

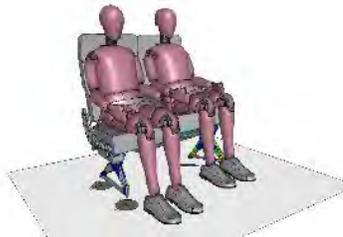
ANSYS



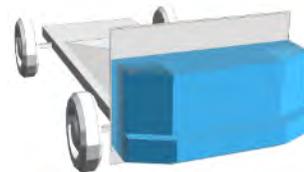
BETA CAE



LST



OASYS



LS-DYNA CONFERENCE 2020

16th International LS-DYNA[®] Conference Virtual Event

June 10-11, 2020 | **Free Online Live Event**



FEA Information Engineering Solutions

www.feapublications.com

The focus is engineering technical solutions/information.

FEA Information China Engineering Solutions

www.feainformation.com.cn

Simplified and Traditional Chinese

The focus is engineering technical solutions/information.

Livermore Software Technology, an ANSYS company

Development of LS-DYNA, LS-PrePost, LS-OPT,

LS-TaSC (Topology), Dummy & Barrier models and

Tire models for use in various industries.

www.lstc.com

To sign up for the FEA News send an email - subject "subscribe" to news@feainformation.com

To be removed from the FEA News send an email - subject "Remove" to news@feainformation.com

If you have any questions, suggestions or recommended changes, please contact us.

Editor and Contact: Yanhua Zhao, Noi - news@feainformation.com

Platinum Participants

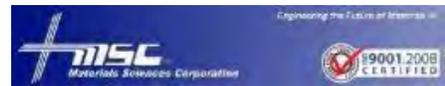


Table of contents

02 FEA Information Inc. Profile
04 TOC

03 Platinum Participants
05 Announcement

Articles – Blogs – News

06	ANSYS	3 Amazing Structural Analysis Examples for Engineers
09	BETA CAE Systems	BETA CAE Systems announces the release of the v19.1.7 of its software suite
10		BETA CAE Systems launches NEERE, the new remote work & collaboration platform
12	d3View	3VIEW Platform Components
13	DYNAmore GmbH	DYNAmore online seminars and webinars
14	ESI Group	Dive into the World of Zero Tests, Zero Prototypes, Zero Downtime
17	ETA	ACP Process
18	FEA Not To Miss	Rollover Analysis of Pickup Truck
19	Hengstar Technology	Online workshop on the GISSMO failure model and application
21	JSOL	Airbag folding -JFOLD
22	KAIZENAT	LUPA
23	LST	16th International LS-DYNA Conference Virtual Event
26	Material-Sciences	Progressive Composite Damage Modeling in LS-DYNA (MAT162 & Others)
27	OASYS	Oasys LS-DYNA Update Webinars
29	Predictive Engineering	XFEM - Galactic Extended FEM - Coming to a Screen Near You
31	Rescale	2020, the ultimate test of business flexibility
34	Shanghai Fangkun	Shanghai Fangkun LS-DYNA Related Training Course for May
36	Terrabyte	Products, Sales, Consulting

Automotive, Resource links, LS-DYNA Training

37	Automotive News - High School Students From Michigan and California Take Top Spots in FCA Drive for Design Competition
39	LS-DYNA – Resource Links
40	Training - Webinars

LS-DYNA New Feature and Application

41	Response spectrum analysis and DDAM analysis in LS-DYNA®
----	----------------------------------------------------------

Resources

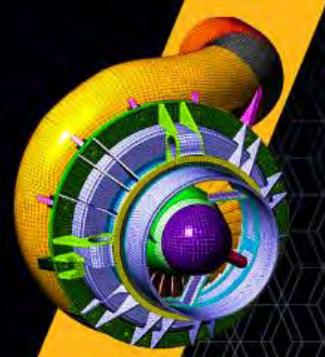
51	Engineering Solutions	65	ATD - Barrier - THUMS
60	Cloud - HPC Services - Subscription	68	Social Media

Announcements

LS-DYNA CONFERENCE 2020

16th International LS-DYNA Conference
Virtual Event

June 10-11, 2020 | Free Online Live Event



About The Conference

Two days.

Countless opportunities to learn. Zero barriers to entry.

June 10-11, 2020

For the first time ever, the annual LS-DYNA User Conference will be a free to attend, virtual event — coming to you live from your computer.

Today, business environments are changing more rapidly than ever, and technologists must innovate quickly to incorporate new features while reducing development costs and delivering new products to market before the competition. We look forward to bringing key industry & academic stakeholders together to discuss the newest technological advancements in finite element analysis (FEA). We will address issues related to complex, real-world problems, look at ways to increase efficiency, reduce cost and understand how LS-DYNA plays a key role in achieving these goals.

With over 1,000 attendees, exhibits and hundreds of technical presentations, this conference is an excellent opportunity for networking with LS-DYNA developers, product engineers, industry leaders, researchers & academia; across all industries from aerospace to automotive and beyond.

[Register](#)



About ANSYS, Inc.

If you've ever seen a rocket launch, flown on an airplane, driven a car, used a computer, touched a mobile device, crossed a bridge or put on wearable technology, chances are you've used a product where ANSYS software played a critical role in its creation. ANSYS is the global leader in engineering simulation. Through our strategy of Pervasive Engineering Simulation, we help the world's most innovative companies deliver radically better products to their customers. By offering the best and broadest portfolio of engineering simulation software, we help them solve the most complex design challenges and create products limited only by imagination. Founded in 1970, ANSYS is headquartered south of Pittsburgh, Pennsylvania, U.S.A., Visit www.ansys.com for more information.

ANSYS and any and all ANSYS, Inc. brand, product, service and feature names, logos and slogans are registered trademarks or trademarks of ANSYS, Inc. or its subsidiaries in the United States or other countries. All other brand, product, service and feature names or trademarks are the property of their respective owners.



Published on April 14, 2020

by Marisa Melchiorre

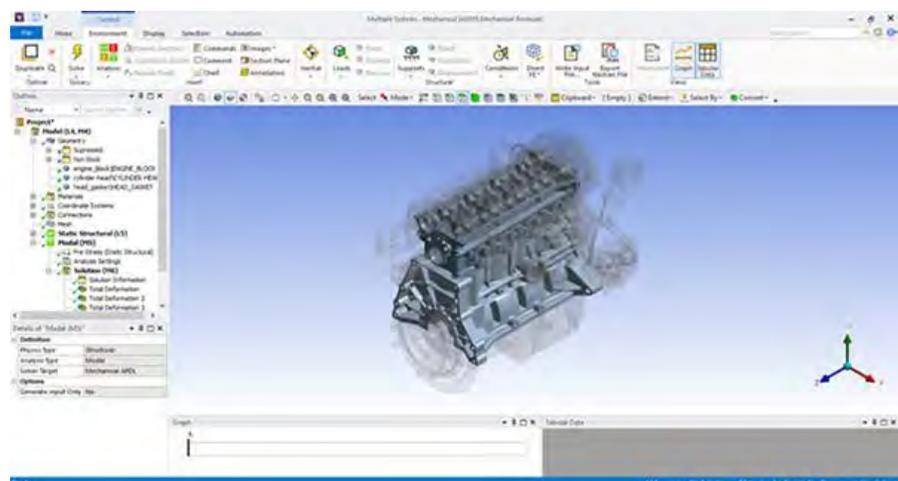
Structural Analysis

Ansys Additive Suite, Ansys LS-DYNA, Ansys Mechanical, Additive Manufacturing, Structural Analysis

3 Amazing Structural Analysis Examples for Engineers

Since the debut of Ansys' structural mechanics solutions in 1969, engineers have relied on structural analysis software to optimize their designs and validate their products.

Ansys simulation technology continues to evolve to meet the needs of engineers who use simulation software to create innovative products, systems and processes.

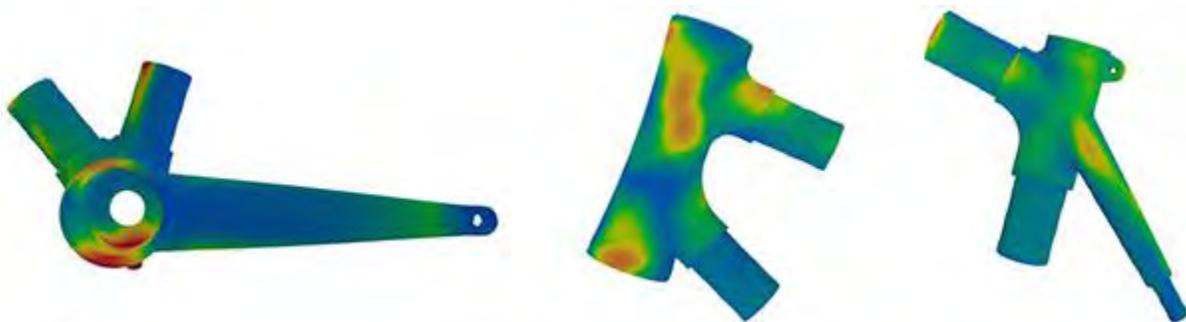


So, without further ado, here are three structural analysis examples that highlight the importance of simulation software.

For history on [Ansys Mechanical](#), read: [Making the Best in Class Even Better](#). For a look into Mechanical's future, read: [Structure a New Industry Standard](#).

Structural Analysis Example of How Engineers Design Parts for Additive Manufacturing

Rosswag Engineering formerly underwent 10 printing iterations before their additive manufacturing (AM) team produced a part that met specifications. Because one print could cost a company thousands of dollars in development time, delays and materials, the trial and error approach wasn't conducive to business.



These bicycle frame parts need to align if they are to fit into the assembly. This can be a challenge when engineers produce the parts using additive manufacturing. Ansys Additive Print reduces distortions enabling the part to be built properly the first time.

Rosswag later introduced [Ansys Additive Print](#) into the development cycle to help predict the internal stresses of the part and how the printing material would perform.

By predicting the distortions and stresses using this simulation process, Rosswag successfully optimized its designs to compensate. As a result, the development time reduced by months and the parts printed properly on the first build.

To learn more about how Rosswag achieved this, read: [Reducing the Strain of Additive Manufacturing](#).

The History of Hallquist's Creation of a Structural Analysis Tool for Nonlinear Dynamics

With the [acquisition of Livermore Software Technology Corporation \(LSTC\)](#), Ansys users will benefit from increased multiphysics compatibility between the Ansys portfolio and the nonlinear dynamics solver of LS-DYNA. This enables engineers to study systems that experience severe material deformation, or failure, over a short timeframe.

John Hallquist began creating LS-DYNA in 1976 at Lawrence Livermore National Laboratory to code a solver with explicit time integration that could study nonlinear dynamics. The software's success led to the creation of LSTC in 1987 — with LS-DYNA serving as the flagship product.

Hallquist and LSTC continued to improve the software to support other analysis methods including:



Ansys LS-DYNA created this car crash simulation.

- Arbitrary Lagrangian Eulerian method
- Incompressible computational fluid dynamics (CFD)
- Conservation element/solution compressible fluids
- Discrete element method (DEM)
- Electromagnetism
- Element-free Galerkin method
- Fluid–structure interaction (FSI)
- Implicit simulations
- Noise, vibration and harshness (NVH)
- Smooth particle hydrodynamics
- Heat transfer

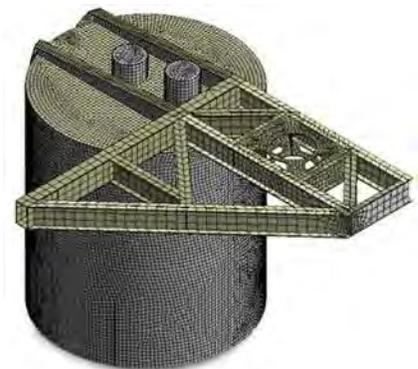
To learn more of the history of [LS-DYNA](#) and how its various functionalities will fit into the Ansys portfolio, read: [Ansys Expands Access to Advanced Multiphysics Simulation with LSTC Acquisition](#).

This Structural Analysis Example Piles on the Material Savings

Suction piles are a fascinating offshore mooring technology. These devices are essentially a cylinder with one end open. This involved placing the pile on the seabed, suction the water out of the structure and use that differential under pressure to push the device into the soil.

Once the pile enters the soil, it provides a strong anchor for offshore drilling, exploratory vessels, windmills and anything else that needs to remain stationary in water and above 3000m.

The stronger the soil, the better stability it offers. However, that also means that engineers need to ensure the suction pile can withstand more pressure as it digs into the soil.



The mesh of a suction pile

Traditionally, engineers simulated the system using radial springs with nonlinear stiffness. This created a conservative solution that used a lot of expensive steel to create the structure.

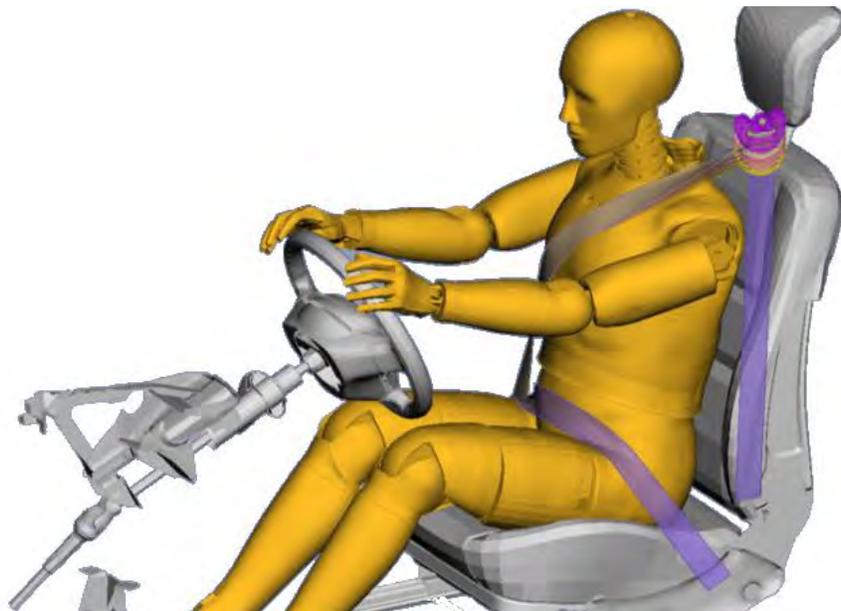
To address this challenge, Ansys elite channel partner EDRMedeso used Ansys Mechanical to simulate the system using finite element analysis (FEA) and the geomechanics library. They saved their client over \$280,000 in material costs without risking the performance of the pile.

To learn how, read: [Stability Under Pressure](#).

Developing CAE software systems for all simulation disciplines. Products: ANSA pre-processor/ EPILYSIS solver and META post-processor suite, and SPDRM, the simulation-process-data-and-resources manager, for a range of industries, incl. the automotive, railway vehicles, aerospace, motorsports, chemical processes engineering, energy, electronics...

BETA CAE Systems announces the release of the v19.1.7 of its software suite

May 4, 2020



Beyond code fixes in the identified issues, this version also incorporates several noteworthy enhancements and implementations, anticipated by our customers who are committed to the v19x of our suite. The most important of those enhancements and fixes that were implemented appear in the announcement on our web site

Customers who are served directly by BETA CAE Systems, or its subsidiaries, may download the new software, examples and documentation from their account on our server. They can access their account through the "sign in" link at our web site. Customers who are served by a local business agent should contact the local support channel for the software distribution details. All the files that are required for the installation of this version reside in the folder named "BETA_CAЕ_Systems_v19.1.7" and are dated as of May 4, 2020.

[DISCOVER](#)

[DOWNLOAD](#)

BETA CAE Systems International AG

Platz 4, 6039 Root D4, Switzerland

t: +41-41-545-3650 | e: ansa@beta-cae.com | www.beta-cae.com

BETA CAE Systems launches NEERE, the new remote work & collaboration platform

FOR IMMEDIATE RELEASE April 16, 2020



The incorporation of remote communication and collaboration solutions in fast-paced environments, where global businesses seek effective ways to streamline product development processes, had already reached its limits. Today's unprecedented circumstances push these limits further as organizations struggle to ensure business continuity through work-from-home. The deployment of an effective and productive professional remote work and collaboration environment became a necessity.

Team members, of varying levels of office distance and specialization, need an efficient medium through which they can communicate, put down plans, or discuss problem solutions and counter measures. Especially in the field of engineering simulation the evolution of analysis models and the evaluation of results, on different design stages and centers, was not until now as time-efficient and effective as required. At the same time, working or communicating from distance, with non-reliable and not-secure platforms, was adding risk and reservations.

BETA CAE Systems brings forth NEERE, a new software, with the aim to meet existing needs and take remote work and collaboration to new levels. Our purpose is to offer to the Industry the capability to mobilize and make available data and information stored in corporate systems, but also to allow knowledge and experience sharing, in a manner that ensures confidentiality. At the same time, we are committed in offering new tools and practices that expand the capabilities and effectiveness of collaboration procedures.

NEERE is an on-premises, web-based tele-collaboration environment, tailor-made for the engineering community. It enables remote work and teamwork, and boosts productivity through the direct engagement of users from all over the globe, in a secure, enterprise-ready, multi-OS web-platform. This environment offers a complete toolset to share and control desktop workstations via web-browser, control access, run software, communicate through messages, voice, live videos, and jointly experience virtual environments. Integrated with ANSA, META, and META VR, NEERE provides a complete collaboration platform that makes sharing of knowledge and exchange of ideas effortless. Teams with interdisciplinary members can now work together in real-time technical meetings, fostering innovation and reducing virtual product development cycles.

“NEERE comes right on time. Exploiting our long experience on how our global customers and partners work to achieve their goals and listening to their requirements and bottlenecks, we created and continue to improve a tool that ensures the efficiency and value creation of their teams in a trustworthy manner” says Sam Saltiel, CCO of BETA CAE Systems. “It’s remarkable that a large number of our esteemed customers adopted and deployed NEERE while it was still in its earlier pre-release stages”.

NEERE is available worldwide by BETA CAE Systems and its business partners.

About BETA CAE Systems

BETA CAE Systems transformed engineering simulation by introducing revolutionary process automation software tools and practices into Simulation and Analysis, almost 30 years ago. Committed to our mission to enable engineers to deliver results of high value, we continue to offer state-of-the-art, highperformance software and best-in-class services to the Industry, around the world. Our simulation solutions unleash low-risk and high Return-On-Investment innovation. We first established our reputation in the Automotive sector and now we are proud of the deployment of our software also in the Aerospace, Defense, Biomechanics, Electronics, Energy and other Industries. The groundbreaking technology, the excellent services and our high standards of business values and ethics are the three pillars on which BETA was founded and grows since then.

For more information about NEERE:

NEERE Release Announcement: https://www.beta-cae.com/news/20200415_announcement_neere_v1.0.0.htm

NEERE web-page: <https://www.beta-cae.com/neere.htm>

For more information about BETA CAE Systems:

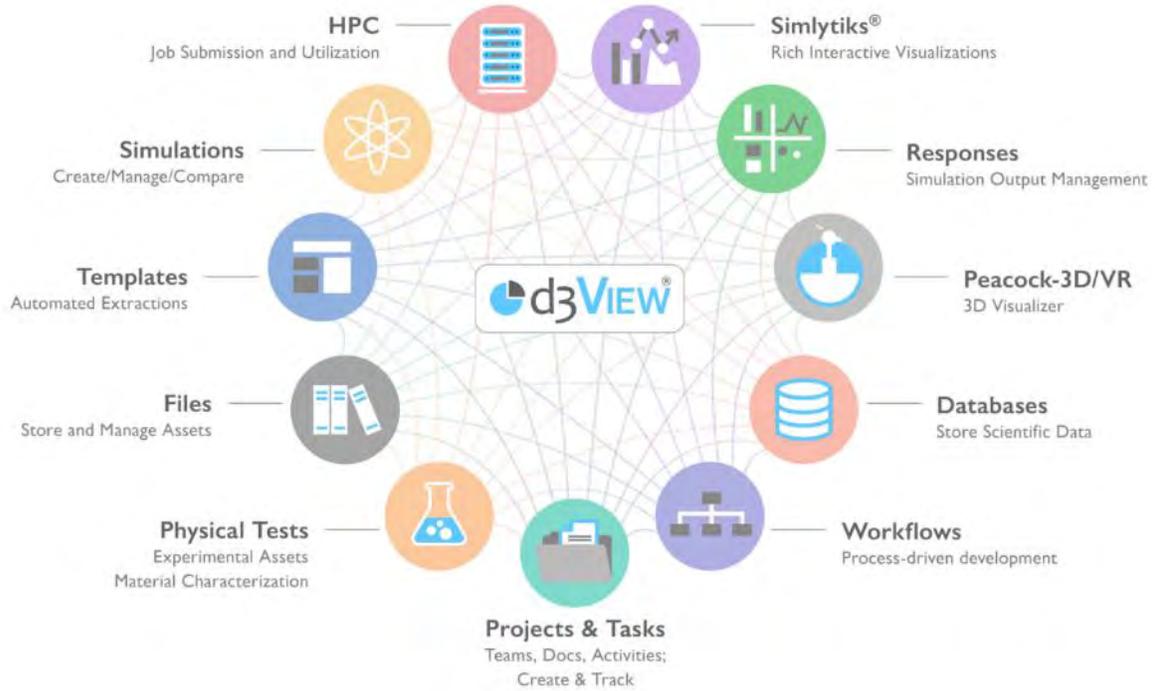
BETA CAE Systems web site: <https://www.beta-cae.com>

BETA CAE Systems Email: ansa@beta-cae.com

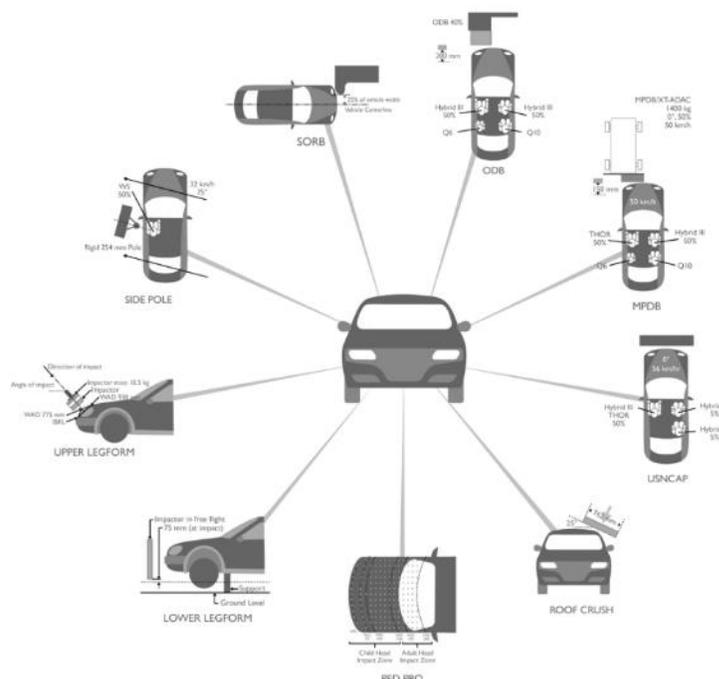
d3VIEW is a data to decision platform that provides out-of-the box data extraction, transformation and interactive visualizations. Using d3VIEW, you can visualize, mine and analyze the data quickly to enable faster and better decisions.



d3VIEW Platform Components



d3VIEW
Built-In
Automotive
Templates



www.d3view.com

For more information email
info@d3view.com



DYNAmore training offer

DYNAmore online seminars and webinars

More information: www.dynamore.de/seminars

DYNAmore Express webinar series

As the situation caused by the corona virus continues, we also are continuing our online training offer. In addition to the webinars already offered, there will be webinars on various topics relating to LS-DYNA and LS-OPT. The approximately one-hour webinars called "DYNAmore Express" can be found on our website at

www.dynamore.de/en/training/seminars.

Participation is free of charge.

DYNAmore Online-Seminars

In addition to the free offers, there are also two online-seminars permanently offered. The online seminars were recorded as video in Stuttgart and correspond to the original seminars in terms of content. After payment of the seminar fees the participants will receive the seminar documents by mail. Access to the videos will be granted with the seminar confirmation.

Please note that for security reasons, each chapter of the course may only be completed once and the password loses its validity after 14 days.

“Introduction to LS-DYNA”

Our online seminar "Introduction to LS-DYNA" is now available. We have divided the three-day seminar into eleven chapters, which can be watched separately. All exercises are also part of the offer. Please register at:

www.dynamore.de/c2076e

“Crashworthiness with LS-DYNA”

The 4-day seminar with Paul Du Bois was recorded as a video and divided into 15 chapters.

Please register at www.dynamore.de/c2011e

We will inform about new online seminars in the FEA Newsletter and in the DYNAmore Infomail (Registration:

www.dynamore.de/infomail-e).

Please note that our online-seminars are only available to members of companies. Students and private persons are excluded from use.

Contact

DYNAmore GmbH

Industriestr. 2, D-70565 Stuttgart, Germany

Tel. +49 (0) 7 11 - 45 96 00 - 0

E-Mail: forum@dynamore.de

www.dynamore.de



Courtesy of Daimler AG



A leading innovator in Virtual Prototyping software and services. Specialist in material physics, ESI has developed a unique proficiency in helping industrial manufacturers replace physical prototypes by virtual prototypes, allowing them to virtually manufacture, assemble, test and pre-certify their future products.

Dive into the World of Zero Tests, Zero Prototypes, Zero Downtime

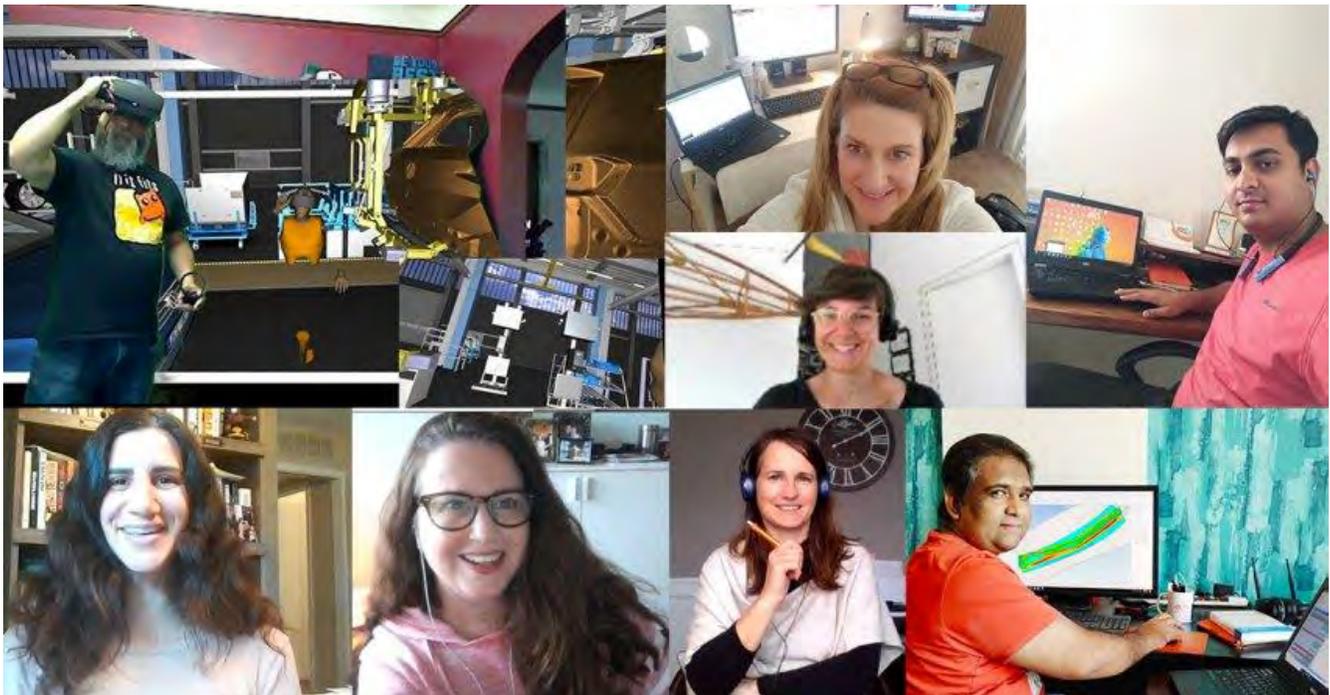


Distant yet Connected: The New Customer Training?

The coronavirus has unquestionably changed the way we work, interact with colleagues, and conduct business. Recommendations from renowned consultants on how to best maneuver through this crisis and plan the next normal are flooding in. Yet, what do we make out of all this and how do we manage uncertainty while ensuring agile operations?

Wednesday, May 6, 2020

By Natasha Baccari



In what seemed like an instant, the coronavirus (COVID-19) went from watercooler talk to a global pandemic, halting travel, economies, and, yes, even handshakes and hugs. Just like that, our lives changed. But that doesn't mean everything has to stop. We must find ways to carry on, especially when it comes to letting customers know we are there for them no matter the situation.

The evolution of customer training

Checking in, pinning a nametag to a shirt, collecting a pen and notepad, and picking a seat – these are the kind of face-to-face training rituals our customers are used to. But when suddenly, the unthinkable happens and human interaction is banned, how do we pivot to support our customers?

At ESI, we are committed to maintaining the highest customer support, especially in the most challenging of times. And in our 47 years in business, we are no stranger to external factors liable to disrupt even the strongest businesses. What keeps us going is knowing that, regardless of the noise around us, we must be a dependable rock for our customers to stand on.

Like us, our customers are committed to moving forward no matter the challenge. As calls keep coming in for customer training, we recognize this as just another opportunity to pivot.

Which is why we have quickly shifted to “at home” customer training.

Does remote training actually work?

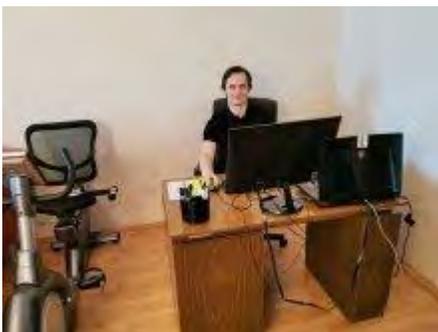
When working on the fly, no two trainings will look the same. The most important thing is to create a setting in which trainees feel comfortable and to encourage flexibility wherever needed so that attendees get the highest value for their time spent with you.

I asked a few of our engineers to weigh in on how they were able to manage from their home offices (or home gyms!) and this is what they had to say:

Purna Musunuru

Application Engineer for System Modeling

“Over the course of four days, I conducted a thermal systems analysis training. With these web-based formats, we have been able to spread the trainings across several days (2-4 hours a day), and I can say with confidence that four, two-hour sessions were much more productive than a full 8-hour session. Additionally, I noticed that spreading out the sessions gave the attendees time to digest and process the information better, going by the follow-up questions at the beginning of the following training session.”



Viacheslav Kotov

Business Development Manager

“Training is typically hosted over two days and the benefit is that the preparation time is the same as it is for traditional face-to-face training. We like to use the web camera at the beginning of the training to greet people but not during the training as it becomes a distraction. This just means that I spend more time checking in to see how good they are on their own and make sure they walk away really understanding how to use the software on their own.”

Adwait Vishwas Pande

Senior Engineer, Technical Support

“Overall, these dedicated team sessions went better than anticipated with such a short turnaround time. Most importantly, we were able to stay connected with our customers, and, to us, there is nothing better than that. And because the trainings were company-specific, participants shared their know-how and experience, resulting in fruitful discussions. “



Are remote trainings here to stay?

For now, it seems yes. Although we heard about some of the pitfalls, mainly not being able to see customers in order to gauge their understanding of the topic, overall the experiences were positive. Being able to stay connected to customers, propel their knowledge of our solutions forward, and maintain some sort of normalcy is the goal for us all during these incomparable times.

We look forward to evolving with the situation, and with our customers, and experimenting with new ways of working until things are ‘back to normal’ – as difficult as that might be to imagine right now.

Stay healthy and stay safe, wherever you are in the world.

If we can help you with a remote training please visit <https://myesi.esi-group.com/resources/trainings>

For more information visit <https://www.esi-group.com/engineering-services>

About ESI Group

ESI Group is a leading innovator in Virtual Prototyping software and services. Specialist in material physics, ESI has developed a unique proficiency in helping industrial manufacturers replace physical prototypes by virtual prototypes, allowing them to virtually manufacture, assemble, test and pre-certify their future products. Coupled with the latest technologies, Virtual Prototyping is now anchored in the wider concept of the Product Performance Lifecycle™, which addresses the operational performance of a product during its entire lifecycle, from launch to disposal. The creation of a Hybrid Twin™, leveraging simulation, physics and data analytics, enables manufacturers to deliver smarter and connected products, to predict product performance and to anticipate maintenance needs.

ESI is a French company listed in compartment B of NYSE Euronext Paris. Present in more than 40 countries, and addressing every major industrial sector, ESI Group employs about 1200 high-level specialists around the world and reported annual sales of €139 million in 2018. For more information, please visit www.esi-group.com.

ETA has impacted the design and development of numerous products - autos, trains, aircraft, household appliances, and consumer electronics. By enabling engineers to simulate the behavior of these products during manufacture or during their use, ETA has been involved in making these products safer, more durable, lighter weight, and less expensive to develop.



ACP Process

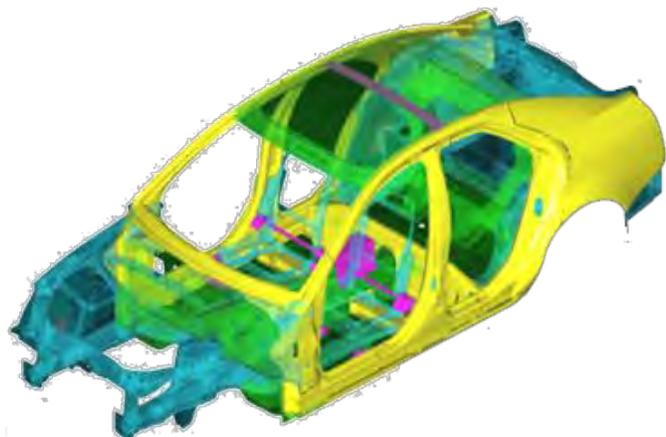
The patented Accelerated Concept to Product (ACP) Process[®] has revolutionized and streamlined the product development process, through optimization led design. The performance-driven development process relies heavily on simulations to meet timing and budget targets, whereas the traditional processes have been built around a build-test philosophy.

The key benefits of the ACP Process include a demonstrated capability to reduce product development costs significantly, reduce product mass by approximately 20 - 40% and reduce product development time, while improving product performance in terms of stiffness, NVH, crash/safety, durability.

This technique is a proprietary, performance-driven, holistic product design development method, which is based on design optimization. ACP incorporates the use of multiple CAE tools to generate an optimal design solution. 3G Optimization is employed and allows engineers to design a concept model using holistic design approach. It incorporates material types and its properties (Grade and Gauges), Geometry (shape) and manufacturing processes for the optimum weight and performance.

Contrary to conventional methods where just one or a few design concepts are evaluated, with the ACP process hundreds of design concepts under multiple load conditions are evaluated simultaneously. Only those concepts, which meet all of the design targets and manufacturing constraints, are initiated. The resulting concept(s) is designed, analyzed and optimized using loading, manufacturing, material, and cost constraints. CAD data is then generated for the optimal design. Finally, our team takes the design to the production level (preparing it for manufacturing) based on the available manufacturing processes and provides production support.

Using this system, the resulting product meets all performance, mass, cost and manufacturing constraints. Applied at the component, sub-system, or full-system level, significant efficiencies and product improvement are achievable using the ACP Process. In this practice, ETA's expert team revisits process requirements and uses the most advanced technology, tools, and materials to give the client the most lightweight structure possible.



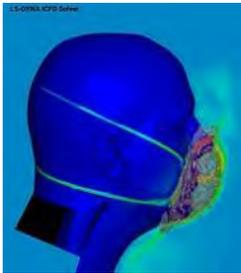
FEA Not To Miss, is a weekly internet blog on helpful videos, tutorials and other Not To Miss important internet postings. Plus, a monthly email blog.



Start your Monday with coffee or tea reading our engineering blog, at the FEA Not To Miss coffee shop. Postings every Monday on what you have missed

www.feantm.com

Monday 05/11/2020 -I just need to figure a mask with a straw through it where it is safe. Then I can have Mask Ala Mode Coffee flavor! I like it! NO, you can't use the straw for beer! It is only a coffee drinking idea.



[ICFD LS-DYNA: Coughing flow through porous commercial masks: FSI model adjustment around the face](#)

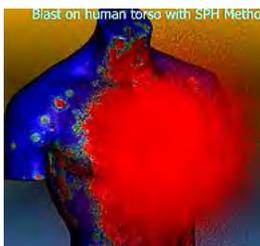
Monday 05/03/2020 - I'm not sure what I like most - lego's, dreaming that I own a Porsche, or dreaming of owning a Bugatti. Well since I can rule out owning a Porsche or Bugatti I will name this week's coffee Dreaming with a hint of mocha almond! I can afford Coffee - Life is good!



[LS-DYNA® simulation vs. real LEGO® crash](#)

- Porsche (42056) vs. Bugatti (42083) view from left behind
This video shows the crash of the Porsche and Bugatti LEGO® models from a view left behind.

Monday 04/27/2020 - OUCH! Even watching this video makes me yell OUCH and hold my coffee cup up for protection. That will work - it is magical coffee called Kevlar repell with our chocolate magical repell blast spell.



[Blast on human torso with SPH Method in the LS-DYNA](#)

Cihan SAVAŞ - Did you ever think that what would happen if blast on human torso is performed ?

Shanghai Hengstar & Enhu Technology sells and supports LST's suite of products and other software solutions. These provide the Chinese automotive industry a simulation environment designed and ready multidisciplinary engineering needs, and provide a CAD/CAE/CAM service platform to enhance and optimize the product design and therefore the product quality and manufacture.



Online workshop on the GISSMO failure model and application

Shanghai Enhu & Hengstar Technology organized an online workshop for the CAE engineers about “The GISSMO failure model and application” on May 11th, 2020. The purpose of this workshop was to help LS-DYNA CAE engineers better understand the GISSMO failure model and to effectively use it to improve the accuracy of the simulation with detailed failure material model. The content of this workshop included metal material model in LS-DYNA, GISSMO failure theory, and identification of the GISSMO damage parameters using LS-OPT etc.

Nearly 50 CAE engineers attend this online workshop. After presentation and discussion, all attendees agree that the workshop was held successfully and help them to use GISSMO in their CAE projects.



Online Seminar of User Subroutine Development in LS-DYNA

Shanghai Enhu & Hengstar Technology will organize a Web Seminar of User Subroutine Development in LS-DYNA on May 29th 2020. The following topics will be discussed with interactive sessions to the attendees..

- User Subroutine Package:**

- User Materials, EOS, Thermal Materials
 - User Elements, User Contact Friction,
 - User Loading Other User Features

- The Structure of the User Subroutine Package**

- Subroutines, source files, and libraries

- General Practice**

- User Materials, User Parameters, Memory Management & Alignment Parallelization & Vectorization

- Debugging & Performance turning-up**

Dr. Zhidong Han from LST Ansys will provide this 4 hours seminar. Dr. Han received his Ph.D in the field of computational mechanics from Tsinghua University. He has been working on DYNA since 2004 and joined LSTC in 2011. He has been working on the MPP contact with the latest features such as groupable, consistency, non-blocking, and so on. He has also worked with other developers on various features in LS-DYNA, including the user subroutine package. His research interests lie in the disciplinary areas of: theoretical, applied, and computational mechanics of solids and other novel computational methods.

Language: Mandarin

Contact:

Xixi Fei: Tell: 021-61630122 13524954631 Email: Training@hengstar.com

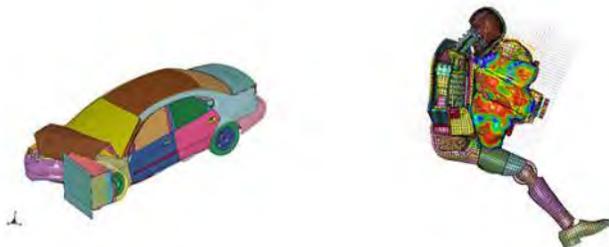
Shanghai Hengstar Technology Co., Ltd

hongsheng@hengstar.com

<http://www.hengstar.com>

Shanghai Enhu Technology Co., Ltd

<http://www.enhu.com>



JSOL supports industries with the simulation technology of state-of-the-art. Supporting customers with providing a variety of solutions from software development to technical support, consulting, in CAE (Computer Aided Engineering) field. Sales, Support, Training.

Accurate airbag deployment simulation

Airbag-folding simulation system for LS-DYNA

Airbag folding

JFOLD®

- Easy, user-friendly, interactive tool setting
- Preview for checking tool performance
- Manage complicated folding process using a flowchart
- Save calculation results and patterns periodically
- Sewing simulation for 3D airbag



JFOLD Features

Towards more accurate airbag deployment simulation

JFOLD was developed to fold airbags for automotive crash simulation. JFOLD can be used to generate a folded airbag model using LS-DYNA simulation, regardless of the complexity of the geometry.

Airbags are one of the important safety devices for protecting the occupant during an accident: airbags are folded compactly and stored in the interior. The deployment behavior of an airbag depends on the pattern through which it is folded. The risk of occupant injury during airbag deployment, the out-of-position problem, considerably affects the occupant's safety performance.

Recently, the demand for more accurate airbag deployment simulation to improve the occupant's safety has been increasing. Building a folded airbag model with complicated geometry was an issue for CAE engineers to address.

JFOLD can manage the complicated folding process of an airbag using a flowchart in an easy-to-understand tree view. Users can build, manage, and view the airbag models in various folding patterns. The intuitive and interactive GUI facilitates the operation of defining the position and behavior of the folding tools.

JFOLD Functions

Building an airbag model with intuitive and interactive tools and flow-charted process management

JFOLD manages the complicated folding process with a flowchart, in a tree view. Users can build, manage, and view the airbag models in various folding patterns. The intuitive and interactive GUI facilitates the operation of defining the position and behavior of the folding tools.



KAIZENAT Technologies Pvt Ltd is the leading solution provider for complex engineering applications and is founded on Feb 2012 by Dr. Ramesh Venkatesan, who carries 19 years of LS-DYNA expertise. KAIZENAT sells, supports, trains LS-DYNA customers in India. We currently have office in Bangalore, Chennai, Pune and Coimbatore.



LUPA

Answers for the below questions are the most sought after ones by business leaders while planning for software investment.

- Are the existing resources utilized effectively?
- How to track the accountability of software license usage?
- How to improve the effectiveness of my investments in software?

Predictive Analytics with usage data can provide clear answers for above questions. Learn how.

It's Predictive Analytics capability helps business leaders to forecast their license utilization for the coming year and plans for the investments accordingly.

Benefits of User login

- ✓ Total Number of licenses(cores) utilized by the user
- ✓ Number of hours solver license used
- ✓ Highest utilized month & year
- ✓ Lowest utilized month & year
- ✓ Visualize YoY, MoM usage of user

Benefits of Manager login

- ✓ Total number of licenses(cores) used in a department
- ✓ Number of hours solver license used in a department
- ✓ User with highest utilization in a department
- ✓ User with lowest utilization in a department
- ✓ Visualize YoY, MoM usage of Department
- ✓ Forecasting next year's usage based on existing utilization

Benefits of Admin login

- ✓ Total number of licenses (cores) used in an organization
- ✓ Number of hours solver license used in an organization
- ✓ User with highest utilization in an organization
- ✓ User with lowest utilization in an organization
- ✓ Department with highest utilization
- ✓ Department with lowest utilization
- ✓ Visualize YoY, MoM usage (user | department | overall)
- ✓ Forecasting next year's usage based on existing utilization

www.kaizenat.com

Contact

Email : support@kaizenat.com Phone: +91 80 41500008

A team of engineers, mathematicians, & computer scientists develop LS-DYNA, LS-PrePost, LS-OPT, LS-TaSC, and Dummy & Barrier models, Tire models.



16th International LS-DYNA Conference Virtual Event

June 10-11, 2020 | Free Online Live Event

Speakers



Dr. Ajei Gopal
President & CEO, Ansys

Ajei Gopal is president and CEO of Ansys. Ajei has been associated with Ansys since joining the board of directors in 2011.

He previously served as operating partner for Silver Lake Partners, one of the largest technology investors in the world. As senior vice president and general manager of Hewlett-Packard Software, Ajei was directly responsible for \$2.6 billion in revenue and leading core business initiatives, including growing license revenue by attracting new customers through organically developed SaaS offerings. As executive vice president for CA Technologies, he directly managed \$4 billion in revenue, defined and implemented a winning strategy to compete in SaaS and cloud markets and drove double-digit new license growth for strategic products.

Ajei was the founder, CEO and director of Reefedge Networks, a wireless LAN security company, which was acquired by Symantec. He held several roles at IBM Research and IBM's Software Group and began his career at Bell Communications Research in 1984.



Dr. Prith Banerjee
Chief Technology Officer, Ansys

Prith Banerjee is chief technology officer at Ansys, responsible for leading the evolution of Ansys' technology strategy and championing the company's next phase of innovation and growth.

Prior to joining Ansys, Prith served as senior client partner at Korn Ferry, responsible for IoT and digital transformation in Global Industrial Practice. Before

that, he was executive vice president and chief technology officer at Schneider Electric. Prith also served as managing director of Global Technology Research and Development at Accenture, chief technology officer and executive vice president at ABB, senior vice president of Research at Hewlett-Packard and director at Hewlett-Packard Labs.



Al Hancq

VP Development, Mechanical BU

Al is vice president of development and in charge of the Mechanical Business Unit at Ansys. He has been at Ansys since 1994, starting as an intern on the APDL solver team. Throughout his career at Ansys he has worked on all facets of development.

Highlights including writing the Ansys fatigue module, developing the solver interface for Mechanical, and leading the Mechanical application development team.

THE MUST ATTEND EVENT FOR FEA

From modeling and optimization to biomedical and blast industries, you'll find the latest developments on the LS-DYNA User Conference agenda. Don't just attend — immerse yourself in a tailored learning & interactive experience to build the best set of tools you'll need to succeed in this competitive technology environment.

Full Agenda Coming Soon!

Why Attend

Program:

There's no better way to master the latest technologies and business concepts than by hearing from the global leaders that have experience with the solutions you need.

Exhibits:

Be among the first to see the latest products and solutions, then implement them into your organization and beat your competitors to market.

Network:

Meet industry innovators, thought leaders and technology enthusiasts at exhibits and live chat rooms.

Session Categories

- Aerospace
- Automotive
- Biomedical
- Blast
- Composites
- Computing technology
- Constitutive Modeling
- Connections
- Electromagnetics
- FSI/ALE
- ICFD
- Implicit
- Isogeometric Analysis (IGA)
- Metal Forming Modeling
- NVH
- Occupant Modeling
- Optimization
- Post-Processing
- Simulation
- SPG
- SPH
- Thermal
- THUMS
- Topology & Optimization

Sponsors



Become a conference sponsor

Be a part of the most dynamic and respected FEA conference in the world!
Contact us for more information.

[Become a Sponsor](#)



Providing engineering services to the composites industry since 1970. During this time, we have participated in numerous programs that demonstrate our ability to perform advanced composite design, analysis and testing; provide overall program management; work in a team environment; and transition new product development to the military and commercial sectors.



Progressive Composite Damage Modeling in LS-DYNA (MAT162 & Others)

Bazle Z. (Gama) Haque, Ph.D.

Senior Scientist, University of Delaware Center for Composite Materials (UD-CCM)
 Assistant Professor of Mechanical Engineering, University of Delaware, Newark, DE 19716
 P: (302) 690-4741 | E: bzhaque@udel.edu

2020 Workshops

Webinar Course Dates

March 10, 2020

July 14, 2020

November 17, 2020

In House Course Dates

March 11, 2020

July 15, 2020

November 18, 2020

Cost:

In-House Class: \$695 per person

Includes: Coffee, Lunch, Parking, USB with Course Content

email [Corinne Hamed](mailto:Corinne.Hamed) for driving direction

Web Conference: \$695 per person

Includes: CD with Course Content

Description:

Progressive damage modeling of composites under low velocity impact, and high velocity impact is of interest to many applications including car crash, impact on pressure vessels, perforation and penetration of thin and thick section composites. This course will provide a comparison between available composite models in LS-DYNA for shell and solid elements, e.g., MAT2, MAT54, MAT59, & MAT162. Among these material models, rate dependent progressive composite damage model MAT162 is considered as the state of the art. This short course will include the theory and practice of MAT162 composite damage model with applications to low and intermediate impact velocities, understanding the LS-DYNA programming parameters related to impact-contact, damage evolution, perforation and penetration of thin- and thick-section composites. Printed copies of all lecture notes will be provided along with a CD containing all example LS-DYNA keyword input decks used in this short course.

Topics Covered in this Short Course:

Impact and Damage Modeling of Composites

Application of MAT162 in Engineering and

Research Problems

Introduction to Composite Mechanics

Introduction to Continuum Mechanics and

Composite Mechanics

Composite Material Models in LS-DYNA for Shell and Solid Elements

Discussion on MAT2, MAT54, MAT59, & MAT162

Theory and Practice in MAT162 Progressive

Composite Damage Model for Unidirectional and

Woven Fabric Composites

MAT162 User Manual – Version 15A 2015

Progressive Damage Modeling of Plain-Weave

Composites using LS-Dyna Composite Damage

Model MAT162

Unit Single Element Analysis

Comparison between Different LS-DYNA

Composite Models

Sphere Impact on Composite SHELL & SOLID

Plates

Low Velocity Impact and Compression after Impact Applications

Modeling the Low Velocity Impact and

Compression after Impact Experiments on

Composites Using MAT162 in LS-DYNA

Perforation Mechanics of 2-D Membrane and Thin

Composites

Penetration Mechanics of Composites and Soft-

Laminates

Introduction to LS-DYNA (Document Only)

To register, email [Corinne Hamed](mailto:Corinne.Hamed) your full name, and if you're attending in house or web conference.

Oasys Ltd is the software house of Arup and distributor of the LS-DYNA software in the UK, India and China. We develop the Oasys Suite of pre- and post-processing software for use with LS-DYNA.



Oasys LS-DYNA Update Webinars

While our physical Users' Meetings are postponed due to the COVID-19, you can learn about the exciting new features of the recently released Oasys Suite 17.0 as well as LS-DYNA developments through this series of webinars:

LS-DYNA Updates
Oasys Integrated Solutions
New features to accelerate your workflow with the Oasys LS-DYNA Environment
Oasys Suite – Latest expert tools for LS-DYNA models

Click [here](#) to watch

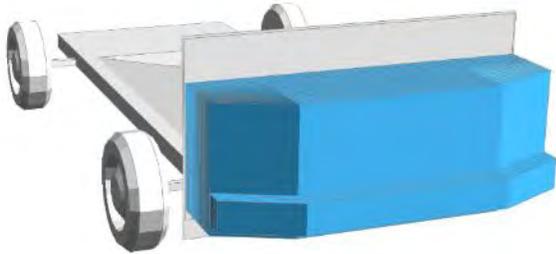


Working from home? Let us help... Practical steps and top tips

Like you, we're monitoring the news about COVID-19 and doing all we can to support you with your work, both in the office and at home. We've created a page on our website with some practical steps and top tips we can offer. Please view these [here](#). This includes advice for using the Oasys LS-DYNA Environment efficiently when working remotely.

We also know it's important for you to access the Oasys software to continue your work, even from home. You may now download your 'Working from Home' Oasys license [here](#).

If you have any questions about licensing options whilst you're working from home please get in [contact with us](#).



IIHS Solid barrier

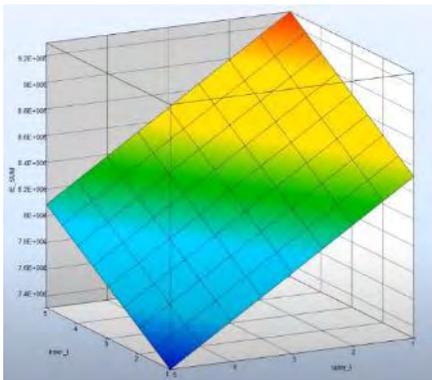
New version now available

The Oasys team is currently working with Cellbond to develop a new Shell LS-DYNA model for the upcoming updated version of the barrier to be used in the IIHS side impact crashworthiness evaluations.

In the meantime, we are pleased to offer our clients an interim model to get a rough understanding of the behaviour of this updated version of the IIHS side barrier.

We have updated our existing solid IIHS side barrier model to match the dimensions of the new design. As we do not have test data available for the new barrier yet, we have not been able to calibrate the model and its material properties. Therefore, we have parametrised the material properties so that the user can adjust them accordingly using its own test data.

The model will be offered free of charge to the clients with a license for the existing IIHS solid model. Please contact us via dyna.support@arup.com if you have a license for it and would like to receive the update, or if you're interested in a free trial license.



Top Tip video:

LS-OPT PRIMER Morphing

First in the series of video Top Tips - now available on Oasys LS-DYNA YouTube channel.

[Click here to view it.](#)

Predictive Engineering provides FEA and CFD consulting services, software, training and support to a broad range of companies.

Contact:



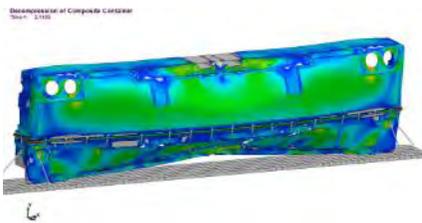
Predictive Engineering – Western States ANSYS LS-DYNA Distributor – Your Free Coffee Cup is On Its Way!

LS-DYNA has been one of Predictive's core analysis tools pretty much since we got started in 1995. It is an amazing numerical workhorse from the basic linear mechanics (think ANSYS or Nastran) to simulating well nigh the impossible. At least that is the way I feel at times when the model is not solving and spitting out arcane error messages and I'm basically questioning my sanity for accepting this project from hell that has a deadline at the end of the week. Which brings me to my favorite project management image – "trough of despair followed by wiggles of false hope then crash of ineptitude and finally the promised land" but I'll leave that for another blog.

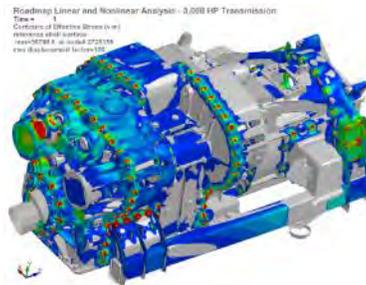
For now, let's talk about those free coffee cups. Predictive is now the western states distributor of ANSYS LS-DYNA and provides complete sales, training and services for ANSYS LS-DYNA clients in this region. It is a continuation of our prior setup with LSTC (now ANSYS LST) with the addition of Predictive's ability to offer ANSYS Workbench with LS-DYNA and other ANSYS software tools. So where's my free coffee cup? If you are a current Predictive ANSYS LS-DYNA client, we'll be shipping'em out to you at the end of February and for our new client's – just send us an email or give us a call.

View our portfolio [FEA, CFD and LS-DYNA consulting projects](#)

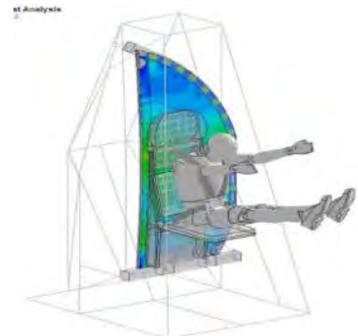
Composite Engineering



Nonlinear Dynamics



Aerospace



Address:
2512 SE 25th Ave
Suite 205
Portland, Oregon 97202
USA

Phone:
503-206-5571
Fax:
866-215-1220
E-mail:
sales@predictiveengineering.com

XFEM - Galactic Extended FEM - Coming to a Screen Near You

April 12, 2020 George Laird

Extended finite element method (XFEM) was developed by the late, great Dr. Ted Belytschko et al. at the end of the 90's (see Wikipedia for more details). Since he worked closely with the developers of LS-DYNA on many other topics, it is natural to see his work implemented within 'DYNA. I first met him in the early 90's when I took his and Prof. Hughes week-long Nonlinear FEA Methods in Palo Alto, CA. As for myself, I sat in the back with a post-doctoral student from Budiansky's group out of Harvard so he could explain to me what was going on since I was pretty much dazed and confused during the whole week. A little side note, all three, Belytschko, Hughes and Budiansky were Timoshenko Medal recipients. We now fast forward to 2020 and the XFEM is still something of academic interest but finding traction in the world of engineering. It is a lot like eye-candy to see a crack growing magically thru your structure, but the mechanics are real. Predictive Engineering recently completed an engineering services contract with a large US Navy shipbuilder where we used XFEM to make structural integrity predictions. The challenge was to quantitatively calculate the energy required to propagate a crack from a hull engine vent up through the panel and across a stiffener. The goal was to demonstrate that the crack could be arrested prior to reaching the main deck. The work was backed up via fracture mechanics calculations and static work calculating the localized mode I stress intensity factor (KI). Using XFEM we were able to optimize the crack arrestor bulb from somewhat massive dimensions to something that could be reasonably manufactured and thereby shaving a few tons of weight off the FFG(X)'s design.

US Navy's Next Generation FFG(X) Ship



Did I Just Lose 50% of You?

What XFEM Does

Extended FEM: Level Set + Local PU (Belytschko et al. 2000)

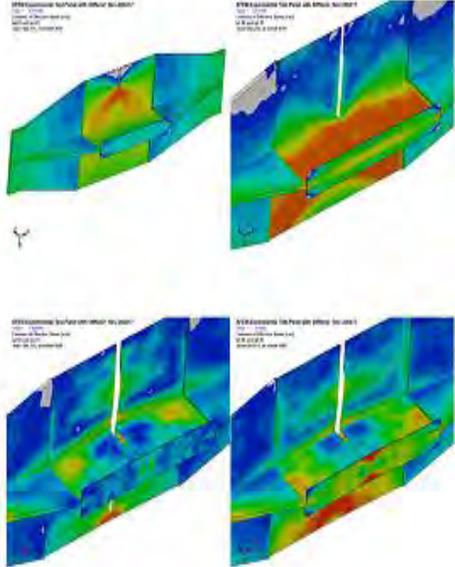
Level Set
 Discontinuity defined by two implicit functions: $f(X)$ and $g(X)$
 Signed distance function: $f(X) = \min(X - X_0, 0) + \max(X - X_0, 0)$
 Discontinuity: $X \in \Gamma \iff f(X) = 0 \text{ and } g(X) > 0$

Define implicit functions locally
 $f(X) = \sum f^i(X)$
 $g(X, i)$ replaced by index for elementwise crack propagation

Local Partition of Unity

$$\phi^i(X) = \sum_{j \in N_i} \phi_j^i(X) + \sum_{k \in N_i} \psi_k^i(X)$$

$$\psi_k^i(X) = \begin{cases} \phi_k^i(X) & \text{if } \text{fully cut element} \\ \phi_k^i(X) & \text{if } \text{contain crack tip} \end{cases}$$



Offering industry-leading software platforms and hardware infrastructure for companies to perform scientific and engineering simulations. Providing simulation platforms that empower engineers, scientists, developers, and CIO and IT professionals to design innovative products, develop robust applications, and transform IT into unified, agile environments.



2020, the ultimate test of business flexibility

May 8, 2020

Life Science, Thought Leadership
Garrett VanLee

How does a company pivot from manufacturing vehicles ([Tesla](#)) to ventilators, or from personal computers ([Apple](#)) to personal protective equipment (PPE)? Many firms across a spectrum of industries have answered the call to pivot from their existing business models to focus on solutions that combat COVID-19 in some form. For some, this means completely retooling production lines to simulate then manufacture entirely different products. While particularly important to global health right now, R&D flexibility is generally a strategic advantage. So what is a key differentiator among the most adaptable and innovative R&D organizations? If you guessed computing power you would be on the right track but there is more to the story.

Non-healthcare company innovators from aerospace to automotive demonstrated impressive feats of flexibility by designing and manufacturing new products to alleviate the shortage of ventilators ([CAE](#), [NASA](#)) and PPE (Ford, Volkswagen). Pivoting existing computer-aided design (CAD) and engineering (CAE) tools to new simulation applications, data types, and workloads poses a challenge for many companies who rely on fixed infrastructure. Homogeneous computing architectures do not stand the tests of time and variation in simulation needs. The emergence of flexible, heterogeneous HPC stacks are giving a leg up to companies that adopt them, allowing them to quickly get answers to new engineering questions and scale up with the best architecture for the job.

“The ability to quickly and successfully pivot has a lot to do with each manufacturer’s decision to invest in digital technologies. Digital transformation including the streamlining of core applications and the adoption of market facing solutions is helping manufacturers rapidly mobilize and alternate their production output to much-needed items, including ventilators.”

Todd Rovak, Global Head of Innovation and Strategy at Capgemini Invent, Industry Week

Whether developing new drugs or designing ventilation systems (Dassault) for ICU hospitals, time is of the essence to develop a viable product that passes the regulatory approvals necessary to begin manufacturing. For example, even with “priority” treatments, accelerated FDA reviews can be as long as 6 months, with standard approvals taking 10 months or longer (Drugwatch). From design, to testing and manufacturing, every stage of

getting a new medical treatment to the market is subject to stringent review. In order “to inform study designs and to optimize dose selection” for patients, the FDA has recommended the use of HPC modeling and simulation which can also significantly reduce the extent of wet lab testing and risks to trial patients (FDA). Even in the early stages of its adoption in the medical industry, HPC was credited for 50% faster product development cycles and time-to-market, with 97% of users claiming HPC is “indispensable” to their business (Council on Competitiveness).

Since those early days, big strides have been made in the architectures and applications of computational discovery and simulation for the medical field. In applications of computer-aided drug design (CADD), HPC is being used in “methods such as structural refinement, molecular docking, and virtual screening.” But on fixed, constrained infrastructures, these computationally intense and distinct applications will continue to be a “bottleneck” for scientists (Taylor and Francis Group).

Fixed compute infrastructure with predefined architectures are designed and deployed with a limited number of possible applications and workflows under consideration. Though on-premise infrastructure from the supercomputing era works well for the intended, well-planned, specific purpose, these compute architectures are not well suited for agility when the organization’s priority and strategy shifts. For example, if a company intends to pivot to simulate drug development for COVID-19 using applications that utilize specialized hardware acceleration tools like GPUs, they won’t be able to do so if their fixed infrastructure does not include such resources. Conversely, an organization’s infrastructure built for CFD applications may or may not be well suited to run molecular dynamics workflows.

HPC practitioners and their research teams have discovered that “drug discovery can greatly benefit from a diversity of HPC architectures, such as grid and cloud computing, the latter being the most adequate solution for drug discovery calculations. Cloud computing is a very cost effective solution to quickly access and exploit the required high computing power.” But deployment of these diverse architectures in the cloud requires an “understanding of computer architecture, parallel computing, and specific abilities of software management” which can stand in the way of their use. (Taylor and Francis Group)

Pioneering life science scientists and engineers use Rescale today to reap the benefits of diverse computing infrastructures and cloud flexibility. Navigating the variations of chemical compounds and device designs to find the most viable candidate requires cross-disciplinary simulations like molecular dynamics and CFD. Rescale helps scientists and engineers by automating the end-to-end selection, tuning, and deployment of the best infrastructure and software for the job. Having instant access to the world’s best infrastructure, pre-installed software with on-demand licensing, and virtually limitless compute capacity, can mean a significant acceleration in the time-to-answers for simulations across the entire R&D process.

In a recent interview with medical device entrepreneur Ben Hertzog, Managing Director of Hertzog Partners, describes the impact of simulation on bringing new devices to market:

“We have to find new ways to reduce innovation cycle time and the FDA is increasingly accepting of simulation and modeling as a part of the early datasets needed for approvals. So

more than ever, simulation and the ability to get answers quickly is an important tool in the life science community. “

Today, Rescale manages complex HPC workflows for disruptors and market leaders in biotechnology, pharmaceutical, and medical device industries. These companies rely on Rescale to meet the diverse computing needs across multiple stages and entities involved in the R&D process. Additionally, the proliferation of data generated throughout the process of clinical trials requires ongoing computation to inform models. Rescale is flexible enough to handle sharp compute fluctuations and provides enterprise-grade controls and reporting across the organization. R&D leaders use Rescale to orchestrate collaboration between business units and more accurately track progress against key deadlines. This visibility can also provide deep simulation insight for responding to regulator’s questions, leading to easier, faster, and more reliable approvals.

Science and engineering’s use of advanced computing techniques will continue to push the boundaries of medical discoveries and patient outcomes. Advancement in computing has always shown promise, but with slowing gains from Moore’s law, innovators look to flexible platforms of open access to diverse resources that enable agile development cycles. Because breakthroughs require continuous testing and iteration on multiple therapy candidates then pivoting resources to the more viable ones, an integrated-cloud HPC platform is the best way to ensure architecture flexibility and readiness to scale up quickly. For the enterprise, a managed platform like Rescale ensures close oversight of business units’ budgeting, collaboration, and infrastructure performance. And for researchers and scientists, time is spent generating critical insights instead of troubleshooting applications and infrastructure best suited for their research, leading to better health outcomes, faster.

Rescale is a proud member of the Tech Against Covid Consortium which offers high performance computing resources available at no cost to engineers, scientists, and researchers fighting COVID-19. Through this initiative, the Rescale platform has enabled individuals, academic institutions, and major pharmaceutical companies to launch their novel solutions in the cloud at the scale they need. Current COVID-19 projects include genomics research for susceptibility, contagion-spread modeling, and multiple vaccine candidate development. While Rescale is excited to highlight the exceptional work being done on the medical front, the platform is also home to a variety of R&D from building safer autonomous vehicles and more accurate storm predictions. You can find more information on these use cases and many others at rescale.com.

LS-DYNA China, as the master distributor in China authorized by LST, an Ansys company, is fully responsible for the sales, marketing, technical support and engineering consulting services of LS-DYNA in China.



仿坤软件
LS-DYNA China

Shanghai Fangkun LS-DYNA Related Training Course for May

Shanghai Fangkun will keep to provide more various webinars and training courses for domestic users and will keep mission firmly in mind, devote to improving user satisfaction of LS-DYNA and providing high-quality technical support and engineering consulting services for users. Recently Shanghai Fangkun releases training courses for May as below, we welcome any users who are interested to join our event.

- **Topic: ICFD analysis FSI coupling and thermal coupling**

Date: Beijing time 2020/05/13 9:30-11:30 AM

Instructor: Zhidan Yuan

Description: ICFD has strong/weak iterative fluid-structure coupling, the computational efficiency can be accelerated by fluid-solid coupling of potential fluid or one-way coupling. In addition, the fluid can not only calculate heat flow analysis, but also can calculate the conjugate heat transfer problems.

- **Topic: S-ALE analysis in LS-DYNA**

Date: Beijing time 2020/05/20 8:00-12:00 AM

Instructor: Dr. Hao Chen

Description: This seminar is to provide users with a thorough understanding of ALE method and ability to model and analyze large scale ALE/FSI engineering problems. The class focuses on Multi-material formulation which is used by most of today's ALE applications.

- **Topic: LS-DYNA LS-DYNA basic training**

Date: Beijing time 2020/05/28-29 9:30-17:00

Instructor: Zhidan Yuan, Yong Li

Description: To help users to better understand LS-DYNA software and use LS-DYNA more efficiently, and provide basic introduction to LS-DYNA.



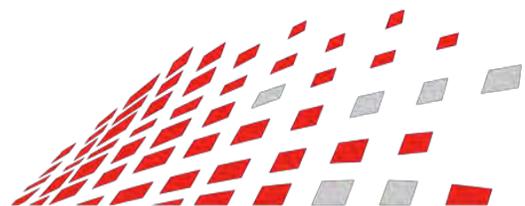
Contacts: Elva Yu

Tel.: 18221209107, 021-61261195

Email: Training@lsdyna-china.com

For more information please follow our

Wechat ID "LSDYNA" and our website www.lsdyna-china.com.



2020 Annual Training & Workshop

Dear LS-DYNA users,

To help users to better understand LS-DYNA software and use LS-DYNA more efficiently, Shanghai Fangkun releases 2020 annual training and workshop plan as following tables. We welcome those who are interested to attend.

Date	Topic	City	Duration
20-21, Feb.	Introduction to LS-DYNA (basic training)	Shanghai	2 days
Mar.	Product design with LS-OPT	Shanghai	1 day
Apr.	Crashworthiness in LS-DYNA	Shanghai	2 days
May	Material models in LS-DYNA (composite, non-metal)	Shanghai	2 days
Jun.	Introduction to LS-DYNA (basic training)	Chongqing	2 days
Jun.	Restraint system in LS-DYNA	Shanghai	2 days
Jul.	Battery multi-physics simulation with LS-DYNA	Shanghai	1 day
Sep.	Implicit analysis in LS-DYNA	Shanghai	1 day
Oct.	Fluid structure interaction with LS-DYNA (ALE, ICFD)	Shanghai	2 days
Nov.	Introduction to LS-DYNA (basic training)	Beijing	2 days
Dec.	User-Defined Materials in LS-DYNA	Shanghai	1 day

2020 LS-DYNA online workshop plan			
Date	Topic	Duration	Fee
13rd Jan.	Introduction to MPDB	3 hours	Free
Apr.	Contact Modeling in LS-DYNA	2 hours	Free
May	SALE method in LS-DYNA	2 hours	Free
Jun.	Introduction to Q series dummies	2 hours	Free
Jul.	NVH, Fatigue, & Frequency Domain Analysis in LS-DYNA	2 hours	Free
Aug.	SPG method in LS-DYNA	2 hours	Free
Sep.	Introduction to LS-PrePost	2 hours	Free
Sep.	Introduction to LS-OPT	2 hours	Free
Oct.	Introduction to LS-Form & Stamp forming	2 hours	Free
Oct.	Performance analysis of bus with LS-DYNA	2 hours	Free
Nov.	LST Dummy & Barrier	2 hours	Free
Nov.	EM method in LS-DYNA	2 hours	Free
Dec.	Summary of fluid structure interaction method in LS-DYNA	2 hours	Free
Dec.	Virtual Proving Ground training	2 hours	Free

Contact: Elva Yu Tel.: 18221209107, 021-61261195 for more detail information

Email: Training@lsdyna-china.com

CAE software sale & customer support, initial launch-up support, periodic on-site support. Engineering Services. Timely solutions, rapid problem set up, expert analysis, material property test Tension test, compression test, high-speed tension test and viscoelasticity test for plastic, rubber or foam materials. We verify the material property by LS-DYNA calculations before delivery.



CAE consulting - Software selection, CAE software sale & customer support, initial launch-up support, periodic on-site support.

Engineering Services - Timely solutions, rapid problem set up, expert analysis - all with our Engineering Services. Terrabyte can provide you with a complete solution to your problem; can provide

you all the tools for you to obtain the solution, or offer any intermediate level of support and software.

FE analysis

- LS-DYNA is a general-purpose FE program capable of simulating complex real world problems. It is used by the automobile, aerospace, construction, military, manufacturing and bioengineering industries.
- ACS SASSI is a state-of-the-art highly specialized finite element computer code for performing 3D nonlinear soil-structure interaction analyses for shallow, embedded, deeply embedded and buried structures under coherent and incoherent earthquake ground motions.

CFD analysis

- AMI CFD software calculates aerodynamics, hydrodynamics, propulsion and aero elasticity which covers from concept design stage of aircraft to detailed design, test flight and accident analysis.

EM analysis

- JMAG is a comprehensive software suite for electromechanical equipment design and development. Powerful simulation and analysis

technologies provide a new standard in performance and quality for product design.

Metal sheet

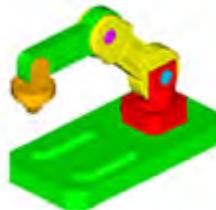
- JSTAMP is an integrated forming simulation system for virtual tool shop based on IT environment. JSTAMP is widely used in many companies, mainly automobile companies and suppliers, electronics, and steel/iron companies in Japan.

Pre/ Post

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

Biomechanics

- **The AnyBody Modeling System™** is a software system for simulating the mechanics of the live human body working in concert with its environment.





High School Students From Michigan and California Take Top Spots in FCA Drive for Design Competition

Competition Educates and Encourages Students to Pursue Careers in Automotive Design

May 8, 2020 , Auburn Hills, Mich. - Three students from Michigan and California have taken the top spots in this year's FCA Drive for Design contest. Entries submitted from high school students in grades 10-12 from across the country were reviewed virtually by FCA's automotive design team and special guest judge Josh Welton. This year's 10-week competition asked students to sketch a Ram truck of the future.

"All of the entries were impressive, the work was very focused with a notable attention to detail, as well as their thought process – these are characteristics we look for when we go to hire designers to work for FCA," said Mark Trostle, Head of Ram Truck and Mopar Exterior Design for FCA – North America. "Automotive design is a growing field and often overlooked by parents and students, our goal is to inspire and change that perspective. There are many career paths available within automotive design where young designers will have the opportunity to create some of the most exciting and technologically advanced products on the road today, as well as create what's possible for the future."

Trostle knows firsthand what it's like to be given an opportunity to excel in this field. In 2013, he introduced Drive for Design, which is based on a contest he won as a high school student. He credits that experience as something that led him to his current professional role, heading the design efforts for some of the most desired vehicles on the road. Today, he's passing the torch to three promising automotive designers.

The three student winners of the 2020 Drive for Design competition are:

- First place – Job Skandera, 12th grade, Santa Clara, California
- Second place – Vincent Piaskowski, 11th grade, Birmingham, Michigan
- Third place – Alex David Kirschmann, 11th grade, Auburn Hills, Michigan

Second-place winner Vincent Piaskowski is also a second-time winner, placing third in last year's competition.



Automotive News – High School Students Design Competition

"I'm a truck guy, so I was especially stoked to see what this year's competitors would bring to the table. They did not disappoint! The three winners each showed off sky high potential in technical skill and imagination without sacrificing what makes a Ram a Ram: functionality," said Josh Welton, Guest Judge. "If it's going to be 'Built to Serve' it needs to first be 'designed to serve,' I'll be first in line to rock any of their drawings should they come to life!"

Due to recent circumstances, awards for the annual contest were changed to include a more hands-on experience that will include virtual networking and design sketching demonstrations with members of the FCA design team along with electronic creative tools of the trade:

First place - Wacom MobileStudio Pro 16

Second and third places - Apple iPad Pro and Apple Pencil

Virtual networking and design sketching demonstrations with FCA designers will be planned for all winners

"While we were not able to carry out our award ceremonies this year, we do want to give special thanks to our partners EyesOn Design and College for Creative Studies," said Trostle.

For detailed contest rules and information, visit www.FCAdrivefordesign.com.



About Drive for Design

Launched in 2013, the FCA Product Design Office created its Drive for Design contest as an innovative way to educate young artists about careers in automotive design. Starting locally in Detroit, Drive for Design has grown to become a national contest that awards talented students with prizes and unique opportunities to further develop their design skills.

About CCS

The College for Creative Studies (CCS) is a nonprofit, private college authorized by the Michigan Education Department to grant bachelor's and master's degrees. CCS, located in midtown Detroit, strives to provide students with the tools needed for successful careers in the dynamic and growing creative industries.

Founded in 1906 as the Detroit Society of Arts and Crafts, CCS plays a key role in Detroit's cultural and educational communities. A private, fully accredited college, CCS enrolls more than 1,400 students, pursuing Master of Fine Arts degrees in Color and Materials Design, Interaction Design, Integrated Design and Transportation Design and Bachelor of Fine Arts degrees in Advertising Design, Art Education, Crafts, Entertainment Arts, Fashion Accessories Design, Fine Arts, Graphic Design, Illustration, Interior Design, Photography, Product Design and Transportation Design.

About EyesOn Design

A benefit for the Detroit Institute of Ophthalmology (DIO), a not-for-profit corporation, EyesOn Design is a major source of revenue for the DIO's research, education and support group programs for the visually impaired. The DIO is a division of the Department of Ophthalmology of the Henry Ford Health System.

LS-DYNA - Resource Links

LS-DYNA Multiphysics YouTube

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

FAQ LSTC

<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/maillinglist

AEROSPACE WORKING GROUP

<http://awg.lstc.com>

Training - Webinars



Participant's Training Classes

Webinars

Info Days

Class Directory

Directory

BETA CAE Systems	www.beta-cae.com/training.htm
DYNAmore	www.dynamore.de/en/training/seminars
Dynardo	http://www.dynardo.de/en/wost.html
ESI-Group	https://myesi.esi-group.com/trainings/schedules
ETA	http://www.eta.com/training
KOSTECH	www.kostech.co.kr
ANSYS LST	www.lstc.com/training
LS-DYNA OnLine - (Al Tabiei)	www.LSDYNA-ONLINE.COM
OASYS	www.oasys-software.com/training-courses
Predictive Engineering	www.predictiveengineering.com/support-and-training/ls-dyna-training

Response spectrum analysis and DDAM analysis in LS-DYNA®

Yun Huang, Zhe Cui

Livermore Software Technology, an ANSYS Company

Abstract

Response spectrum analysis (keyword ***FREQUENCY_DOMAIN_RESPONSE_SPECTRUM**) evaluates the peak response of structures subjected to various loads like ground motions in an earthquake. It combines contribution from each vibration mode of the structures. This feature has important application in Civil and hydraulic engineering, where seismic analysis is critical to the design and safety evaluation of the large scale buildings.

DDAM (Dynamic Design Analysis Method) is a U.S. Navy-developed analytical procedure for shock design. It helps validate the design of onboard equipment and structures subject to dynamic loading caused by underwater explosions (UNDEX). It is a widely accepted procedure for safety evaluation for civil and military ship building. The keyword for response spectrum analysis (***FREQUENCY_DOMAIN_RESPONSE_SPECTRUM**) in LS-DYNA has been extended to run DDAM analysis for shipboard components, with the option **_DDAM**.

This paper first gives a brief review of the theory for response spectrum analysis and DDAM analysis. Then, with several examples, this paper shows how to run response spectrum analysis and DDAM analysis with LS-DYNA and how to perform post-processing of the results. For purpose of cross-validation, the results of DDAM analysis with LS-DYNA are compared with that given by other commercial code.

Keyword: response spectrum analysis, DDAM

Introduction

Response spectrum analysis (***FREQUENCY_DOMAIN_RESPONSE_SPECTRUM**) has been implemented to LS-DYNA since R7 of LS971. It was extended to Dynamic Design Analysis Method since R10. DDAM Dynamic Design Analysis Method (DDAM) is a U.S. Navy standard procedure that has been used for over 30 years for shock design. One can use DDAM to analyze the response of the shipboard equipment, such as antenna, radar, engines, and other critical structures, due to underwater explosions. All mission-essential equipment on board surface ships and submarines must be designed to operate under severe conditions of shock loading, such as from depth charges, explosion of mines, missiles, and torpedoes.

LS-DYNA New Feature and Application

With the fixed structure moving in water, the shock spectrum experienced by the shipboard equipment is higher than that the same equipment fixed on ground would experience. This change in spectrum is called as the spectrum-dip effect, which is similar to soil-structure interaction under earthquake excitation. The interaction between the equipment under shock loading and its fixed structure can be modeled by DDAM. The coefficients included in the load spectrum equation for DDAM analysis allow also for the influence of equipment mounting location and shock direction.

To run DDAM analysis, the first step is to extract natural frequencies and normal modes of the equipment. Then the modal effective mass in each direction (x, y and z) are calculated. After that, DDAM analysis is performed using an input acceleration spectrum of shock design values. The input spectrum values are provided based on equations provided in unclassified U.S. Navy standard documents (NRL Report 1396), for pre-determined mounting location / load direction / material type, etc., together with the modal weight of the equipment. Alternatively, engineers can use customized equations to define the input shock spectrum, based on user-defined coefficients. Those coefficients can be defined for an alternate unit system, or obtained from field testing. NRL (Naval Research Laboratories) sum method is then used to combine the peak responses from all modes into overall response which includes displacements, velocities, accelerations, stresses and strains. After that, evaluation of the DDAM results, in correlation to design standards, or material failure criterion etc., is performed.

There are some limitations on DDAM analysis. First, it is a linear analysis. In other words, some nonlinear behavior or deformation cannot be captured explicitly. Secondly, the available DDAM-NRL coefficients are old and not convenient for new type of the ships and warfare. In addition, those coefficients don't consider the size variation of ships. For example, response of the same device on an aircraft carrier and on a small frigate under same shock load should be different. Understanding the limitations of DDAM analysis is necessary for engineers who need to run shock analysis. However, up to today, DDAM is still the most convenient and efficient method for shock analysis of onboard equipments.

Since the implementation of response spectrum analysis into LS-DYNA, LS-DYNA has been used to run the DDAM analysis, based on users' in house script [1] or pre-defined load spectrum. To make the DDAM analysis more convenient, a `_DDAM` option is added to the keyword ***FREQUENCY_DOMAIN_RESPONSE_SPECTRUM**. With this new option, users can run DDAM analysis with LS-DYNA directly.

Shock spectrum definition

The DDAM SDV (Shock Design Values) is an acceleration spectrum defined in terms of g (gravity acceleration). According to NRL-1396 standard, the following factors are considered to define the SDV

LS-DYNA New Feature and Application

- Type of Ship
 - Surface
 - Submarine
- Mounting location
 - Hull mounted system
 - Deck mounted system
 - shell plating mounted system
- Direction of shock load or attack
 - Vertical
 - Athwartship
 - Fore and aft
- Material type
 - Elastic
 - elastic-plastic

For example, for a hull mounted device on a surface ship, NRL-1396 [2] provides the following reference equations:

$$A_0 = 20 \left[\frac{(37.5 + \bar{W}_a)(12 + \bar{W}_a)}{(6 + \bar{W}_a)^2} \right] \quad (g) \quad (1)$$

$$V_0 = 60 \left[\frac{12 + \bar{W}_a}{6 + \bar{W}_a} \right] \quad (\text{in/sec}) \quad (2)$$

And design values

	Elastic		Elastic-Plastic	
	A_a	V_a	A_a	V_a
Vertical	1.0 A_0	1.0 V_0	1.0 A_0	0.5 V_0
Athwartship	0.4 A_0	0.4 V_0	0.4 A_0	0.2 V_0
Fore and aft	0.2 A_0	0.2 V_0	0.2 A_0	0.1 V_0

Table 1: Shock spectrum design values for surface ship, hull mounted system

where,

$$\bar{W}_a = \frac{M_{eff} g}{1000} \quad (\text{kips}) \quad (3)$$

is the modal weight. M_{eff} is the effective modal mass, provided by implicit modal analysis (using keyword ***CONTROL_IMPLICIT_EIGENVALUE** in LS-DYNA).

So, one can use the modal weight (kips) computed for the mode under consideration, calculate the proper A_0 and V_0 from the reference equations (1) and (2); and then find the appropriate design values A_a and V_a using Table 1; and then multiply A_a by g (386 in/sec²) and V_a by ω_a (round frequency, $=2\pi f$); the SDV is the lesser of these two values. If a value of SDV < 2316 in/sec² (6 g) is determined by this method, the SDV of 2316 in/sec² should be used.

More reference equations and design values, for different ship types and mounting types, can be found in NRL Memorandum Report 1396 [2].

LS-DYNA New Feature and Application

This procedure is repeated for all modes included in DDAM analysis.

LS-DYNA provides also the option to define the SDV by user directly.

For acceleration input spectrum, it is defined by

$$A = \begin{cases} A_f \times A_a \frac{(A_b + \bar{W}_a) \times (A_c + \bar{W}_a)}{(A_d + \bar{W}_a)^2} & \text{if } A_d \neq 0 \\ A_f \times A_a \frac{(A_b + \bar{W}_a)}{(A_c + \bar{W}_a)} & \text{if } A_d = 0 \end{cases} \quad (4)$$

The user defined velocity input spectrum is defined as

$$V = V_f \times V_a \frac{(V_b + \bar{W}_a)}{(V_c + \bar{W}_a)} \quad (5)$$

The parameters A_f, A_a, A_b, A_c, A_d and V_f, V_a, V_b, V_c are defined in Cards 4b.1 and 4b.2 in LS-DYNA keyword ***FREQUENCY_DOMAIN_RESPONSE_SPECTRUM_DDAM**.

NRL Sum method

A series of modal combination methods are available in LS-DYNA, for running response spectrum analysis with ***FREQUENCY_DOMAIN_RESPONSE_SPECTRUM**. They include SRSS, CQC, NRC grouping, etc.

For DDAM, the standard modal combination method is NRL-sum, given as

$$R = |R_1| + \left[\sum_{i=2}^N (R_i)^2 \right]^{1/2} \quad (6)$$

The NRL-sum is a statistical estimate of the maximum response created by taking the response for the mode that exhibits the largest response and adding the SRSS response of other modes. The calculated response could be nodal displacement, velocity or acceleration or element stress / strain components, or forces. With this equation, the contribution on overall response from the mode that exhibits the largest response is emphasized.

Though R_1 is used in equation (6) for the response for the mode that exhibits the largest response, it does not suggest that that mode has to be the first mode.

Mode selection

Modal analysis is the first step for running DDAM. A careful selection of modes is critical to the application of DDAM. A well accepted criterion is that the cumulative modal weight (cumulative modal effective mass) of all modes involved in the shock spectrum must be greater than 80%, in each direction. If not, more normal modes should be included.

LS-DYNA New Feature and Application

Closely spaced modes

Modes are close if their frequencies are within 10% of the mean frequency. Once each CSM pair combination is determined, it is used in the NRL-sum as a single effective mode.

LS-DYNA can identify the closely spaced modes automatically. Alternatively user can pre-define the closely spaced modes pairs using the keyword ***SET_MODE**. If the closely spaced modes are defined by a set ID, additional card (Card 5) is required to input the set ID (sid) for the series of closely spaced mode pairs. For more details about the keyword, please refer to LS-DYNA Keyword Users' Manual [3].

LS-DYNA keywords

To run DDAM analysis, the keyword ***FREQUENCY_DOMAIN_RESPONSE_SPECTRUM_DDAM** is used. Besides, to get the binary plot database d3spcm from DDAM, user needs to define the keyword ***DATABASE_FREQUENCY_BINARY_D3SPCM** and set binary=1 in this keyword. A sample for these keywords is given in Figure 1.

```
*CONTROL_IMPLICIT_GENERAL
$#  imflag      dt0      imform      nsbs      igs      cnstn      form      zero_v
    1      1.0000      0
*CONTROL_IMPLICIT_EIGENVALUE
$#   neig      center      lflag      lftend      rflag      rhtend      eigmth      shfscl
    30      .0
$#  isolid      ibeam      ishell      itshell      mstres      evdump
                        1
*FREQUENCY_DOMAIN_RESPONSE_SPECTRUM_DDAM
$#  mdmin      mdmax      fnmin      fnmax      restrt      mcomb      relatv
    1      30      0.      5000.      4
$#  dampf      lcdamp      ldtyp      dmpmas      dmpstf
$#   std      unit      amin      vid      xc      yc      zc
    1      4      6      1
$#  shptyp      mount      movemt      mattyp
    2      1      3      1
*DATABASE_FREQUENCY_BINARY_D3SPCM
$#  binary
    1
```

Fig.1: Sample keyword setting for running DDAM

Additional keyword ***CONTROL_IMPLICIT_EIGENVALUE** is also needed, to provide natural frequencies and modal shape vectors for the structure under study. The natural frequencies and modal shape vectors are saved in d3eigv binary database, which can be accessed by LS-PrePost. Another keyword ***CONTROL_IMPLICIT_GENERAL** is also needed to activate implicit analysis in LS-DYNA.

LS-DYNA New Feature and Application

As shown in Figure 1, the parameters `mdmin` and `mdmax` pair (or `fnmin` and `fnmax` pair) in card 1 in `*FREQUENCY_DOMAIN_RESPONSE_SPECTRUM_DDAM` define the range of modes to be used in DDAM analysis. The parameter `restrt` defines restart option. When modal analysis was already done before, and `eigout` and `d3eigv` files are available, one can set `restrt = 1` to skip modal analysis in current DDAM computation. LS-DYNA can read `eigout` and `d3eigv` to extract the cumulative effective mass data, and eigen frequencies and eigenvectors. The card for damping (card 2) is not needed for DDAM analysis, and should be blank. In card 3, `unit = 4` means that the unit system [lb, inch, second, lbf and psi] is used. When other units are used, user needs to tell LS-DYNA which set of unit system is used by setting `unit` appropriately (please refer to LS-DYNA Keyword Users' Manual [3] for more details). The equations (1) and (2) for defining the SDV are based on using [g] as unit for acceleration and [inch/s] as unit for velocity. So some unit conversion is needed and carried out in LS-DYNA to convert the SDV to values using acceleration or velocity units consistent with other variables.

With this keyword, we are running DDAM analysis using NRL-1396 design spectrum standard for shock load (`std = 1`). The DDAM analysis is performed on an elastic (`mattyp = 1`) part which is constrained in a surface ship (`shptyp = 2`) using Hull mounted system (`mount = 1`). The shock load is in Fore and Aft direction (`movemt = 3`).

This setting is equivalent to the following setting using user defined spectrum option (`std = -1`).

```
*CONTROL_IMPLICIT_GENERAL
$#  imflag      dt0      imform      nsbs      igs      cnstn      form      zero_v
      1      1.0000      0
*CONTROL_IMPLICIT_EIGENVALUE
$#  neig      center      lflag      lftend      rflag      rhtend      eigmth      shfscl
      30      .0
$#  isolid      ibeam      ishell      itshell      mstres      evdump
      1
*FREQUENCY_DOMAIN_RESPONSE_SPECTRUM_DDAM
$#  mdmin      mdmax      fnmin      fnmax      restrt      mcomb      relativ
      1      30      0.      5000.      4
$#  dampf      lcdamp      ldtyp      dmpmas      dmpstf
$#  std      unit      amin      vid      xc      yc      zc
      -1      4      6      1
$#  af      aa      ab      ac      ad
      0.2      20.      37.5      12.      6.
$#  vf      va      vb      vc
      0.2      60.      12.      6.
*DATABASE_FREQUENCY_BINARY_D3SPCM
$#  binary
      1
```

Fig.2: Sample keyword setting for running DDAM with user defined constants for SDV

The parameters `af`, `aa`, `ab`, `ac`, `ad`, `vf`, `va`, `vb`, and `vc` come from equations (1) and (2) and table 1. More details about the parameters of the keywords can be found in LS-DYNA Users' Keyword Manual [2].

LS-DYNA New Feature and Application

Postprocessing of DDAM results

The results of DDAM analysis are saved in binary plot database d3spcm, as other response spectrum analysis (***FREQUENCY_DOMAIN_RESPONSE_SPECTRUM**). To get d3spcm, one needs to set binary = 1 in ***DATABASE_FREQUENCY_BINARY_D3SPCM**.

This database is accessible to LS-PrePost (version 4.0 and above). There is only one state in this database, which shows the peak values of response due to the shock loading. The response includes nodal displacement, velocity, acceleration, and elements' stresses and strains, as shown in Figure 3.

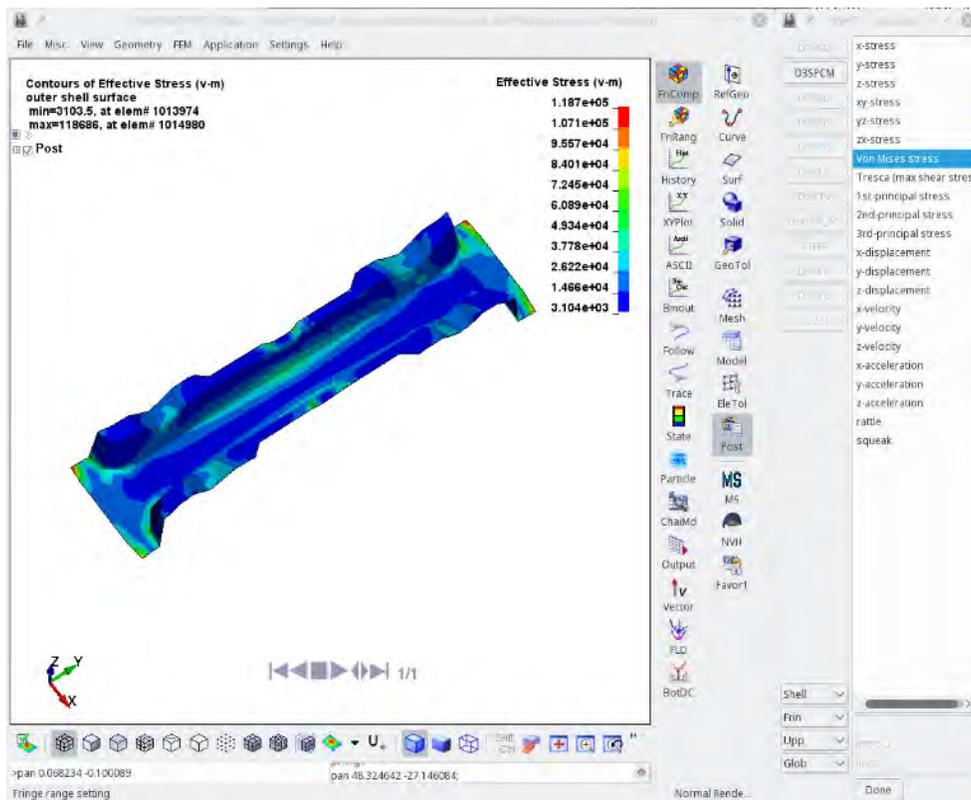


Fig.3: Fringe components of d3spcm, as shown in LS-PrePost

Examples

A benchmark example for a bracket model

A bracket model shown in Figure 4 is adopted for cross-validation of DDAM analysis by LS-DYNA and by third party commercial software - ANSYS. The ANSYS DDAM results were provided by a customer.

The LS-DYNA keyword setting for this model is shown in Figure 1. For this example, the SDV comes from NRL-1396 design spectrum standard (std = 1). The bracket model is elastic (mattyp = 1), and it is fixed on a surface ship (shptyp = 2) using Hull mounted system (mount = 1). The shock load is in Fore and Aft direction (movemt = 3). 30 normal modes are used in DDAM analysis, both in ANSYS and LS-DYNA.

LS-DYNA New Feature and Application

The x-displacement results are shown in Figures 4 and 5. The Von Mises stress results are shown in Figures 6 and 7. One can see that the results given by ANSYS and by LS-DYNA not only match well in numbers, but also match in the fringe plot of the response.

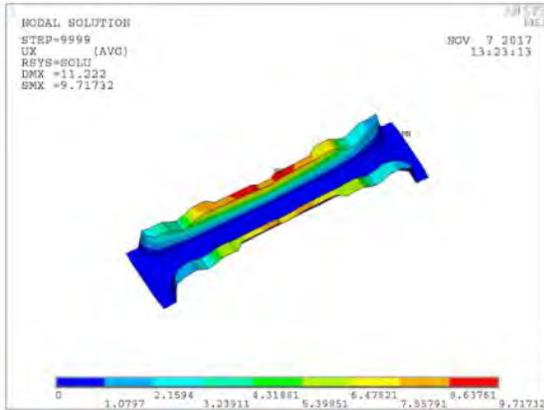


Fig.4: X-displacement by ANSYS

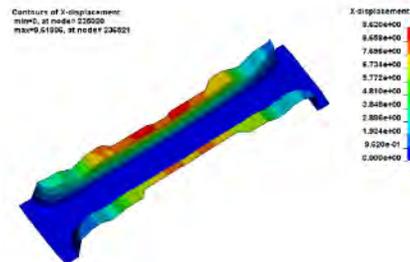


Fig.5: X-displacement by LS-DYNA

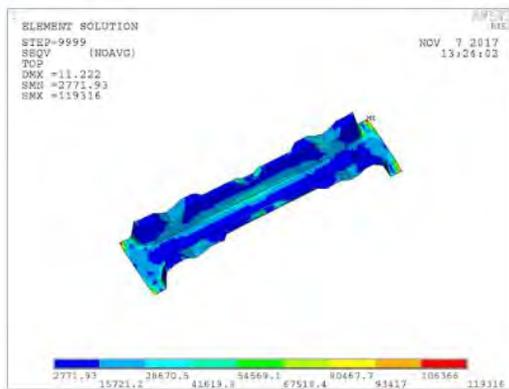


Fig.6: Von Mises stress by ANSYS

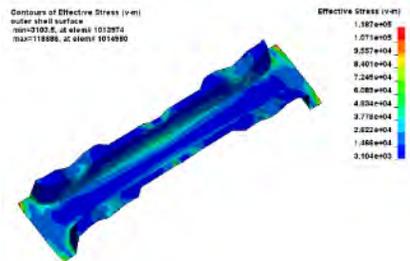


Fig.7: Von Mises stress by LS-DYNA

Table 2 below compares the maximum values of response, by ANSYS and LS-DYNA. For most items in Table 2 there is a good match between ANSYS results and LS-DYNA results.

		ANSYS	LS-DYNA	Diff (%)
Displacement (inch)	x	9.717	9.620	1.00%
	y	1.835	1.856	1.14%
	z	6.304	6.375	1.13%
Velocity (inch/s)	x	206.393	204.265	1.03%
	y	45.884	46.440	1.21%
	z	154.401	156.737	1.51%
Acceleration (inch/s ²)	x	5592.22	5571.59	0.37%
	y	2303.57	2438.19	5.84%
	z	6056.48	6306.27	4.12%
Von Mises stress (psi)		119316	118686	0.53%

Table 2: Maximum response values by ANSYS and LS-DYNA

Example of a simplified engine model

For the second example, a simplified engine model as shown in Figure 8 is considered. The engine model is deck-mounted on a surface ship (shptyp = 2, mount = 2). The shock load is in vertical direction (movemt = 1). Elastic material is used (mattyp = 1). 35 normal modes are used in DDAM analysis.

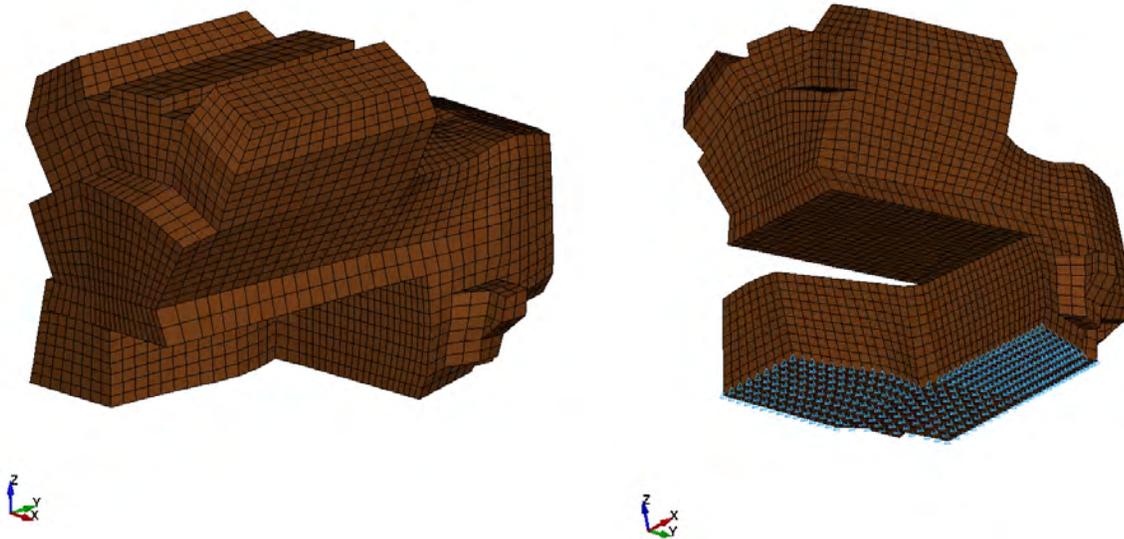
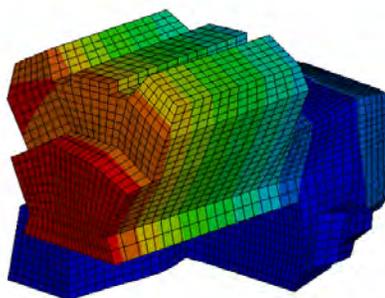


Fig.8: Engine model deck-mounted on a surface ship

The DDAM analysis results on this model are given in Figures 9-12 for velocity and Von Mises stress.

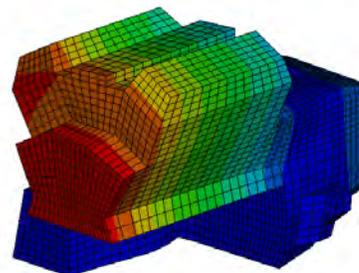
To study the effect of CSM (closed spaced modes), two sets of results are given. The first set of results are obtained without considering closed spaced modes and the second set of results are obtained with consideration of closed spaced modes. The pairs of closed spaced modes are identified by LS-DYNA automatically, based on the rule that two modes are close if their frequencies are within 10% of the mean frequency.

Contours of Z-velocity
min=0, at node# 2845533
max=1.34702, at node# 2846026



Z-velocity
1.347e+00
1.212e+00
1.078e+00
9.429e-01
8.082e-01
6.735e-01
5.389e-01
4.041e-01
2.694e-01
1.347e-01
0.000e+00

Contours of Z-velocity
min=0, at node# 2845533
max=1.34608, at node# 2846026



Z-velocity
1.346e+00
1.211e+00
1.077e+00
9.423e-01
8.076e-01
6.730e-01
5.384e-01
4.038e-01
2.692e-01
1.345e-01
0.000e+00

Fig.9: Z-velocity response without considering CSM

Fig.10: Z-velocity response with considering CSM

LS-DYNA New Feature and Application

Mode 1	Mode 2	Frequency 1 (Hz)	Frequency 2 (Hz)	closeness
1	2	161.916	183.585	6.27%
8	9	2154.123	2388.604	5.16%
10	11	2514.085	2568.140	1.06%
13	14	2900.369	2978.841	1.33%
15	16	3109.892	3235.419	1.98%
17	18	3440.616	3518.140	1.11%
20	21	3755.087	3769.748	0.19%
23	24	3998.838	4030.054	0.39%
25	26	4119.330	4185.419	0.80%
27	28	4337.447	4368.439	0.36%
29	30	4440.072	4477.796	0.42%
34	35	4885.955	4925.765	0.41%

Table3: Closed spaced modes pairs identified by LS-DYNA

In Table 3, the values in closeness column (to show how close the two modes are in relation to their mean frequency) are computed as

$$\frac{f_2 - f_1}{f_2 + f_1} \times 100\% \quad (7)$$

For this example, it seems that there is no big difference in the response with or without considering closed spaced modes (of course, this does not have to be true for other cases). Generally speaking, without considering closed spaced modes effect, the total response could be larger.

Summary

DDAM is a standard procedure to validate the design of onboard equipment and structures subject to dynamic loading caused by underwater explosions (UNDEX). Up to today, it is still a convenient and efficient method for shock analysis.

This paper introduces the DDAM analysis feature of LS-DYNA, as an extended option for response spectrum analysis (***FREQUENCY_DOMAIN_RESPONSE_SPECTRUM**). LS-DYNA provides flexible ways to run DDAM analysis. User can run DDAM analysis with NRL-1396 standard shock spectrum, or with customized shock spectrum with self-defined constants. Closed spaced modes can be considered in DDAM analysis.

Benchmark examples were given in the paper, to show the accuracy and reliability of the DDAM solver. Post-processing of the results by using LSTC'S LS-PrePost software, is also reviewed.

Literature

- [1] Koehler M, McCoy W, Patel M: "Dynamic Design Analysis Method to Evaluate Shipboard Shock in LS-DYNA®", Proceedings of the 15th International LS-DYNA® Users' Conference, June 10-12, 2018, Dearborn, MI, USA.
- [2] O'Hara, G, Belsheim, R: "Interim design values for shock design of shipboard equipment", National Technical Information Service, 1963.
- [3] Hallquist, J. "LS-DYNA Keyword User's Manual, Volume I". LSTC, Livermore, CA, USA, 2017.



BETA CAE Systems.

www.beta-cae.com

BETA CAE Systems - ANSA

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

BETA CAE Systems μ ETA

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



ETA – Engineering Technology Associates
etainfo@eta.com

www.eta.com

Invention Suite™

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

Invention'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

Invention'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.



get it right® 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.

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.

VisualDSS 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. VisualDSS 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, an ANSYS Company
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 LST, an ANSYS company. 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.

LST, AN ANSYS COMPANY 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.

LST, AN ANSYS COMPANY Barrier Models

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



Material Sciences Corporation

www.materials-sciences.com

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

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

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

failure modeling of composite structures currently available.

MSC/LS-DYNA Composite Software and Database -

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

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

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

Oasys

LS-DYNA ENVIRONMENT

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



www.predictiveengineering.com

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

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

Our History

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



Shanghai Hengstar

www.hengstar.com

Center of Excellence: Hengstar Technology is the first LS-DYNA training center of excellence in China. As part of its expanding commitment to helping CAE engineers in China, Hengstar Technology will continue to organize high level training courses, seminars, workshops, forums etc., and will also continue to support CAE events such as: China CAE Annual Conference; China Conference of Automotive Safety Technology; International Forum of Automotive Traffic Safety in China; LS-DYNA China users conference etc.

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

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

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

Consulting

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

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



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

**JSOL Corporation is cooperating with chosen
cloud computing services**

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

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

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

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

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

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

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

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

Platform Computation Cloud - CreDist.Inc.

PLEXUS CAE

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

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

Cloud - HPC Services - Subscription *RESCALE*

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.

Cloud - HPC Services - Subscription **RESCALE**

Rescale Cloud Simulation Platform

www.rescale.com

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 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

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

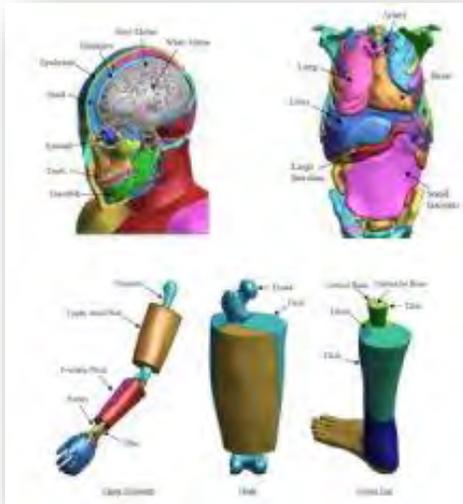
Collaboration

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:

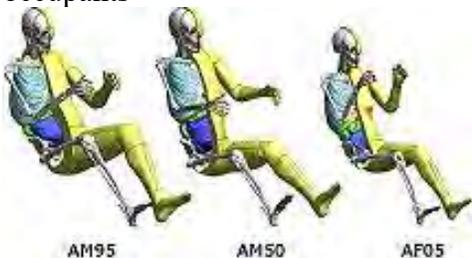
- Data, workflow or project asynchronous collaboration
- Multi-user, browser based collaboration for CAD, geometry, mesh and results models
- Real-time design review with notes, annotations and images archiving and retrieval
- Email invite to non ESI Cloud users for real time collaboration

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.

ATD - Human Models - Barrier

LST, An ANSYS Company – Dummy Models

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



ATD - Human Models - Barrier

LST, An ANSYS Company – 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

LSTC ODB and MDB models are developed to correlate to several tests provided by our customers. These tests are proprietary data and are not currently available to the public.

All current models can be obtained through our webpage in the LSTC Models download section or through your LS-DYNA distributor.

To submit questions, suggestions, or feedback about LSTC's models, please send an e-mail to: atds@lstc.com. Also, please contact us if you would like to help improve these models by sharing test data.



Social Media



FACEBOOK

[BETA CAE Systems](#)
[ESI Group](#)

[CADFEM](#)
[Lenovo](#)



TWITTER

[BETA CAE Systems](#)
[ETA](#)

[ESI Group](#)
[CADFEM](#) [Lenovo](#)



LINKEDIN

[BETA CAE Systems](#)
[DYNAmore Nordic](#)
[ESI Group](#)

[CADFEM](#)
[ETA](#)



YOUTUBE

YOUTUBE Channel

[BETA CAE Systems](#)
[CADFEM](#)
[ESI Group](#)
[ETA](#)
[Lancemore](#)
[Lenovo](#)

WebSite URL

www.beta-cae.com
www.cadfem.de
www.esi-group.com
www.eta.com
www.lancemore.jp/index_en.html

GOOGLE+

[BETA CAE Systems](#)