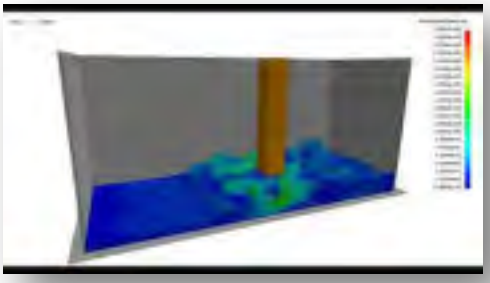
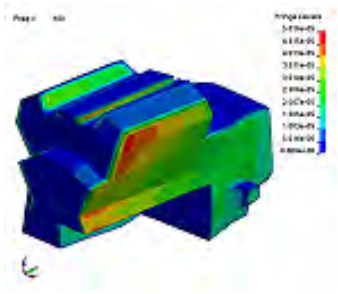
fea INFORMATION Engineering Solutions

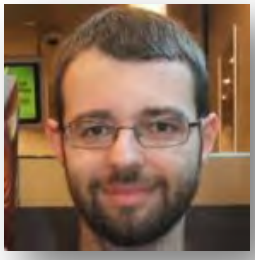
Volume 5, Issue 08, August 2016



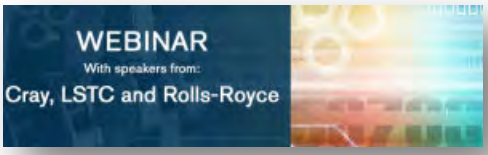
YouTube Showcase



ERP density fringe plot

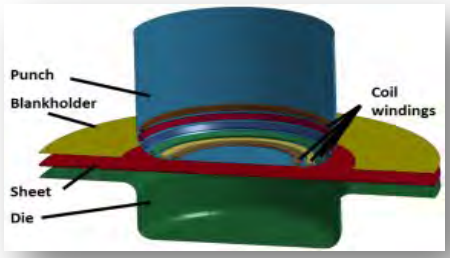


Francois-Henry Rouet



Live webinar on Tuesday, September 13

AGENDA



EM Module

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
- FEA Information China Engineering Solutions

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.

logo courtesy - Lancemore

logo courtesy - Lancemore

FEA Information News Sections

Articles – Blogs - News

AUTOMOTIVE & AEROSPACE NEWS & EVENTS

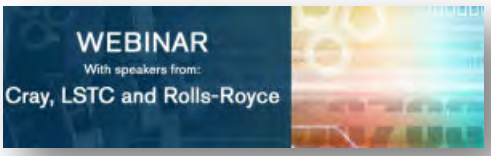
LS-DYNA Update/News

Announcements

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

AUGUST PRESENTATION Showcase
Equivalent Radiated Power calculation with LS-DYNA
Yun Huang, Zhe Cui

Woosik Chung - THEME – Korea new email address:
Theme Engineering (South Korea) wschung7@gmail.com Tel: +82 2-839-5804



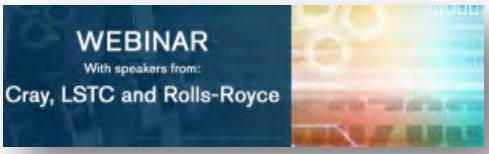
Tuesday – September 13th
CRAY – LSTC – ROLLS ROYCE

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

CRAY – LSTC & Rolls-Royce Webinar

http://web.cray.com/CAE_webinar_series_LSTC

Live webinar on Tuesday, September 13



Enhance the scaling and reduce the elapsed time of simulations so even the largest jobs run with overnight turnaround.

If you're running LS-DYNA simulations, you know how demanding – and time consuming – they can be.

But LS-DYNA simulations are extremely valuable in product design process. How can you increase the model accuracy and continue to meet the product development schedules?

Cray and LSTC, the developers of LS-DYNA, have been working with leading-edge users – including Rolls-Royce – to enhance the scaling and reduce the elapsed time of simulations so even the largest jobs run with overnight turnaround.

Join us for a live webinar on Tuesday, September 13th

WEBINAR DETAILS http://web.cray.com/CAE_webinar_series_LSTC

Date: **Tuesday, September 13**
First session: **8 a.m. PT/10 a.m. ET/4 p.m GMT (UTC +7)**
Second session: **6 p.m. PT/ 9 a.m Next Day CST (UTC +8)**
6:30 a.m. Next Day IST (UTC +5:30)

You'll hear about new performance improvements for LS-DYNA 8.0, get details from a recent benchmark project using a large aerospace turbine engine model, and leave with a better understanding of application scalability requirements for LS-DYNA simulations.

CRAY – LSTC & Rolls-Royce Webinar

http://web.cray.com/CAE_webinar_series_LSTC

The Webinar will provide an opportunity to ask questions of the LSTC, Rolls-Royce and Cray engineers working on this joint project.

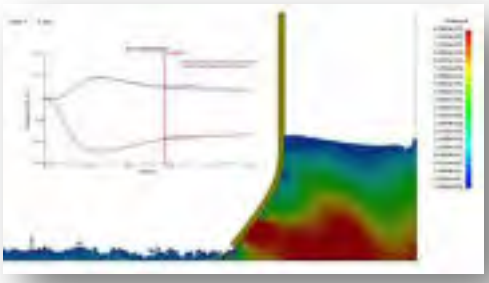
Inaki Caldichouri
Software engineer
Livermore Software Technology Corp.,

Inaki Caldichouri is a software engineer at Livermore Software Technology Corp., where he is responsible for development, support activities, code validation and quality assurance on the computational fluid dynamics and electromagnetics modules. He graduated from ISAE, the French Institute of Aeronautical and Space Engineering, in 2011 with a degree in aeronautics, and joined LSTC the same year.

James Ong
Business Improvement Lead in Core Design
Rolls-Royce

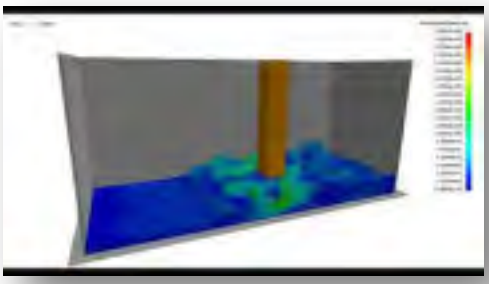
James Ong, Ph.D. is Extreme Event Management System Lead/Senior Technical Specialist at Rolls-Royce with experience in developing math-based design tools for structural design systems. His work experience includes using LS-DYNA to analyze and design the gas turbine engine applications with highly material & geometry nonlinear and dynamic behaviors. Currently, he is part of the team at Rolls-Royce to evaluate LS-Dyna's implicit and explicit solver performance on HPC. He also earned his Ph.D. and M.S. in Theoretical and Applied Mechanics from Northwestern University. He has published 13 research papers and received 1 US patent.

August LS-DYNA YouTube Showcase –

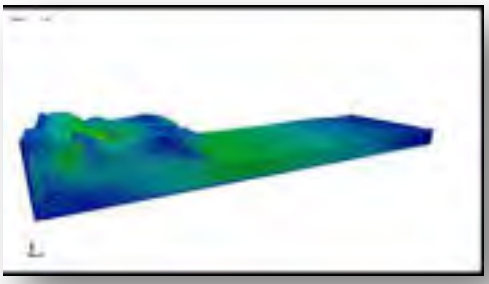


FSI Validation problem of an gate opening due to the pressure forces of water. Solid modeled with a hyperelastic material (Mooney rivlin rubber) in order to match with experimental data.

LS-DYNA SPH : Dam break with elastic gate
References :
[1] Numerical simulation of fluid-structure interaction by SPH.
Carla Antoci, Mario Gallati, Stefano Sibilla
[2] Fluid-Structure Interaction Simulation using an incompressible SPH method.
Ashkan Rafiee, Krish P. Thiagarajan
[3] SPH Simulation of Fluid-Strucrue Interaction Problems with Application to Hobercraft
Qing Yang (PHD thesis)



Test problem using the SPH solver in LS-DYNA.
References for the case :
[1] Wave-Structure interaction using smoothed particle hydrodynamics
[2] SPHysics –development of a free-surface fluid solver–Part2: Efficiency and test cases
[3] Computational techniques for stabilized edge based finite element simulation of non linear free surface flows

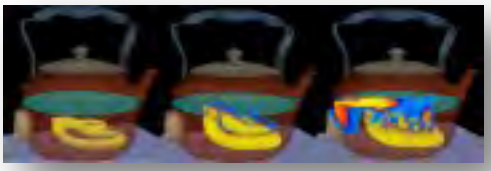


Test Problem using the SPH solver in LS-DYNA
Reference :
[1] : A Volume-of-Fluid based simulation method for wave impact problems. K. Kleefsman, G. Fekken, A. Veldman, B. Iwanowski and B. Buchner
[2] : Application of weakly compressible and truly incompressible SPH to 3D water collapse in waterworks. E. Lee, D. violeau, R. Issa and S. Ploix

Previous Months - Hailong Teng LS-DYNA on YouTube
Scientist/software developer at LSTC responsible for the development of Discrete Element Method (DEM), Particle Blast Method (PBM), and High order Element.

LS-DYNA electromagnetism (EM) module

The LS-DYNA electromagnetism (EM) module allows performing coupled mechanical/thermal/electromagnetic simulations. It uses a Finite Element Method (FEM) for the solid conductors coupled with a Boundary Element Method (BEM) for the surrounding air hence avoiding the need to mesh the air and allowing simulations with moving and/or deformable conductors. The EM solver is automatically coupled with the mechanics and the thermal solvers, allowing for accurate and easy to set up multiphysics simulations. Consequently, the LS-DYNA EM solver has been widely adopted by the electromagnetic metal forming and welding community.

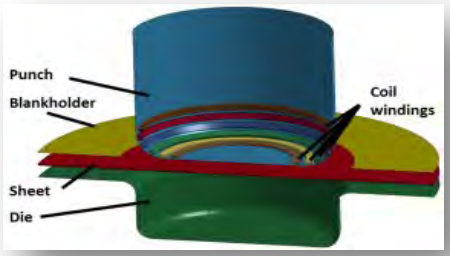


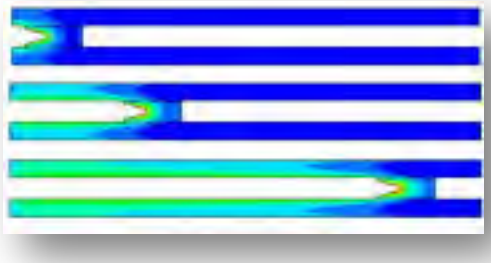
Features:

- Easy connection with external circuits
- Computation of self and mutual inductances
- 3D and 2D axisymmetric versions
- Electromagnetic contact
- Available with solid, shells and thick shells

Main Applications:

- Magnetic metal forming or welding
- Induced heating
- Resistive spot welding
- Sliding contact for rail gun applications
- Coupling with CFD solver for kettle applications
- Battery crush in electric car crash





web site: www.lstc.com/applications/em/

youtube channel: www.youtube.com/channel/UCPuoss7k_-IouTDXGT2EFiw

CAE Associates - Most Read Posts of 2016

Christina Capasso Jamerson -- August 2, 2016

Most Read Posts of 2016

The engineers at CAE Associates enjoy bringing you educational, informative blog posts each week. This week, we are reflecting back on the year so far and want to share the Top 5 Most Read posts of 2016. Take a moment to be sure you've viewed them all!

https://caeai.com/blog/most-read-posts-2016

1) 2D or not 2D? That is Often the FEA Modeling Question

Two-D, or not Two-D: that is the question: Whether 'tis nobler in the mind to suffer the slings and arrows of outrageous CPU time from 3D analyses; or to take arms against a sea of data, and by opposing, gain valuable results in a short period of time with a 2D simulation...

2) Mean Stress Corrections in Fatigue

An important topic in fatigue is accounting for the effect of non-zero mean stress.Mean stress is equal to the average of the maximum and minimum stress during a fatigue load cycle...

3) Tips & Tricks for FEA Modeling of Rubber and Elastomers - Part 1

Are you having problems solving a detailed stress analysis of an O-ring or seal? This post provides a series of tips for enhancing the accuracy and convergence of your simulation...

4) Tips & Tricks for FEA Modeling of Rubber and Elastomers - Part 2

In Part 1, three tips to consider when solving a detailed stress analysis of an O-ring or seal, including: material testing, material law selection, and testing of the selected material law were discussed. In this post, here are more great tips for enhancing the accuracy and convergence of your simulation...

5) Understanding Geometric Nonlinearities

When performing structural finite element analysis (FEA), there are three types of nonlinearities that the analyst needs to consider including in their simulation. Material nonlinearities are needed to predict plastic strains in metallic parts, cracking or crushing of concrete, or extreme deformation of plastic or rubber materials. Contact nonlinearities are required to predict change in status and/or sliding friction between assembly parts. The third option, geometric nonlinearity, involves a few different concepts and it is not always easy to identify when it is required...

Rescale Inc., - Announces Rescale Japan and Tokyo Office

This article was written by Rescale. http://blog.rescale.com/ August 17, 2016

Rescale establishes a new business entity Rescale Japan K.K. and an office in Otemachi, Chiyoda-ku, Tokyo

To oversee new and existing partnerships in Japan, Rescale appoints Atsuhiko Fukuda as the General Manager of Rescale Japan.

Rescale Inc., the San Francisco-based global leader in cloud HPC, today announced the establishment of a new business entity Rescale Japan K.K. and an office in Otemachi, Chiyoda-ku, Tokyo in order to accelerate Rescale's growth in the Japanese HPC market. To meet increasing demand from Rescale's customers in Japan and oversee new and existing partnerships, Rescale appoints Atsuhiko Fukuda as the General Manager of Rescale Japan.

Atsu brings rich experience in cloud and HPC enterprise sales in Japan to the company. Prior to joining Rescale, Atsu was responsible for enterprise partner sales at NVIDIA Japan and partner and OEM sales at Sun Microsystems. At Rescale, he will leverage his industry ties and local market knowledge to expand and deepen Rescale's presence in Japan, where HPC and cloud computing are strong sectors of Japan's leading IT industry. Atsu says, "I am very excited to be joining Rescale and look forward to evangelizing Rescale's unified cloud HPC platform throughout Japan to give our customers affordable, customizable, and intuitive cloud computing for a variety of HPC applications."

The first international office for Rescale marks an important step in the company's expansion of its product to global customers. With an expanded presence in Japan, Rescale will be able to better serve its existing partners and customers in Japan, as well as build and foster new relationships. Japan is home to a number of companies on the bleeding edge of R&D in automotive, rendering software, and deep learning. The new Tokyo office will provide better access to these customers, whose demanding computational needs and specialty hardware requirements are well-aligned with Rescale's product offering.

Rescale Inc., - Announces Rescale Japan and Tokyo Office

This article was written by Rescale. http://blog.rescale.com/ August 17, 2016

Rescale CEO Joris Poort shares Atsu's excitement, saying, "Japan is a critical market for Rescale, and we are lucky to have Atsu joining us to lead our growth in Japan. Atsu's experience, relationships, and knowledge of the Japanese HPC market will help us meet the increasing demands from leading Japanese companies to shift from legacy on-premise hardware systems to the latest cloud HPC platform technologies."

About Rescale

Rescale is the world's leading cloud platform provider of simulation software and high performance computing (HPC) solutions. Rescale's platform solutions are deployed securely and seamlessly to enterprises via a web-based application environment powered by preeminent simulation software providers and backed by the largest commercially available HPC infrastructure. Headquartered in San Francisco, CA, Rescale's customers include global Fortune 500 companies in the aerospace, automotive, life sciences, marine, consumer products, and energy sectors. For more information on Rescale products and services, visit www.rescale.com

JOIN RESCALE

- **2016 CONVERGE** User Conference - Stop by the Rescale booth at the CONVERGE User Conference at the Edgewater Hotel in Madison, WI / Sep 26, 2016
- **Rescale and IBM Cloud in Amsterdam** where we will present on designing interactive, scalable deep neural networks in the cloud. / Sep 28, 2016
- **GTC Europe** - Join Rescale and IBM Cloud in Amsterdam where we will present on designing interactive, scalable deep neural networks in the cloud. / Sep 28, 2016
- **GTC Japan** -Join Rescale and IBM Cloud for GTC Japan in Tokyo. / Oct 5, 2016
- **LS-DYNA Forum 2016** - Join Rescale in Bamberg where we'll present on how cloud HPC enables the digital transformation in product development / Oct 11, 2016

August – 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.

August Update

History Variables for Certain Material Models

www.dynasupport.com/howtos/material/history-variables

a new table of history variables of certain material models available in LS-DYNA.

Previous Changes

Jul 14, 2016

LS-DYNA R7.1.3 (R7.107967) released

May 26, 2016

Some guidelines for implicit analyses using LS-DYNA

BETA CAE Systems announces the release of the v16.2.2 of its software suite

www.beta-cae.com/news/20160810_announcement_suite_v16.2.2.htm

BETA CAE Systems announces the release of the new ANSA / Eπilysis / μETA v16.2.2 suite.

This maintenance release focuses on the correction of identified issues for the 16.2x branch and is addressed to those who wish to continue to use the v16.2x branch -and not upgrade to v17.x.

Excerpt from known issues resolved in ANSA – See website for full listings

NVH Console:

- Assembly Loadcase output would require excessive time to complete due to the performed renumbering.

LS-DYNA

- : Input CONTROL options might not be merged upon file input despite activating the "Header: Merge" option in the LS-DYNA Input Parameters window.
- Output Includes with encrypted content would not be output when the options "General>Output:'Model'" or "Misceleneous>Output: 'Disregard includes'" were selected.

Known issues resolved in Eπilysis

General:

- Improvements in Data Recovery performance in GPFORCE, Element Strain Energy and DISPLACEMENT calculation.
- When thermal loads were applied, element strain energy wasn't calculated correctly.
- Missing Header completely would cause termination with a core dump and without a specific FATAL Message, when solving "In ANSA".

Output

- A warning message has been added in case SPCD is applied on node not belonging in s-set due to missing SPC.
-

Known issues resolved in μETA

General

- Unexpected termination could occur upon visualizing deformation results as vector plot.
- Exporting a U3DPDF file might lead to unexpected termination.
- Strain gauge center/direction point coordinates could not be defined.

Supported Interfaces

- Erroneous ids of solid elements were generated when reading Pam-Crash ERFH5 files.
- Certain Ensight cases could not be read.
- SETs hierarchy would not be correctly read from PLMXML files.

BETA CAE Systems announces the release of the v16.2.2 of its software suite

www.beta-cae.com/news/20160810_announcement_suite_v16.2.2.htm

Curve Functions

- The Neck Injury Criterion was erroneously calculated for unit systems other than the S.I.
- The Percentile function could lead to unexpected termination.

NVH Calculators

- An unexpected termination could occur when saving an FRF.
- Panel Participation calculations were not correct in v16.2.1.

Projects & MetaDB

- The compression of saved projects was different from interface compared to sessions.
- Mapped results were not properly saved in projects.
- Unexpected termination could occur upon saving projects with planes.

Compatibility and Supported Platforms

- ANSA files saved by all the first and second point releases of a major version are compatible to each other. New major versions can read files saved by previous ones but not vice versa.
- To read μETA Project files by versions earlier than v16.2.2, they have to be saved selecting the option "Version <16.2.2".
- Support for 32-bit platform has been discontinued for all operating systems.

BETA CAE Open Meetings 2016 - White Papers – Case Studies

www.beta-cae.com/ourevents.htm

Recent white papers:

- ANSA & µETA for Fatigue analyses
- The µETA ASAM ODS Browser
- Multivariant / Multidiscipline Modeling
- Modeling for Nastran Embedded Fatigue

Case Studies:

- Honda R&D: Exterior Acoustics full vehicle model generation
- Opel: ANSA in Pedestrian Safety Analysis
- Selected cases from the
- Automotive Industry

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 Beijing China
November 22, 2016
Beijing, China
hosted by Beijing E&G Software

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

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

SPONSORED EVENTS: BETA CAE Systems participation

The 14th International Symposium CMBBE - September 20-22, Tel Aviv, Israel: Use this unique opportunity to be introduced or updated to the latest developments and existing functionality that can propagate our 20 years CAE experience and know how to the biomechanics industry. www.cmbbe2016.com

www.beta-cae.com/ourevents.htm

SPONSORED EVENTS: BETA CAE Systems participation

FISITA 2016 - September 26-30, Busan, Korea: As a major Automotive Industry supplier, showcases its innovative CAE software solutions for this sector, at the exhibition that runs during FISITA 2016. Don't miss our presentation with title: "Rapid NVH design improvements through a unified environment for handling full FE and reduced models". www.fisita2016.com

German LS-DYNA forum 2016 - October 10-12 2014, Bamberg, Germany:

Meet the experts of LASSO Ingenieurgesellschaft mbh and BETA CAE Systems and discuss the benefits and the updates of our software suite. Our presentation: "Model Set-up analysis tools for Squeak and Rattle in LS-DYNA", will feature at the event's agenda. www.dynamore.de

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

BETA CAE Systems is pleased to participate, as a Gold Sponsor, to the 2016 FFT Acoustic Simulation conference & ACTRAN Users' meeting. Take advantage of this opportunity to discuss with our expert engineers the benefits of employing our suite for exterior acoustic analyses using ACTRAN and NASTRAN. www.fft.be

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

BETA CAE Systems, once again, takes its place in this event, organized by VDI, as a major Automotive Industry supplier, and showcases the latest solutions and applications for this sector.
More information: www.vdi-wissensforum.de

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奥雅纳工程咨询(上海)有限公司 (ARUP中国)
上海恒士达科技有限公司 (HengStar)
大连富坤科技开发有限公司 (Dalian Fukun)
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北京思诺信科技有限公司 (AutoCAE)
磐翼信息科技(上海)有限公司 (PAN-I)

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Hengstar Tech.

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www.feapublications.com

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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.

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

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

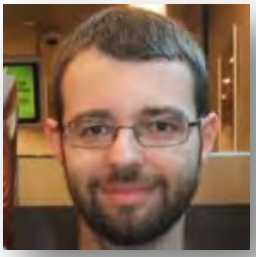
Industry: € 580 - Academic: € 410
All prices excluding VAT.

Exhibiting and sponsoring - Please contact us.

Registration and Contact -

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

LSTC – Research Scientist - Francois-Henry Rouet



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.

AUTOMOTIVE NEWS & EVENTS

Dilip Bhalsod

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FORD - Autonomous Vehicle for Ride Sharing

Ford Corporate Site ©

Ford Targets Fully Autonomous Vehicle for Ride Sharing in 2021; Invests in New Tech Companies, Doubles Silicon Valley Team

•Ford announces intention to deliver high-volume, fully autonomous vehicle for ride sharing in 2021
•Ford investing in or collaborating with four startups on autonomous vehicle development
•Company also doubling Silicon Valley team and more than doubling Palo Alto campus

PALO ALTO, Calif., Aug. 16, 2016 – Ford today announces its intent to have a high-volume, fully autonomous SAE level 4-capable vehicle in commercial operation in 2021 in a ride-hailing or ride-sharing service.

To get there, the company is investing in or collaborating with four startups to enhance its autonomous vehicle development, doubling its Silicon Valley team and more than doubling its Palo Alto campus.

"The next decade will be defined by automation of the automobile, and we see autonomous vehicles as having as significant an impact on society as Ford's moving assembly line did 100 years ago," said Mark Fields, Ford president and CEO. "We're dedicated to putting on the road an autonomous vehicle that can improve safety and solve social and environmental challenges for millions of people – not just those who can afford luxury vehicles."

Autonomous vehicles in 2021 are part of Ford Smart Mobility, the company's plan to be a leader in autonomous vehicles, as well as in connectivity, mobility, the customer experience, and data and analytics.

Driving autonomous vehicle leadership
Building on more than a decade of autonomous vehicle research and development, Ford's first fully autonomous vehicle will be a Society of Automotive Engineers-defined level 4-capable vehicle. Plans are to design it to operate without a steering wheel, gas or brake pedal, for use in commercial mobility services such as ride sharing and ride hailing within geo-fenced areas and be available in high volumes.

"Ford has been developing and testing autonomous vehicles for more than 10 years," said Raj Nair, Ford executive vice president, Global Product Development, and chief technical officer. "We have a strategic advantage because of our ability to combine the software and sensing technology with the sophisticated engineering necessary to manufacture high-quality vehicles. That is what it takes to make autonomous vehicles a reality for millions of people around the world."

FORD - Autonomous Vehicle for Ride Sharing

This year, Ford will triple its autonomous vehicle test fleet to be the largest test fleet of any automaker – bringing the number to about 30 self-driving Fusion Hybrid sedans on the roads in California, Arizona and Michigan, with plans to triple it again next year.

Ford was the first automaker to begin testing its vehicles at Mcity, University of Michigan's simulated urban environment, the first automaker to publicly demonstrate autonomous vehicle operation in the snow and the first automaker to test its autonomous research vehicles at night, in complete darkness, as part of LiDAR sensor development.

To deliver an autonomous vehicle in 2021, Ford is announcing four key investments and collaborations that are expanding its strong research in advanced algorithms, 3D mapping, LiDAR, and radar and camera sensors:

- Velodyne: Ford has invested in Velodyne, the Silicon Valley-based leader in light detection and ranging (LiDAR) sensors. The aim is to quickly mass-produce a more affordable automotive LiDAR sensor. Ford has a longstanding relationship with Velodyne, and was among the first to use LiDAR for both high-resolution mapping and autonomous driving beginning more than 10 years ago
- SAIPS: Ford has acquired the Israel-based computer vision and machine learning company to further strengthen its expertise in artificial intelligence and enhance computer vision. SAIPS has developed algorithmic solutions in image and video processing, deep learning, signal processing and classification. This expertise will help Ford autonomous vehicles learn and adapt to the surroundings of their environment
- •Nirenberg Neuroscience LLC: Ford has an exclusive licensing agreement with Nirenberg Neuroscience, a machine vision company founded by neuroscientist Dr. Sheila Nirenberg, who cracked the neural code the eye uses to transmit visual information to the brain. This has led to a powerful machine vision platform for performing navigation, object recognition, facial recognition and other functions, with many potential applications. For example, it is already being applied by Dr. Nirenberg to develop a device for restoring sight to patients with degenerative diseases of the retina. Ford's partnership with Nirenberg Neuroscience will help bring humanlike intelligence to the machine learning modules of its autonomous vehicle virtual driver system
- Civil Maps: Ford has invested in Berkeley, California-based Civil Maps to further develop high-resolution 3D mapping capabilities. Civil Maps has pioneered an innovative 3D mapping technique that is scalable and more efficient than existing processes. This provides Ford another way to develop high-resolution 3D maps of autonomous vehicle environments

Silicon Valley expansion: Ford also is expanding its Silicon Valley operations, creating a dedicated campus in Palo Alto.

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Adding two new buildings and 150,000 square feet of work and lab space adjacent to the current Research and Innovation Center, the expanded campus grows the company's local footprint and supports plans to double the size of the Palo Alto team by the end of 2017

"Our presence in Silicon Valley has been integral to accelerating our learning and Engineering. "Our goal was to become a member of the community. Today, we are actively working with more than 40 startups, and have developed a strong collaboration with many incubators, allowing us to accelerate development of technologies and services."

Since the new Ford Research and Innovation Center Palo Alto opened in January 2015, the facility has rapidly grown to be one of the largest automotive manufacturer research centers in the region. Today, it is home to more than 130 researchers, engineers and scientists, who are increasing Ford's collaboration with the Silicon Valley ecosystem.

Research and Innovation Center Palo Alto's multi-disciplinary research and innovation facility is the newest of nearly a dozen of Ford's global research, innovation, IT and centers. The expanded Palo Alto campus opens in mid-2017.

About Ford Motor Company: Ford Motor Company is a global automotive and mobility company based in Dearborn, Michigan. With about 203,000 employees and 67 plants worldwide, the company's core business includes designing, manufacturing, marketing, financing and servicing a full line of Ford cars, trucks, SUVs and electrified vehicles, as well as Lincoln luxury vehicles. At the same time, Ford aggressively is pursuing emerging opportunities through Ford Smart Mobility, the company's plan to be a leader in connectivity, mobility, autonomous vehicles, the customer experience, and data and analytics. The company provides financial services through Ford Motor Credit Company. For more information regarding Ford, its products worldwide or Ford Motor Credit Company, visit www.corporate.ford.com.

Risk Factors: This news release and the related presentations contain forward-looking statements. These statements are based on Ford's current expectations for future events. There are risks, uncertainties, and other factors that could cause actual results to differ materially from those stated, including: lower-than-anticipated market acceptance of new or existing products or services; discovery of defects in vehicles resulting in delays in new model launches, recall campaigns or increased warranty costs; increased regulations; and cybersecurity risks. For additional information about these risks, see Ford's 2015 Form 10-K report, as updated by Ford's Form 10-Q and Form 8-K reports.

AEROSPACE NEWS & EVENTS

Marnie Azadian

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F-35C carrier variant lands on USS George Washington

(Source: USS George Washington; posted Aug 16,2016)

GW Welcomes the F-35C Lightning

An F-35C carrier variant lands on USS George Washington during the final stage of sea trials, in preparation of the initial operational capability (IOC) slated for 2018. (UWW GW photo)

ATLANTIC OCEAN --- The aircraft carrier USS George Washington (CVN 73) welcomed F-35C Lightning II carrier variant Patuxent River Integrated Test Force team of test pilots, engineers and squadron Sailors and Marines aboard to complete developmental testing (DT-III), Aug. 14.

The Navy's newest strike fighter features cutting edge technology to progress from the hazardous 'Dog Fighting' of the past to a more technological future of warfare, emphasizing stealth.

"Sensor-fusion," said Sylvia Pierson, F-35 Lightning II Joint Program Office/Naval Variants Public Affairs Officer. "The full complement of F-35 sensors delivers a spherical view of the battlespace that equips the pilot, the commander at sea, and the commander on the ground with information from many sources and enables the carrier strike group and joint force to make critical decisions based upon that information. The aircraft combines this sensing capability with the Navy's first stealth at-sea to see adversaries first, take decisive action, and come home safely. Overall, this fusion of information that is shared by the pilot with those on the ground and on the sea is a game-changer."

Courtesy of Lockheed Martin, the F-35 Lightning II combines advanced stealth technology with strike fighter maneuverability and innovative communications with an information infrastructure designed to generate a user-friendly maintenance program.

"We test to make sure the aircraft meets all the specifications, and we test in the at-sea environment across the spectrum of operations the aircraft will be called upon to perform," said Pierson. "When the aircraft is declared ready for combat operations and a squadron takes it on deployment, the warfighter can rest assured that every scenario in which they could possibly fly has already been tested by the Pax River Integrated Test Force."

F-35C carrier variant lands on USS George Washington

(Source: USS George Washington; posted Aug 16,2016)

"Somebody may launch with all their weapons but they may land asymmetrical. We are testing for symmetric and asymmetric loads. We test different weights, in terms of fuel and weapons. We test in crosswind conditions and evaluate the aircraft with regard to the movement of air around the island. We conduct a lot of testing at Naval Air Station Patuxent River, Md., but you can't replicate the carrier environment."

The testing is the final at-sea stage in preparation of the initial operational capability (IOC) slated for 2018.

"May of 2013 the Marine Corps told Congress, 'we want to declare IOC for the F-35B in July of 2015,'" said Pierson. "July 31, 2015 we had completed all the testing of the aircraft and the Marine Corps was satisfied with all of our testing. They were able to determine the F-35B was ready for operational capability in the same month they projected two years prior. The Air Force declared IOC of their aircraft (F-35A) this summer (2016)."

Each variant of the F-35 has been successful in completing all of their milestones and the carrier variant, F-35C, is on target to do so by 2018.

"Prior to DT-I, the first developmental test phase at sea, the team determined that the tailhook required a redesign. Together they identified the problem, designed and tested a solution, and it worked," said Pierson. "The aircraft conducted 124 catapult launches, 124 arrested landings, experienced no unintentional bolters, and was a three-wire machine. We had such confidence in the aircraft that we even conducted night operations for the first time during DT-I since the F-4 era. Ultimately, that's what we are here to do with the aircraft. The manufacturer builds the aircraft, and the Navy, as a customer, has to go test drive it, to make sure that it does everything that it is supposed to do."

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**

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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.

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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.

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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.

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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.

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- 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.
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With Cray TAS you can:

- Deploy tiered storage and archives faster
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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.

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

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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.

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etainfo@eta.com

Inventium Suite™

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

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

PreSys

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

VPG

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

DYNAFORM

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

Latest Release is ESI Visual-Environment 12.0

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

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

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

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

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

Latest Release is ESI Visual-Environment 12.0

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

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

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

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

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

HYCRASH

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

JSTAMP/NV

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

JMAG

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

Livermore Software Technology Corp. **www.lstc.com**

LS-DYNA

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

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

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

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

LSTC Dummy Models:

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

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

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

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

Oasys PRIMER

Key benefits:

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

www.oasys-software.com/dyna

Oasys D3PLOT

Key benefits:

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

Oasys T/HIS

Key benefits:

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

Oasys REPORTER

Key benefits:

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

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

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

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

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

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

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

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

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

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

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

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

Distribution/Consulting	Asia Pacific	Distribution/Consulting

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

Rescale Cloud Simulation Platform

www.rescale.com

Rescale: Cloud Simulation Platform

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

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

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

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

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

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

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

Industry-Leading Security

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

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

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

LSTC - DYNAmore GmbH JSOL Corporation

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

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

ESI Cloud Based Virtual Engineering Solutions

www.esi-group.com/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

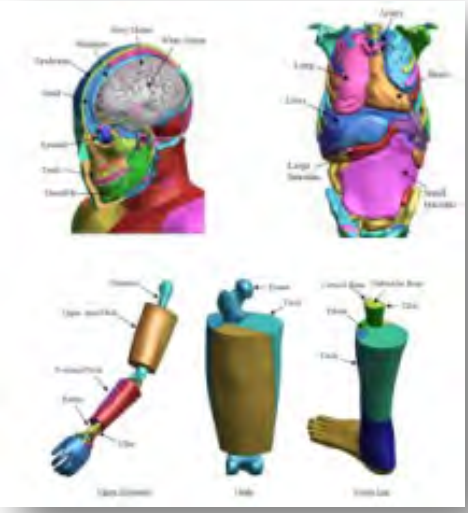
Collaboration

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:

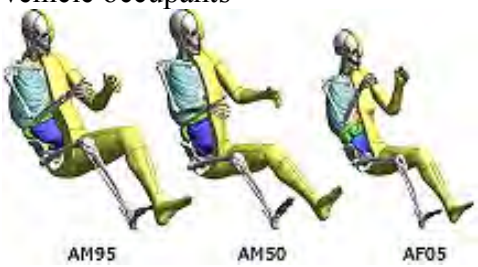
- Data, workflow or project asynchronous collaboration
- Multi-user, browser based collaboration for CAD, geometry, mesh and results models
- Real-time design review with notes, annotations and images archiving and retrieval
- Email invite to non ESI Cloud users for real time collaboration

TOYOTA - Total Human Model for Safety – THUMS

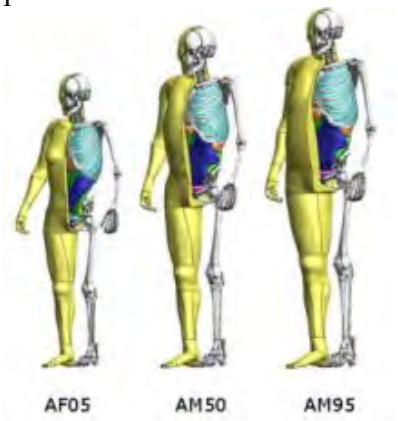


The Total Human Model for Safety, or THUMS®, is a joint development of Toyota Motor Corporation and Toyota Central R&D Labs. Unlike dummy models, which are simplified representation of humans, THUMS represents actual humans in detail, including the outer shape, but also bones, muscles, ligaments, tendons, 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

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AUGUST PRESENTATION

Equivalent Radiated Power calculation with LS-DYNA

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1. Introduction

Computing radiated noise from vehicles is an important topic in NVH analysis. There are several ways to do numerical simulation for such problems, like boundary element method (BEM), finite element method (FEM) and statistical energy analysis (SEA). For BEM and FEM, they can be accurate with sufficient number of elements in the modeling. But they are usually very CPU and memory intensive. SEA requires less computation resources. But it is mostly applicable to mid to high frequency problems. Besides it only provides solution in an averaged sense.

As an alternative, ERP (equivalent radiated power) method has been well established and widely used. It is based on plane wave assumption for the radiated acoustic waves. It is a reduced calculation method to characterize the structure borne noise, especially in an early phase of the product development. With ERP, engineers can have a quick look at the possible maximum radiated power for specific excitations in frequency domain. They can also get the idea about how each panel contributes to the total noise radiation and get useful information and directions on structural optimization towards noise.

In LS-DYNA, ERP calculation has been implemented as an option for Steady State Dynamic analysis (see keyword ***FREQUENCY_DOMAIN_SSD**). The ERP results are given in 1) binary plot database, d3erp; and 2) ASCII xyplot files, ERP_abs and ERP_dB. They are all accessible to LS-PrePost.

2. Brief theory and assumption

As we know, the acoustic intensity can be computed as

$$I = \frac{1}{2}\mathrm{Re}\left[p\,\bar{v}_n\right] \tag{1}$$

where p is the pressure at the point, v_n is the normal velocity, and $\bar{}$ denotes the complex conjugate.

The acoustic power W radiated from the surface is the integral of the intensity over the whole surface and is given by

$$W = \int_S I_n \, dS \tag{2}$$

Where I_n is the component of the acoustic intensity normal to S.

We assume that the radiated acoustic wave follows the plane wave theory (it is a one dimensional wave, and the sound pressure and particle velocity are in phase), and the radiation is perfect. Based on these assumptions, the resulting impedance can be given as

$$Z = \frac{p}{v_n} = \rho c \tag{3}$$

where ρ is the density of the acoustic medium (e.g. air) and c is the sound speed. With the substitution of equation (3) into equation (1), one can obtain the equivalent radiated power density, defined as

$$ERP_\rho = \frac{1}{2}\rho c \,\mathrm{Re}\left[v_n \cdot \bar{v}_n\right] \tag{4}$$

The ERP absolute value radiated from the vibrating panel is the integral of the ERP density over that surface and is given by

$$ERP_{abs} = \int_S ERP_\rho dS = \frac{1}{2}\rho c \int_S \mathrm{Re}\left[v_n \cdot \bar{v}_n\right] dS \tag{5}$$

And it can be expressed in dB values by the following equation if a reference value ERP_{ref} is provided.

$$ERP_{dB} = 10\log_{10}\frac{ERP_{abs}}{ERP_{ref}} \tag{6}$$

3. Keyword in LS-DYNA

In LS-DYNA, ERP calculation is implemented as an option for Steady State Dynamics (SSD, see keyword ***FREQUENCY_DOMAIN_SSD**). With ERP, the keyword looks like this

***FREQUENCY_DOMAIN_SSD_ERP**

$#	mdmin	mdmax	fnmin	fnmax	restmd	restdp	lcflag	relatv
	1	100	0.	2000.				
$#	dampf	lcdam	lctyp	dmpmas	dmpstf	dmpflg		
	0.01							
$#			memory	nerp	strtyp	nout	notyp	nova
				1				
$#	r0	c	erprlf	erpref				
	1.21	340.0	1.	5.e-13				
$#	pid	ptyp						
	1							
$#	nid	ntyp	dof	vad	lc1	lc2	lc3	vid
	131	0	3	0	100	200		

where nerp = 1 means that there is only 1 panel radiating acoustic pressure (which is part 1, as defined by card 5). Card 5 can be repeated multiple times if nerp is larger than 1. “erprlf” is ERP radiation loss factor and “erpref” is ERP reference value (to convert ERP absolute

value to dB value). For more details about the keyword, please refer to LS-DYNA Keyword User's Manual.

4. Post-processing of the results

The ERP calculation results are saved in binary plot database d3erp, which is activated by the keyword ***DATABASE_FREQUENCY_BINARY_D3ERP**. D3erp is accessible to LS-PrePost and the following results are included in the database for each excitation frequency:

- Normal velocity on the surface (real part, imaginary part and magnitude)
- acoustic intensity
- ERP density.

The frequency variation of the ERP absolute value and ERP dB value are saved in the ASCII files: ERP_abs and ERP_dB. They can be plotted as xy curves with LS-PrePost.

5. A simple example of ERP calculation with an auto engine

As a demonstration of this feature we consider a simplified engine model, which has 16041 nodes and 13484 solid elements. The whole surface of the engine is defined as sound radiating panel, by a set of segments (***SET_SEGMENT**). To model the excitation from the ground, we assume that the model is fixed on a shaker table and a constant horizontal acceleration 0.02g is provided with the shaker table, for the range of frequency 10-1000 Hz.

The ERP density results are shown in Figures 1 and 2 for two excitation frequencies. The ERP absolute value vs. frequency curve (ERP_abs) is plotted in Figure 3.

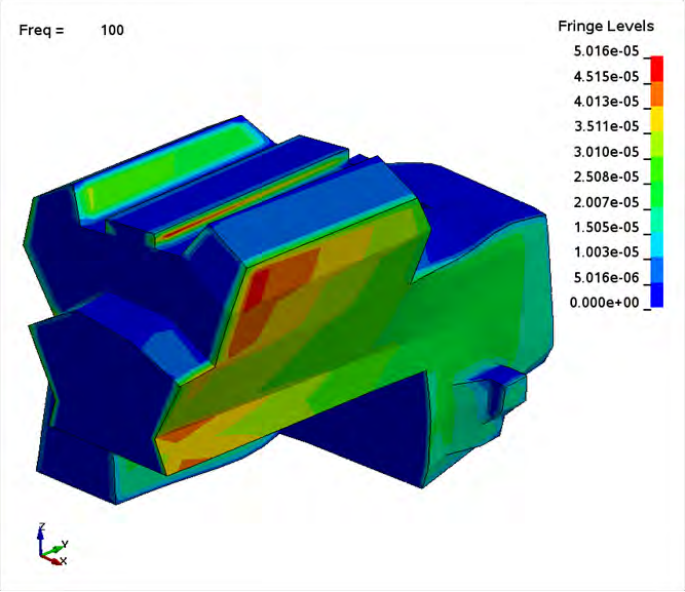

Figure 1. ERP density fringe plot at frequency 100 Hz

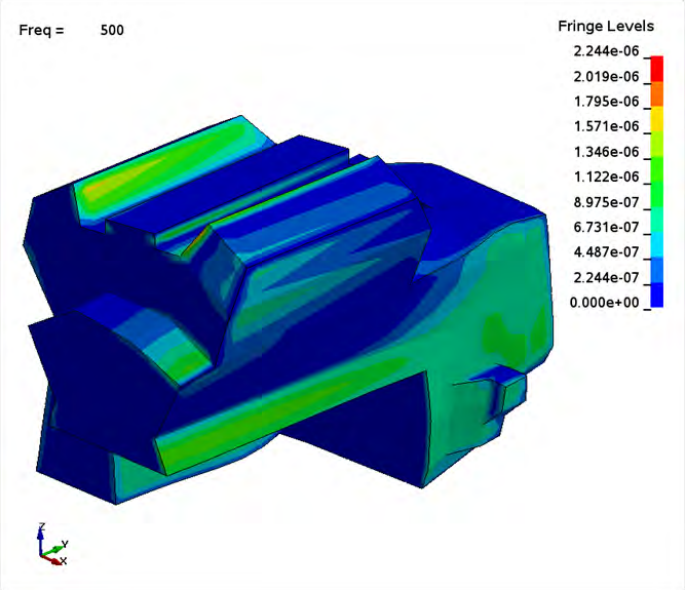

Figure 2. ERP density fringe plot at frequency 500 Hz

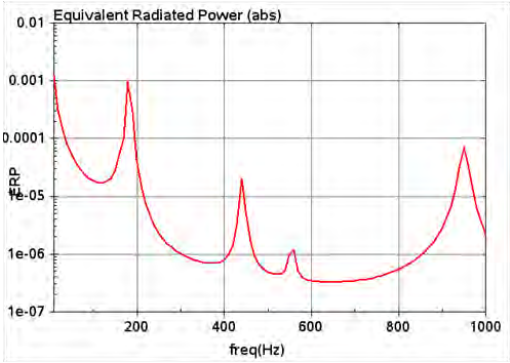

Figure 3. ERP absolute value vs. frequency curve

Based on the d3erp fringe plots, one can find out which part / area of the structure gives higher contribution towards the radiated noise, for a specific excitation frequency. This can be useful if one need to reduce the radiated noise or optimize the structure towards the noise. With ERP_abs and ERP_dB one can get the change of radiated power along with frequency. So by moving the excitation frequency we can avoid the peak values of the radiated power, which are shown in the ERP_abs / ERP_dB curves.