown in Figure 1, the keyword defines a unique id within the current input deck of the dynamic library to be loaded. The title is just for information purposes. The existing user subroutines prior to R9.0 can be built into a dynamic library, instead of a customized executable. It can be loaded by the MODULE-enabled LS-DYNA executable through keyword *MODULE_LOAD. The dynamic library can be used without recompilation if the LS-DYNA executable is updated, as they are completely decoupled. The user may put all dynamic libraries in a common shared folder, and use the keyword *MODULE_PATH to specify this folder. So the LS-DYNA executable is able to load the required dynamic libraries from there.

Card Sets. Repeat as many sets data cards as desired (cards 1 and 2) to load multiple libraries. This input ends at the next keyword ("*") card.

Card 1	1	2	3	4	5	6	7	8
Variable	MDLID		TITLE					
Type	A20		A60					
Default	none		none					

Card 2	1	2	3	4	5	6	7	8
Variable	FILENAME							
Type	C							
Default	none							

Figure 1. keyword *MODULE_LOAD

One of the most important uses of the MODULE is to load multiple user dynamic libraries. For example, three dynamic libraries are required within one job, one is developed and compiled in house and other two are provided by the material vendors without the source code. Keyword *MODULE_LOAD can load all libraries at once, as

```
*MODULE_LOAD
my_mod
libusermat_105657.so
mod_a
/vendor/lib_vendorA.so
mod_b
/vendor/lib_vendorB.so
```

in which three unique ids are defined for three dynamic libraries, as "my_mod", "mod_a", and "mod_b". Let us assume that the following user material models are implemented in each dynamic library,

```
my_mod contains UMAT41
mod_a contains UMAT41, UMAT42, UMAT43
mod_b contains UMAT41, UMAT42, UMAT45, UMAT46
```

Case 1:

For a simple case, the model needs UMAT41 in "my_mod", UMAT42 in "mod_a", and UMAT45 & UMAT46 in "mod_b". In other words, UMAT41 defined in the model should be mapped to "my_mod", and UMAT42 to "mod_a", and UMAT45 & UMAT46 to "mod_b". One may define the rules with the use of keyword *MODULE_USE as shown in Figure 2, in a straight forward manner, as

```
*MODULE_USE
my_mod
UMAT, 41, 41
*MODULE_USE
mod_a
UMAT, 42, 42
*MODULE_USE
mod_b
UMAT, 45, 45
UMAT, 46, 46
```

It does not require any changes to the existing input deck except adding the MODULE keywords.

The rules defined in *MODULE_USE are applied to only one dynamic library.

Card 1	1	2	3	4	5	6	7	8
Variable	MDLID							
Type	A20							
Default	none							

Rule Cards. Card 2 defines rules for the module specified in Card 1. Repeat as many cards as needed if defining multiple rules. New rules override existing rules, in case of a conflict. Input ends at the next keyword ("*") card.

Card 2	1	2	3	4	5	6	7	8
Variable	TYPE		PARAM1		PARAM2			
Type	A20		A20		A20			
Default	none		blank		blank			

Figure 2. keyword *MODULE_USE

Case 2:

For another simple case, the model needs UMAT41 from all three libraries. UMAT41 defined in the model should be mapped to UMAT41 in “my_mod”, UMAT42 to UMAT41 in “mod_a”, and UMAT43 to UMAT41 in “mod_b”. The corresponding rules can be defined as

```
*MODULE_USE
my_mod
UMAT, 41, 41
*MODULE_USE
mod_a
UMAT, 42, 41
*MODULE_USE
mod_b
UMAT, 43, 41
```

Case 3:

As a general practice, one may use virtual material model IDs to define the rules. With LS-DYNA, the material IDs from 1001 to 2000 can be used as UMAT TYPE in the user material card, besides ten reserved IDs from 41 to 50 (referring to *MAT_USER_DEFINED_MATERIAL_MODELS). The virtual material IDs can be assigned to the dynamic libraries from the vendors. For example,

UMAT IDs 1201~1210 are assigned to UMAT41~50 in “mod_a”

UMAT IDs 1211~1220 are assigned to UMAT41~50 in “mod_b”

Then the corresponding user material models can always be used through their virtual material IDs. For the example defined in Case 2, the rules can be defined as

```
*MODULE_USE
my_mod
UMAT, 41, 41
*MODULE_USE
mod_a
UMAT, 1201, 41
*MODULE_USE
mod_b
UMAT, 1211, 41
```

in which UMAT41 in “mod_a” is always used as UMAT1201, and UMAT41 in “mod_b” as UMAT1211.

Some New Keywords for User Subroutines

Two new keywords are under development to support user subroutines. The first one is keyword *USER_PARAMETER. Some user parameters/data can be provided in the input deck for the user subroutines to access during runtime. These data can be integers, real numbers, or multiple line text, with a unique label. The LS-DYNA executable reads and saves the data into memory as is. The use of the data is solely dependent on the implementation of the user subroutines. Some typical uses may include extra parameters for the material models, version control, settings, and so on.

Another keyword is *USER_KEYWORD. Once the LS-DYNA keyword reader reaches this keyword, the keyword reader provided in the dynamic library will continue to read the input deck and generate the dynamic keywords for the LS-DYNA keyword reader. It means that the user keyword reader can read its own keywords and create models during runtime. Such models can be generated from the parameters read from the input deck, loaded from the central database, or any other sources.

Some Remarks

The new framework is under development. Its MPP version is available in R9.0 for the Linux system. The new framework will strive to maintain backward compatibility. The dynamic libraries compiled for R9.0 will be loaded and used by the later LS-DYNA MODULE-enabled executables, as in its binary form. It becomes easier to maintain the user subroutines which become a part of the input deck.

Appendix A: A sample input deck

```
*KEYWORD
*TITLE
$#                                                                         title
UMAT development
*MODULE_LOAD
myumat41
demo.so
*CONTROL_TERMINATION
$#  endtim    endcyc     dtmin    endeng    endmas
  1.000000         0     0.000     0.000 1.0000E+8
*DATABASE_BINARY_D3PLOT
$#      dt      lcdt      beam     npltc    psetid
    1.0E-2         0         0         0         0
*BOUNDARY_PRESCRIBED_MOTION_SET
$#    nsid       dof       vad      lcid        sf       vid     death     birth
         1         1         0         1       1.0         0 1.0000E28       0.0
*SET_NODE_LIST_TITLE
x=L
$#     sid       da1       da2       da3       da4    solver
         1       0.0       0.0       0.0       0.0MECH
$#    nid1      nid2      nid3      nid4      nid5      nid6      nid7      nid8
         2         4         6         8         0         0         0         0
*BOUNDARY_SPC_SET
$#    nsid       cid      dofx      dofy      dofz     dofrx     dofry     dofrz
         2         0         1         0         0         0         0         0
*SET_NODE_LIST_TITLE
x=0
$#     sid       da1       da2       da3       da4    solver
         2       0.0       0.0       0.0       0.0MECH
$#    nid1      nid2      nid3      nid4      nid5      nid6      nid7      nid8
         1         3         5         7         0         0         0         0
*BOUNDARY_SPC_SET
$#    nsid       cid      dofx      dofy      dofz     dofrx     dofry     dofrz
         3         0         0         1         1         0         0         0
*SET_NODE_LIST_TITLE
```

```
all
$#     sid       da1       da2       da3       da4    solver
         3       0.0       0.0       0.0       0.0MECH
$#    nid1      nid2      nid3      nid4      nid5      nid6      nid7      nid8
         1         2         3         4         5         6         7         8
*PART
$#                                                                         title
one-element test
$#     pid     secid       mid     eosid      hgid      grav    adpopt      tmid
         1         1         1         0         0         0         0         0
*SECTION_SOLID
$#   secid    elform       aet
         1         1         0
*MAT_USER_DEFINED_MATERIAL_MODELS
$#     mid        ro        mt       lmc       nhv    iortho     ibulk        ig
         1    7800.0        41         4         0         0         3         4
$#   ivect     ifail    itherm    ihyper      ieos      lmca    unused    unused
         0         0         0         0         0         0
$#      p1        p2        p3        p4        p5        p6        p7        p8
    1.5E11      0.25    1.0E11      6E10
*DEFINE_CURVE_TITLE
X-velocity
$#    lcid      sidr       sfa       sfo      offa      offo    dattyp     lcint
         1         0       1.0       1.0       0.0       0.0         0         0
$#                a1                  o1
                 0.0                 1.0
                 1.0                 1.0
*ELEMENT_SOLID
$#   eid     pid      n1      n2      n3      n4      n5      n6      n7      n8
       1       1       1       2       4       3       5       6       8       7
*NODE
$#   nid               x               y               z      tc      rc
       1             0.0             0.0             0.0       0       0
       2             2.0             0.0             0.0       0       0
       3             0.0             1.0             0.0       0       0
       4             2.0             1.0             0.0       0       0
       5             0.0             0.0             1.0       0       0
       6             2.0             0.0             1.0       0       0
       7             0.0             1.0             1.0       0       0
       8             2.0             1.0             1.0       0       0
*MAT_ELASTIC
$#     mid        ro         e        pr        da        db  not used
        11    7800.0    1.5E11      0.25       0.0       0.0         0
*END
```

New Features in *ELEMENT_LANCING

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LSTC

INTRODUCTION

New features have been developed related to metal forming lancing process simulation:

1. A part set is now allowed, which enables lancing across tailor-welded blanks.
2. IGES format curves can now be used as input to define the lancing route.
3. Meshes along the lanced boundary is now automatically adapted to provide a smooth edge.
4. Trimming now can be defined after lancing to remove the scrap. This is done with the new keyword *DEFINE_LANCE_SEED_POINT_COORDINATES.
5. Lancing activation distance can now be defined using a new variable CIVD.

MAIN FEATURES/EXAMPLES

1. To accommodate lancing process across the laser welded line, a part set can now be defined. When the variable IDPT is less than zero, the absolute value will be the part set ID, which could include many parts. Lance curves can go across the boundary between the parts therefore performing lancing over two part IDs at the same time. This is illustrated in Figure 1 on a door inner part.

2. Lance curve is defined using the keyword card *DEFINE_CURVE_TRIM_3D. Previously, the curve must be defined using TCTYPE=1 and input as X, Y, Z coordinates under the card. This adds to additional time spent in preparing the input deck. The new feature allows (IGES format) curve file name to be used directly in the keyword as the lancing curve (set TCTYPE=2), much like how one would define a 3-D trimming curve. Supported IGES curve entities include 106, 110, but not 126. The following card includes an IGES format lancing curve with file name of “Lancecurve.iges”.

```
*DEFINE_CURVE_TRIM_3D
$#    tcid    tctype      tflg      tdir     tctol      toln     nseed
         1         2         1               0.100         1
Lancecurves.iges
```

3. To improve the lanced boundary mesh smoothness, meshes around the lanced curve are now automatically refined by activating and setting IREFINE=1 by default. The refinement goes until no adapted nodes exist in the lancing neighborhood. This also improves lancing process simulation robustness. This is illustrated in Figure 2 (left), where previous lanced meshes is shown, and in Figure 2 (right), where automatic mesh refinement is performed.

4. The scrap can be removed after an instant lancing simulation. This is effectively a "lanced-trimming" simulation. An extra keyword, *DEFINE_LANCE_SEED_POINT_ COORDINATES is needed to define the portion that would remain after the lancing and trimming. It should be obvious that the lancing curve defined by *DEFINE_CURVE_TRIM _3D must form a closed loop. The following example will trim a part ID 9 with a fully enclosed lancing curve #1, at time=0.049 seconds. Since the termination time is 0.0525 seconds, the scrap will be deleted (trimmed off) before the simulation ends. The scrap, enclosed by the curve, is located outside of the seed node with coordinates (-289.4, 98.13, 2354.679), defined by *DEFINE_LANCE _SEED_POINT_COORDINATES. Using the keyword, the lanced scrap is removed as shown in Figure 3 (left), while in Figure 3 (right), without using the keyword, the scrap remains.

```
*CONTROL_TERMINATION
0.0525
*ELEMENT_LANCING
$     IDPT      IDCV   IREFINE      SMIN        AT      ENDT    NTIMES
         9         1                        0.0490
*DEFINE_CURVE_TRIM_3D
$#    tcid    tctype      tflg      tdir     tctol      toln     nseed
         1         1         1               0.100         1
$#                  cx                  cy                  cz
           172.99310           42.632320           43.736160
           175.69769          -163.08299           46.547531
           177.46982          -278.03793           49.138161
           186.82404          -303.67191           51.217964
           205.16177          -315.33484           53.299248
           223.13152          -308.03534           54.193089
               ⋮                   ⋮                   ⋮
           172.99310           42.632320           43.736160
           172.99310           42.632320           43.736160
*DEFINE_LANCE_SEED_POINT_COORDINATES
$    NSEED        X1        Y1        Z1        X2        Y2        Z2
         1    -289.4     98.13   2354.679
```

This feature also makes it possible to combine the trimming process together with a forming simulation, saving a trimming step in a line-die process simulation by skipping writing out a formed dynain file and reading in the same file for the trimming simulation.

5. Lancing activation distance can now be defined using a new variable CIVD. The tool kinematics (time vs. velocity) is typically defined by the keyword *BOUNDARY_ PRESCRIBED _MOTION_RIGID. If the load curve (LCID) under the keyword is assigned to be the CIVD, the variables AT and ENDT will become the distances from punch bottom. Previously distance inputs were possible for AT and ENDT but would have to be calculated from the kinematics curve using *PARAMETER_EXPRESSION. In the following example, CIVD is assigned as a load curve ID 1113, which is used to prescribe a velocity boundary condition for a rigid PID16 in global Z-direction. Lancing will happen at 15.5 mm from PID16 bottom position.

```
*ELEMENT_LANCING

$     IDPT      IDCV   IREFINE      SMIN        AT      ENDT    NTIMES      CIVD

      -110      1117         1                15.5                          1113

*BOUNDARY_PRESCRIBED_MOTION_RIGID

$   TYPEID       DOF       VAD      LCID        SF       VID     DEATH     BIRTH

        16         3         0      1113

*DEFINE_CURVE
1113

0.0, 0.0

1.0E-03, 5000.0

...
```

6. An example of using the latest features of lance-trimming with negative IDPT, IGES curve, a seed node and CIVD is listed below. The following partial keyword input shows instant lance-trimming across the weld line of a tailor-welded blank using the part set ID “blksid” 100, which consists of PIDs 1 and 9. The part set ID used for *ELEMENT_LANCING input is “idpt”, which is set as the negative of blksid (-100). The lance-trimming curve ID 1117 is defined using the file lance4.iges in IGES format (TCTYPE=2). The variable CIVD is referred to load curve ID 1115, which is the kinematic curve for the punch. The lancing starts at 15.5 mm away from punch bottom (AT=15.5). A lance seed coordinate (-382.0, -17.0, 76.0) is defined using the keyword *DEFINE_LANCE_SEED_POINT_COORDINATES, resulting in the lanced scrap piece being removed after lancing.

```
*PARAMETER

I blk1pid         1

I blk2pid         9

I blksid        100

*SET_PART_LIST

&blksid

&blk1pid    &blk2pid

*PARAMETER_EXPRESSION

I idpt        -1*blksid

*ELEMENT_LANCING
```

```
$     IDPT      IDCV   IREFINE      SMIN        AT      ENDT    NTIMES      CIVD
     &idpt      1117         1              15.5                            1115
*DEFINE_CURVE_TRIM_3D
$#    tcid    tctype      tflg      tdir     tctol      toln    nseed1    nseed2
      1117         2         1         0    0.1000         0
lance4.iges
*DEFINE_LANCE_SEED_POINT_COORDINATES
$     NSUM        X1        Y1        Z1        X2        Y2        Z2
         1  -382.000   -17.000      76.0
*BOUNDARY_PRESCRIBED_MOTION_RIGID
$   TYPEID       DOF       VAD      LCID        SF       VID     DEATH     BIRTH
  &udiepid         3         0      1113                      &clstime
  &bindpid         3         0      1114                      &clstime
  &udiepid         3         0      1115                      &endtime  &clstime
  &bindpid         3         0      1115                      &endtime  &clstime
```

REVISION INFORMATION:

1. Revision 107708: support IREFINE=1.
2. Revision 107262: lancing with trimming is supported.
3. Revision 110173: CIVD is supported, and AT and ENDT become distances from punch home if CIVD is activated.
4. Revision 110177: support negative IDPT for part set ID, enabling lancing across the laser welded line.
5. Revision 110246: lancing curve definition in IGES format is supported.

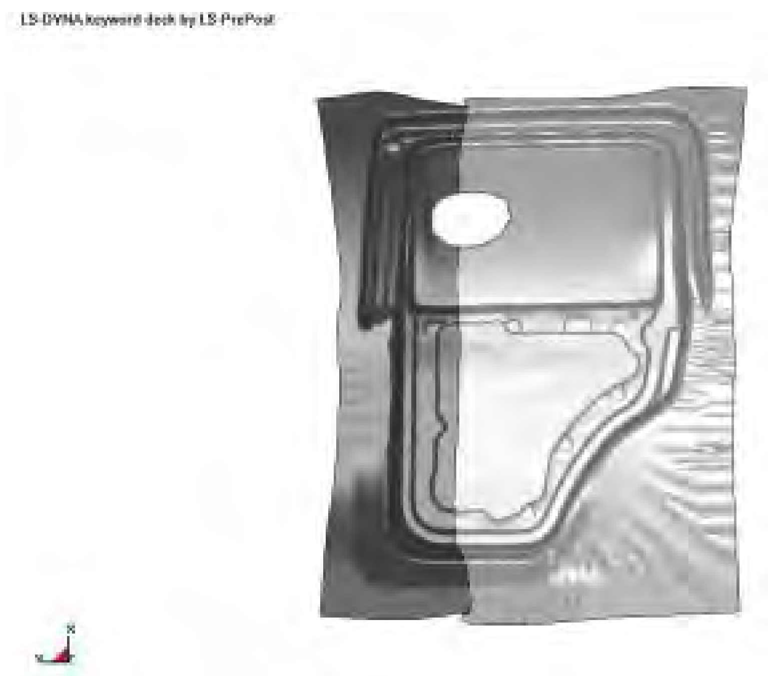

Figure 1. Lancing across .a laser welded line.

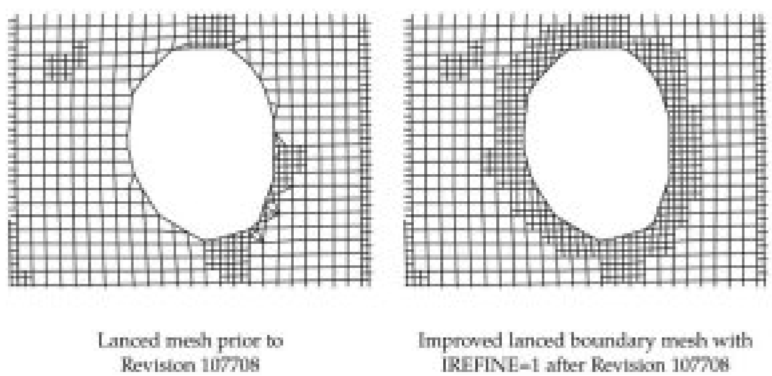

Figure 2. Set IREFINE=1 for mesh refinement along the lancing curve.

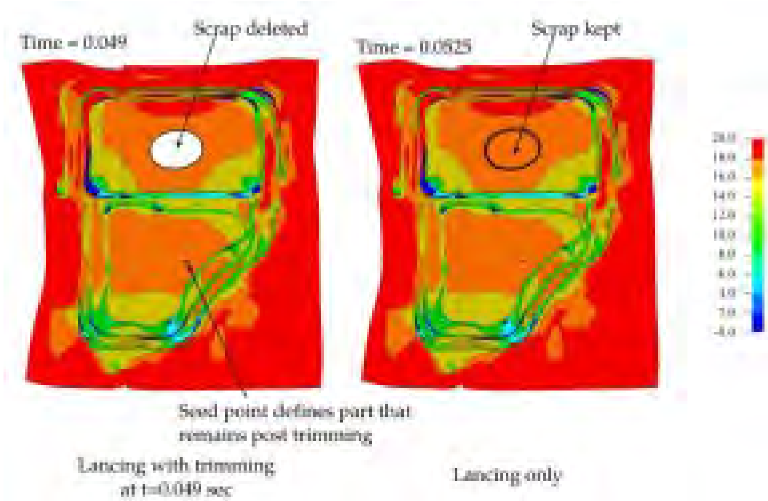

Figure 3. Remove lanced scrap using *DEFINE_LANCE_SEED_POINT_COORINDATES.