fea INFORMATION Engineering Solutions

Ansys LST

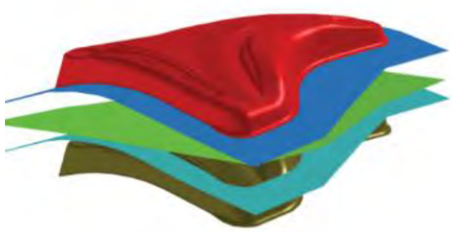
Issue 8, August 2020

www.lstc.com www.ansys.com www.feapublications.com

ANSYS

BETA CAE Systems

ETA



LST

LS-DYNA New Feature and Application

Cross-platform Co-simulation for Vehicle Safety Analysis

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 - news@feainformation.com

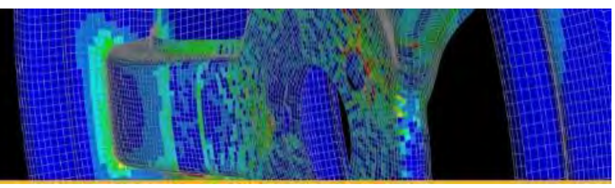
Platinum Particpants

Table of contents

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 Blog



Published on August 13, 2020
by Craig Hillman
Electronics, Automotive
Electronics, Printed Circuit Board (PCB) Design, Semiconductors, Ansys Sherlock

Overcome Automotive Electronics Reliability Engineering Challenges

The basic structure of an automobile hasn't changed for decades: four wheels, engine, radio, doors, hood, etc. What has changed are automotive electronics. Since the 1970s, electronics have gone from about 5% of the bill of materials (BOM) to over 35% and are projected to rise to over 50% by 2030 (Statista).

Electronics in the modern automobile

With the smartphone market saturated, the inclusion of more automotive electronics is great news for the electronics industry. But the test requirements and use environments of vehicles present reliability engineering challenges that traditional design and testing don't take into consideration – and failures result.

Let's look at how and why automotive electronics require consideration beyond conventional approaches to ensure successful reliability engineering.

Learn more about how Ansys Sherlock can improve your automotive electronics reliability.

The Four Categories of Automotive Electronics

Safety features in the modern automobile

The five-decade growth in automotive electronics can be captured in four categories.

1. **Functional electronics** (critical to vehicle operation): anti-lock braking systems (ABS), automatic transmission control, starters, fuel injection, headlights, electromechanical parking brakes.
2. **Regulatory compliance electronics** (mandated by the National Highway Traffic Safety Administration or Department of Transportation in the U.S.): airbags, emission controls, backup camera, collision detection radar.
3. **Differentiating electronics** (distinct, customer-oriented technologies): infotainment, adaptive cruise control, Wi-Fi connectivity and advanced driver assistance systems (ADAS).
4. **Growth opportunities** (for vehicles in general): collision detection, in-dash displays, head-up displays (HUD), enhanced infotainment systems, vehicle-to-vehicle communication (V2V) and improved Wi-Fi.

Not so neatly categorized is the advent of autonomous vehicles. Autonomous vehicles offer great potential for improvements via an increase in highway capacity and traffic flow, faster response times than human drivers, less fuel consumption and less pollution. Automakers are working hard to ensure these vehicles operate safely in both everyday traffic and harsh off-road environments in an effort to overcome some skeptical consumer perceptions.

Reliability Engineering Challenge: Testing for Failure

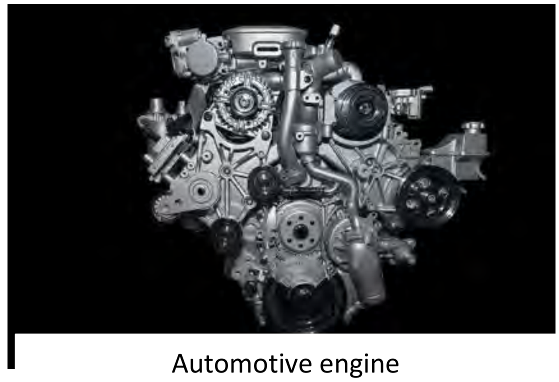
The computer environment in which electronics operate is relatively benign, typically including:

- Immobility/limited vibration.
- Little to no mechanical shock.

- Low humidity/controlled temperatures of office environments.
- Predictable duty cycles.

Under these conditions, concerns for reliability are typically an afterthought. However, the stressors that automotive electronics are exposed to change the game completely. These stressors include:

- A broad range of use cases.
- Elevated temperatures.
- Large temperature swings.
- Sustained periods of vibration and, in the case of accidents, sudden shock.



Automotive engine

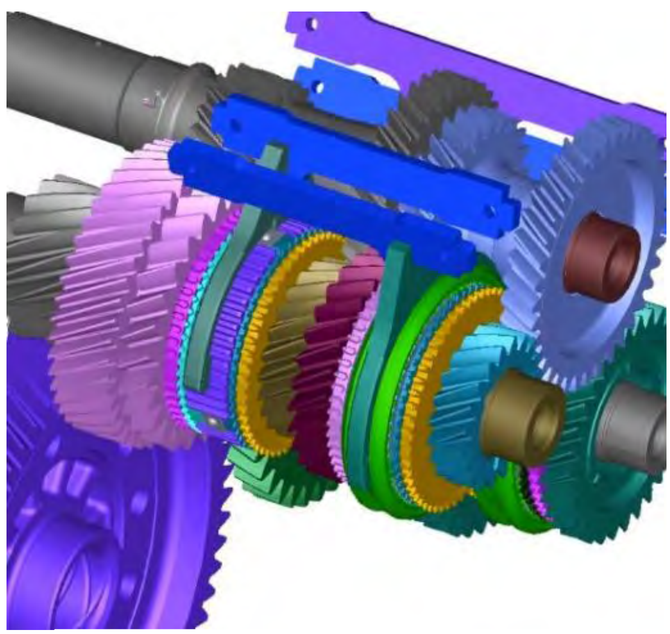
One of the challenges of automotive electronics is the difficulty in using environmental testing for design verification (DV). Failure mechanisms in electronics are difficult to accelerate. Electronics can be embedded in large systems that require long dwell times to stabilize temperatures, and failure behavior can be problematic to detect. Attempts to overcome these limitations by leveraging experiences in other markets (like computers) is increasingly limited as automotive OEMs find themselves on the forefront of the latest technology.

Reliability Engineering Challenge: Semiconductors and Board-Level Reliability

Numerous publications have acknowledged that the shrinking feature size of today's digital integrated circuits (down to 4nm!) makes it increasingly likely that they will be first to fail in the lifetime of an automobile, long before traditional areas of concern such as corrosion (body panels), fatigue (welds), and wear (belts). This is especially true with autonomous taxis that will combine state-of-the-art electronics devices with round-the-clock operation. Placement and operation of the devices become critical, as different environments accelerate different solid-state mechanisms:

- High temperatures accelerate dielectric breakdown and bias temperature instability.
- Cold temperatures accelerate hot carrier effects.

This increasing risk has been acknowledged by best-in-class design teams within automotive Tier 1 suppliers and OEMs, who are increasingly looking for alternatives to traditional design rules, design reviews and physical testing. The most promising approach, already implemented by several organizations around the world, is to introduce more simulation into the DV.



Simulation of a drivetrain in Ansys Motion

Download the "6 Steps to Successful Board Level Reliability" white paper to learn more.

Design for Reliability Best Practices

Ansys Sherlock for automotive electronics reliability

The challenges presented by automotive electronics are real, but they aren't insurmountable when design for reliability (DfR) best practices are applied early in the lifecycle — before the board is even built. Ansys offers a complete workflow for automotive electronics reliability, using a range of software tools based on robust and fully validated simulation engines. These include foundry models embedded within Ansys Redhawk and Ansys Totem, electromigration prediction within Ansys SIwave and reliability prediction with Ansys Sherlock. Sherlock helps to rigorously qualify products against automotive stressors, including thermal, shock, vibration and higher density board challenges. The result? Reliable products, less time spent on product qualification, reduced test cycles and related costs.

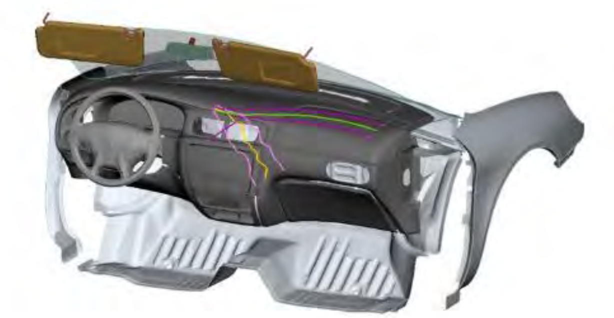
As in other industries, rapid advancement in automotive electronics is, and will continue to be, inevitable. Access the Ansys Sherlock Free Trial to learn more about how you can improve your electronics reliability.

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 new version v21.0.0 of its software suite and the release of v20.0.5 and v20.1.3

August 5, 2020

Read from our web site about v21.0.0, v20.1.3 and v20.0.5



Consistently trying to streamline emerging trends and needs in engineering simulation industry, BETA CAE Systems proudly presents the release of v21.0.0 of its software suite.

Through an attempt to couple the past with your most recent expectations, v21.0.0 offers significant advancements in plenty of fields, providing exemplary user experience and a dynamic insight.

Don't miss:

- The boosted User Performance with the new ANSA Graphics Kernel.
- The augmented pre-processing potential with the advancements in ANSA VR.
- The progressing Optimization capabilities in ANSA, as well as in SOL200 area with EPILYSIS.
- The extended Report & Automation implementations for post-processing applications.
- The promising Machine Learning integration in KOMVOS through ANSA.

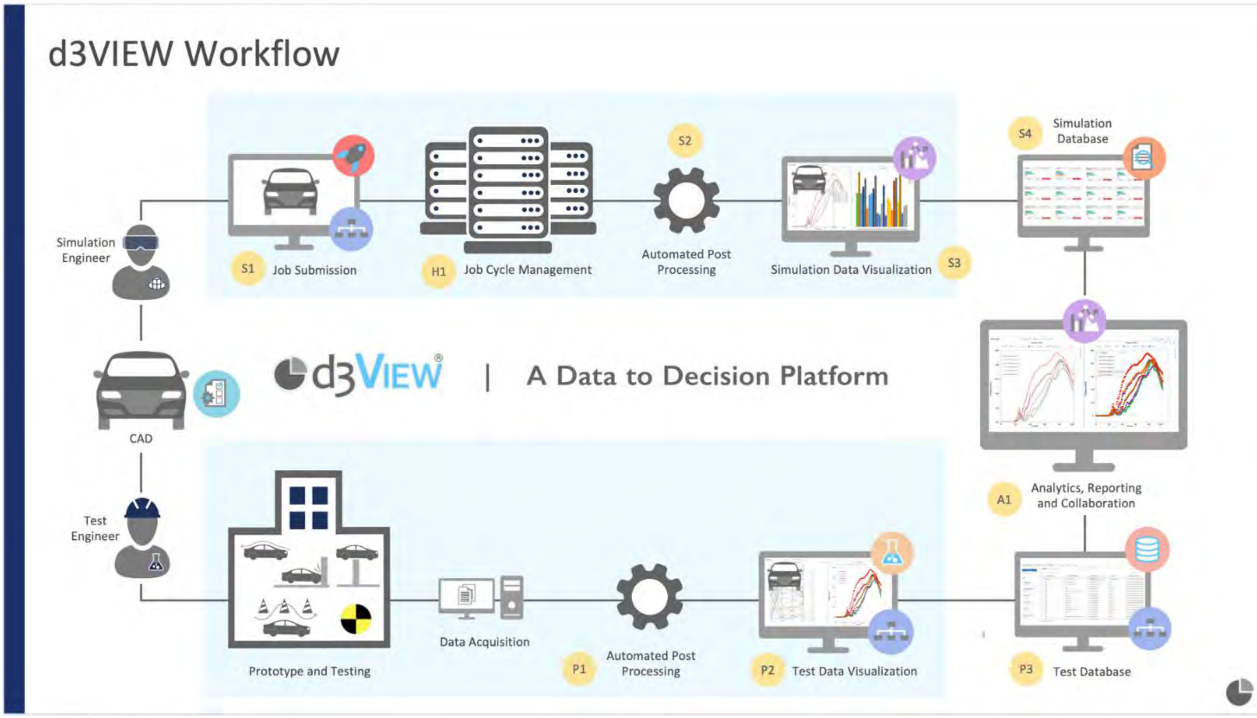
READ MORE ABOUT v21.0.0 VIDEOS HIGHLIGHTS DOWNLOAD

Those who are committed in one of the previous versions of the BETA CAE Systems suite can benefit from the evolution releases of v20.0.5 and v20.1.3. These incorporate important enhancements and code corrections, meeting the expectations of the Industry.

READ MORE ABOUT v20.0.5 READ MORE ABOUT v20.1.3

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

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.



www.d3view.com | support@d3view.com

Author: Christian Frech christian.frech@dynamore.de

NEWS

Papers online, TISAX Audit, New Website, Implicit Toolbar

More information: www.dynamore.de

Papers of the 16th International Conference online

The papers of the first virtual LS-DYNA Conference are now online available at www.dynalook.com

TISAX Audit

For DYNAmore GmbH the confidentiality, availability and integrity of information have great value. We have taken extensive measures on protection of confidential information. Therefore, we follow the question catalogue of information security of the German Association of the Automotive Industry (VDA ISA).

The ENX Association (https://enx.com/tisax) supports with TISAX (Trusted Information Security Assessment Exchange) on behalf of VDA the common acceptance of Information Security Assessments in the automotive industry.

DYNAmore has now conducted the TISAX audit at its locations in Stuttgart and Berlin.

The results can be seen at the ENX portal: https://portal.enx.com/en-US/TISAX/tisaxassessmentresults (registration required). Scope ID: S22TZF, Assessment ID: ACXN71.

New Website online

DYNAmore has recently launched the new website. In addition to the new design, news from the locations are now offered in the respective national language. If you visit the site from www.dynamore.eu you will see the French news first, when you use www.dynamore.it the Italian news will be shown and the swiss news if you are visiting the site from www.dynamore.ch. Please see the new website at www.dynamore.de.

DYNAmore Implicit Toolbar

DYNAmore Nordic has developed a custom toolbar for setting up and checking implicit LS-DYNA models in ANSA. A powerful tool based on the extensive implicit guidelines that helps set-up and troubleshoot implicit LS-DYNA models, highlighting and fixing possible issues with for example contacts, element formulations or unsuitable material parameters. Both the toolbar and of course the implicit guidelines are available free of charge for DYNAmore customers.

Contact the DYNAmore Nordic Support at support@dynamore.se to try it now!

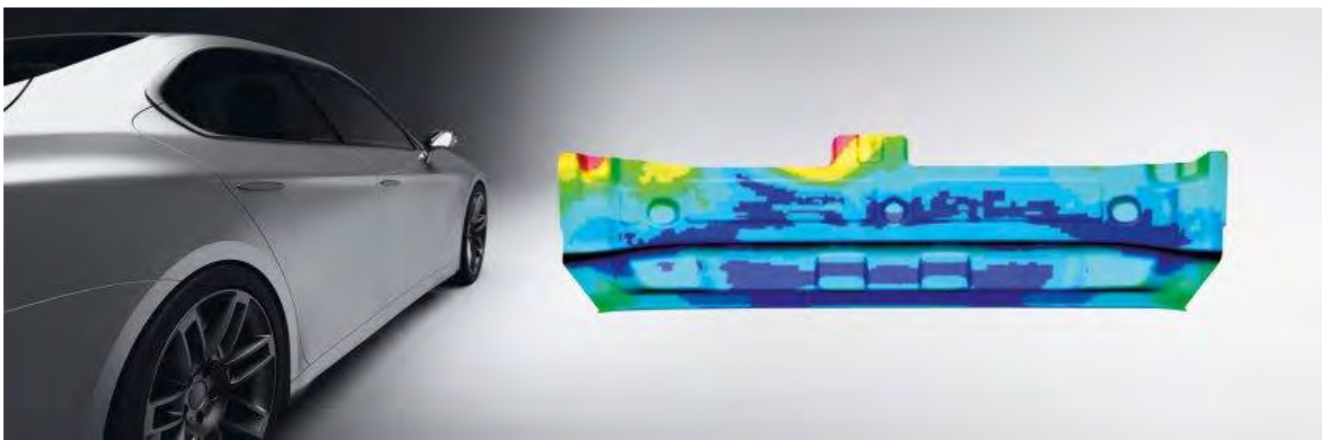
A leading innovator in Virtual Prototyping software and services. Specialist in material physics, ESI has developed a unique proficiency in helping industrial manufacturers replace physical prototypes by virtual prototypes, allowing them to virtually manufacture, assemble, test and pre-certify their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

Combating Springback with Virtual Prototyping Makes Cutting-Edge Materials Possible for Kirchhoff Polska

New, lighter materials not only bring about great advances and better products, but also new problems. Read on to see how Kirchhoff Polska transformed their die design and forming process with simulation.

Wednesday, July 22, 2020

By Mark Vrolijk



Kirchhoff Polska's Challenge

For Kirchhoff Polska, the use of ultra-high-strength steel (UHSS) for their parts created a springback issue that forced them to rethink how they designed and validated their die design and forming process.

The Story

In the ever-changing automotive world, the one thing that never seems to change is the pressure suppliers and OEM's are under to build lighter vehicles in shorter timeframes. Responding to the need to reduce weight, the automotive industry is making better use of ultra-high-strength steels (UHSS). They offer a lightweight option to traditional steels and can thereby contribute to reduced CO_2 emissions.

Of course, it comes as no surprise that great new products bring new challenges. For UHSS, the main challenge is the springback that occurs after forming and trimming operations – a phenomenon with which Kirchhoff Polska became all too familiar. Historically, the company designed tooling using physical trial and error and relied on their designers' experience. Facing the challenge of UHSS, they recognized this approach was not sustainable and that it was necessary to turn to virtual prototyping to address the problematics and arrive at the correct parts.

The PAM-STAMP software has allowed us to reduce the time of reducing the springing effect several times compared to the current trial and error method. The compensation process determines the relaxed surface of the tool, which minimizes the costs associated with additional structural changes and additional machining ~Paweł Bałon, Ph.D,

Senior Tooling Designer & Simulation Engineer, Kirchhoff Polska

Kirchhoff Polska began using ESI PAM-STAMP(link is external) for their tooling design and forming processes. With models of the stamping process, they were able to predict the springback of the blank after each press cycle and automatically correct the tool's surface to compensate. They were quickly able to refine tooling design and avoid delay until the start of production. Parts could be stamped without cracks and wrinkles and be produced on the assigned press line within tolerance specifications. The number of physical try-outs was drastically reduced.

Checking part on controlling devices on the shop floor

The team at Kirchhoff Polska found PAM-STAMP beneficial not only in producing their part without flaws and within tolerances but also in exploring and predicting forming possibilities. They were able to achieve optimal and robust manufacturing processes and benefiting from process engineering. They were able to deliver parts in a shorter timeframe and with fewer resources than ever before.

For more info visit ESI Sheet Metal Forming Solutions

Learn more about Kirchhoff Polska

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.

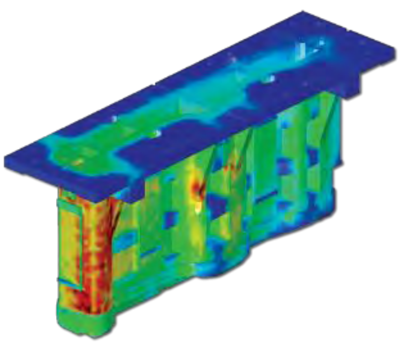
eta Innovation Starts Here

DYNAFORM

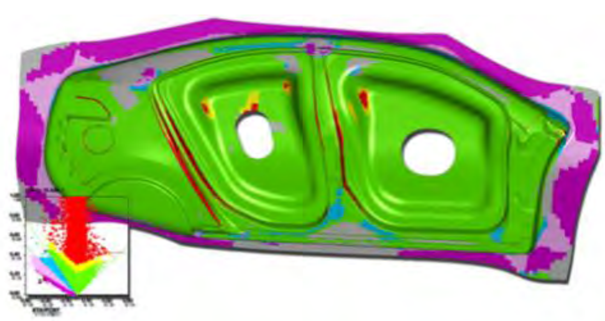
DYNAFORM is a simulation software solution, which allows organizations to bypass soft tooling, reducing overall tryout time, lowering costs, increasing productivity & providing complete confidence in die system design. It also allows for the evaluation of alternative and unconventional designs & materials.

DYNAFORM Version 6.0 is Now Available!

DYNAFORM 6.0 is the sixth-generation DYNAFORM product. It provides a user-friendly and intuitive interface with a streamlined design. The analysis process is fully based on the stamping process, which requires less CAE knowledge, and minimum geometry and element operations. This latest release offers the following features and improvements:



- Intuitive and Streamlined Interface
- Tree Structure to Manage Operation
- Simulation Data Manager
- Customized Icons Grouping for Drop-down Menu Functions
- Separate and Independent Application
- Unified Pre and Post Processing
- Multi-Window View
- Access Functions Using Right Mouse Button Clicks
- Supports Large Forming Simulation Models
- Geometry Manager
- Process Wizard for Blank Size Engineering
- Minimum Geometry and Elements Operations
- New Material Library Window
- New Drawbead Shape and Library
- Coordinate System Manager
- Instant Section Cut
- Tata Steel FLD
- Balloon Label
- PowerPoint and Excel Based Automatic Formability Report Generation



FEA Not To Miss

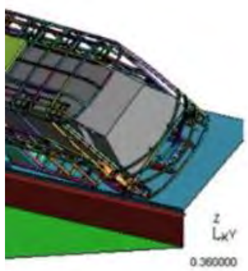
www.feantm.com

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

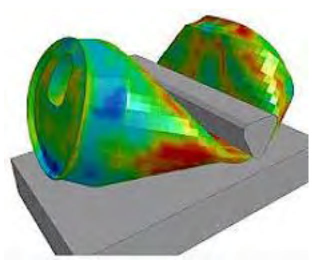
www.feantm.com

Monday 08/17/2020 - Good thing I have very strong lids on my coffee cups! Also good we aren't going to be in the below roll over! Off we go to YouTube!



ECE R66 LS-Dyna Simulation

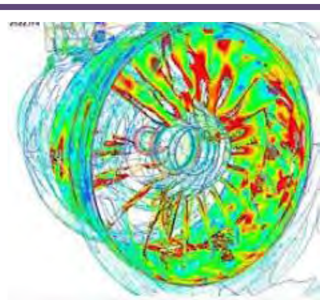
Monday 08/10/2020 - Well, No one can complain about my coffee cups crushing like in the below video. That's why you should drink coffee in a cup, and not in a can!



Soda Can Crush | ANSYS LS-DYNA |

SVS FEM

Monday 08/03/2020 - Well, I don't have any fan blades on the ranch that I can think of BUT that won't stop me from drinking coffee while we head over to LURI Engineering for their simulation and to drink their coffee!!



Fan Blade Off Rig test Isosurfaces

LURI Engineering

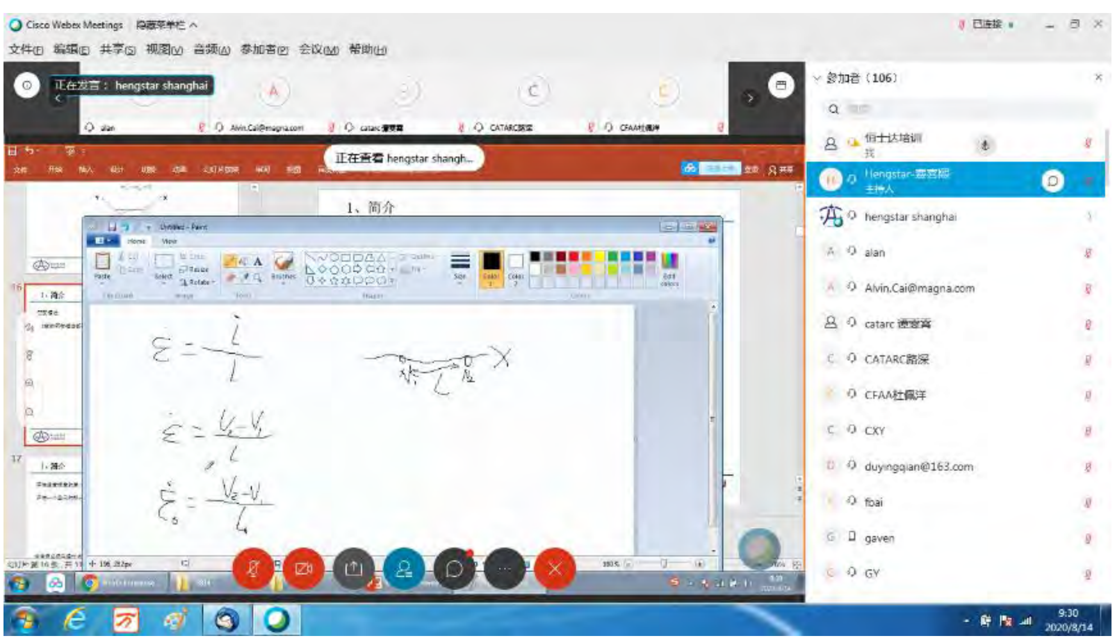
Shanghai Hengstar & Enhu Technology sells and supports LST's suite of products and other software solutions. These provide the Chinese automotive industry a simulation environment designed and ready multidisciplinary engineering needs, and provide a CAD/CAE/CAM service platform to enhance and optimize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

Online Workshop of Material models and parameter identification in LS-DYNA

On August 14, 2020, "Material model and parameter identification in LS-DYNA online seminar" jointly held by Shanghai Hengstar and ANSYS/LST was successfully accomplished.

The seminar was presented by Chen Yongfa from Shanghai Hengstar Company. The course content mainly includes the introduction of simulation models of metal materials, plastics and foam materials in LS-DYNA, as well as the description of stress and strain in the material law, and an overview of viscoelasticity and viscoplasticity. The metal material model was introduced in detail, including Von Mises yield criterion, isotropic hardening and kinematic hardening, and the influence of the strain rate. Finally, the acquisition of model parameters of metal materials and plastic materials was introduced, and the influence of different material hardening formulas was analyzed. In addition, the course also introduced the compression test of foam materials and the process of material parameter fitting. This training allows users to better understand the basic properties of the materials in LS-DYNA, so as to improve the accuracy of simulation.

More than 100 CAE engineers from Chery, SAIC MOTOR ,FAW, Zznissna, GHAC, JMC, GWM, Geely, etc. attended the online seminar. After presentation and discussion, all attendees agree that the workshop was held timely and successfully.



Contact us for our LS-DYNA training courses and CAD/CAE/CAM consulting service, such as

- Crashworthiness Simulation with LS-DYNA
- Restraint System Design with Using LS-DYNA
- LS-DYNA MPP
- Airbag Simulation with CPM
- LS-OPT with LS-DYNA

Our classes are given by experts from LSTC USA, domestic OEMs, Germany, Japan, etc. These courses help CAE engineers to effectively use CAE tools such as LS-DYNA to improve car safety and quality, and therefore to enhance the capability of product design and innovation.

Consulting - Besides solver specific software sales, distribution and support activities, we offer associated CAD/CAE/CAM consulting services to the Chinese automotive market.

Solutions - Our software solutions provide the Chinese automotive industry, educational institutions, and other companies a mature suite of tools - powerful and expandable simulation environment designed and ready for future multidisciplinary CAE engineering needs.

Shanghai Hengstar provides engineering CAD/CAE/CAM services, consulting and training that combine analysis and simulation using Finite Element Methods such as LS-DYNA.

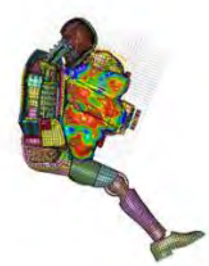
Shanghai Hengstar Technology Co., Ltd

hongsheng@hengstar.com

http://www.hengstar.com

Shanghai Enhu Technology Co., Ltd

http://www.enhu.com

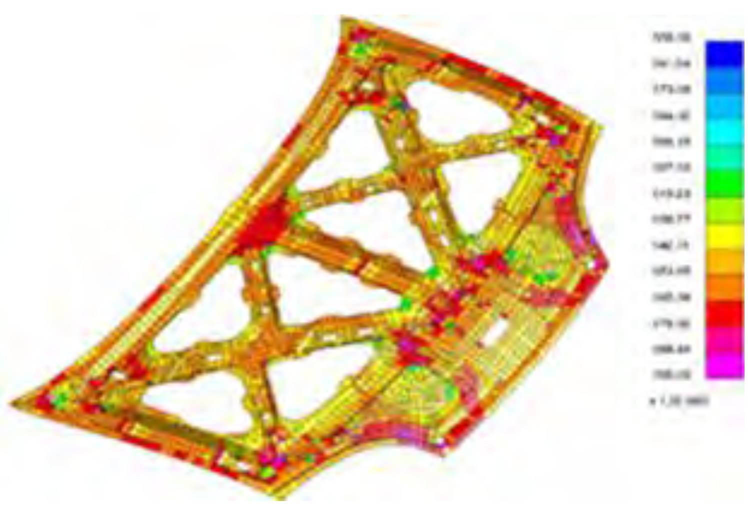


JSOL supports industries with the simulation technology of state-of-the-art. Supporting customers with providing a variety of solutions from software development to technical support, consulting, in CAE (Computer Aided Engineering) field. Sales, Support, Training.

HYCRASH Features

Calculate the thickness and plastic strain for a formed sheet metal from an existing crash simulation model. The result will be the initial conditions for LS-DYNA simulation.

The effect of residual strain distribution and non-uniform thickness due to sheet metal forming - the manufacture process for most of the automotive parts for crash energy absorption - is well known as one of the most affecting factors for correlations between analysis and tests. So that some tries are carried out to calculate the initial strain and thickness before the crash/strength analysis.

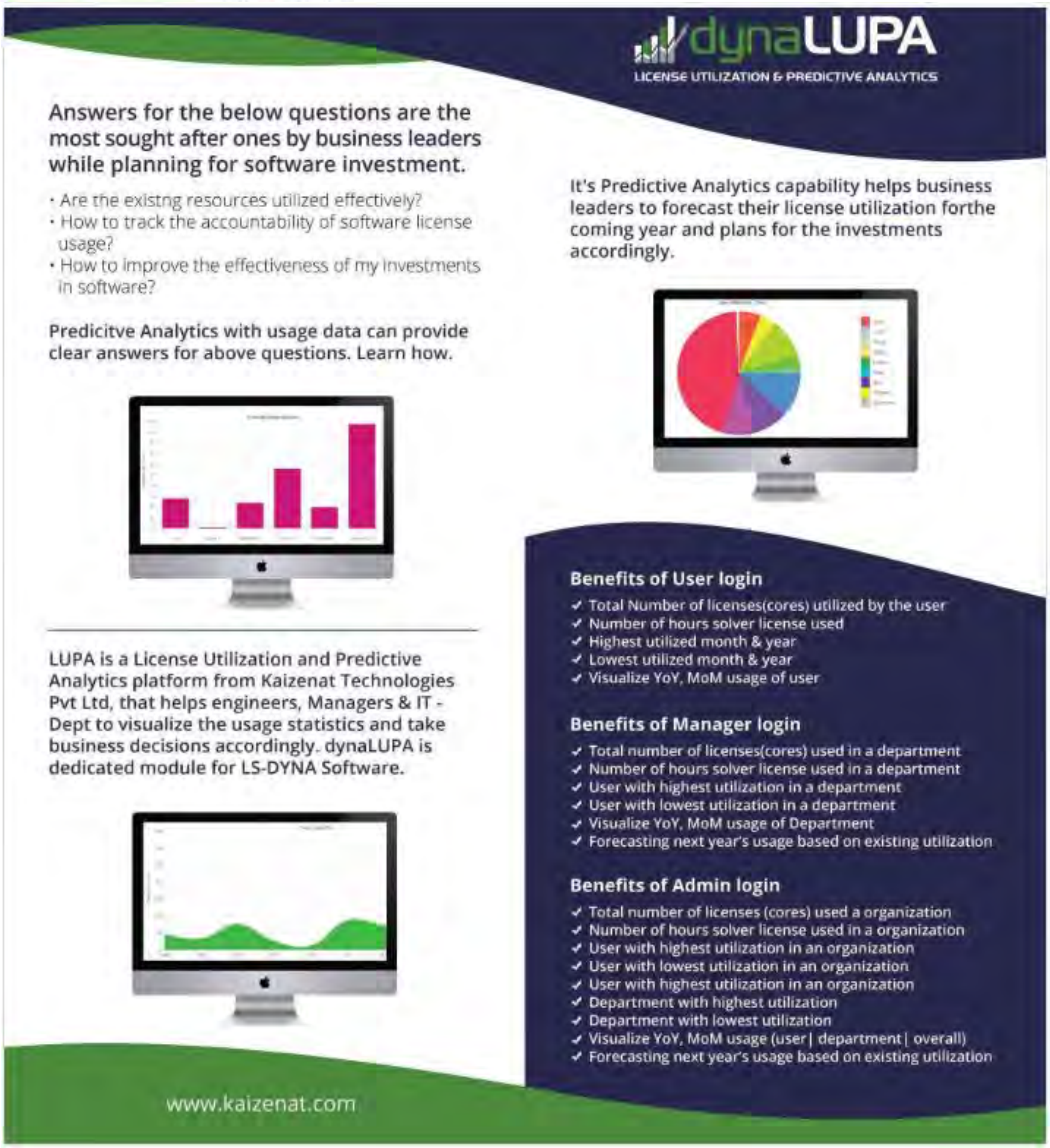


Usually, the element size for crash analysis and metal forming analysis are different due to their difference in geometrical information (R size etc.), so after forming analysis, stress, strains, and thickness are mapped to the structural analysis.

However, this process costs pretty much and not very effective. Moreover, the information of die geometry is required for the forming analysis, which usually doesn't exists in structural analysis phase.

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



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.

LS-DYNA® FMU Manager for Co-Simulation with 3rd Party Software

LS-DYNA® FMU Manager allows LS-DYNA to co-simulate with any 3rd party software, which supports the FMI (Functional Mockup Interface) standard, including Python, ANSYS, MATLAB, etc. It is delivered as an independent plugin and free to LSDYNA users.

Applications:

- Integrated Vehicle Safety Analysis
- Hydraulics Coupled with Structure
- Control with MATLAB, Python
- Machine Learning with Python
- Multi-physics Co-simulation
- Piezo-Electric Analysis

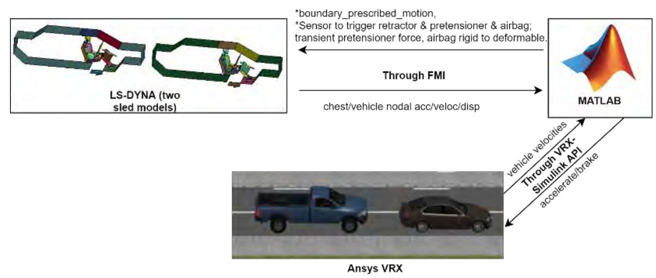
Features:

- Linux/Windows, SMP/MPP supported.
- Support Co-simulation with ANSYS, MATLAB, Python, Hopsan, Adams, etc.
- Export FMU to another software
- Import FMU from another software
- Co-simulation at the master or slave mode.
- Export acceleration, velocity, displacement, curve functions to another software.
- Import force, torque, pressure, boundary conditions to LS-DYNA.

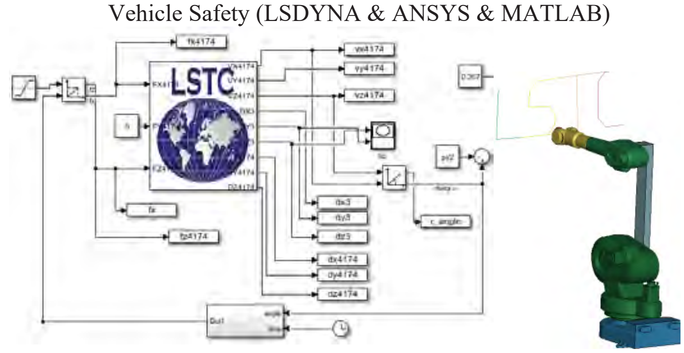
Website:

http://ftp.lstc.com/anonymous/outgoing/xiaomeng/deliver/FMU_Manager_release_note.txt

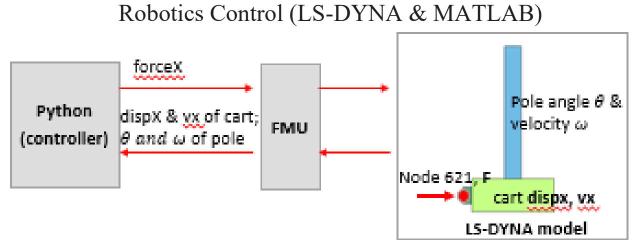
https://fmi-standard.org/



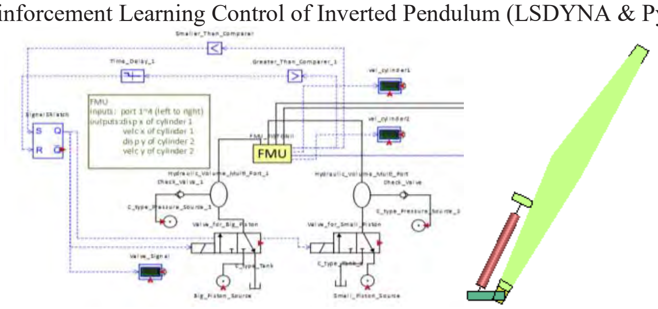
Vehicle Safety (LSDYNA & ANSYS & MATLAB)



Robotics Control (LS-DYNA & MATLAB)



Reinforcement Learning Control of Inverted Pendulum (LSDYNA & Python)



Hydraulic Excavator (LSDYNA & Hopsan)

MSC www.materials-sciences.com

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

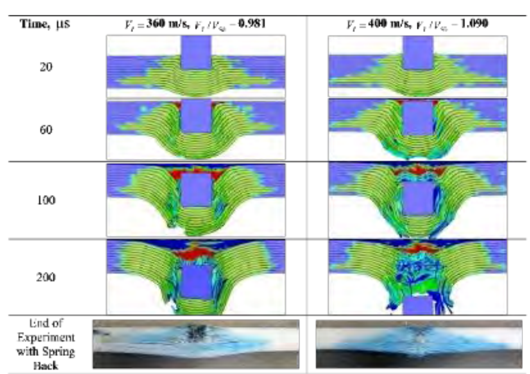
Final 2020 Webinar Course Date
November 17, 2020

Cost: $695 per person
Includes: USB with Course Content

Description:

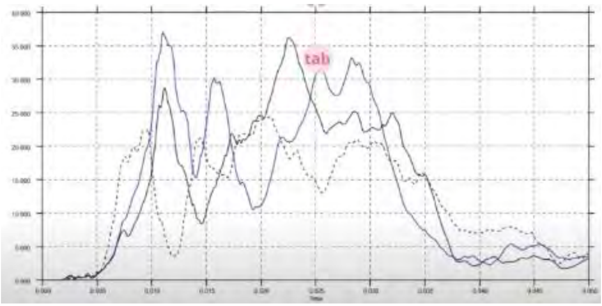
Progressive damage modeling of composites under low velocity impact, and high velocity impact is of interest to many applications including car crash, impact on pressure vessels, perforation and penetration of thin and thick section composites. This course will provide a comparison between available 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, please [click here](#).

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.



Webinar to watch again

Oasys POST: T/HIS curves

This webinar is all about curves: how to manipulate them, filter them, and organise them. Learn how to deal with lots of curves in one session, and quickly home in on the results that matter to you.

View here

Upcoming webinar

16th September 2020

12:30 - 01:30 BST

Oasys PRIMER and D3PLOT: composite tools

This webinar will provide an overview of composite modelling tools in the Oasys PRIMER and D3PLOT software. It will give users a clear understanding of where to find and how to use the tools.

Register here

Top Tip video: Timeline Tool

Did you know Oasys T/HIS has a timeline tool that can be used with Oasys D3PLOT to control which time state is shown?

To watch this video please click here.

We also encourage you to see the previous top tip on model navigation as we demonstrate some of these techniques.

Oasys PRIMER: model navigation

If you would like to view the full playlist of Top Tip videos please click here.

Click here to view it

Oasys LS-DYNA

LinkedIn Group

We would like to invite you to join our Oasys LS-DYNA Environment Software LinkedIn Group. It's a channel to share content with other Oasys LS-DYNA software users, from interesting simulations to information about our webinars and training courses.

Please feel free to join us.

https://www.linkedin.com/groups/4429580/

Predictive Engineering

www.predictiveengineering.com

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

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

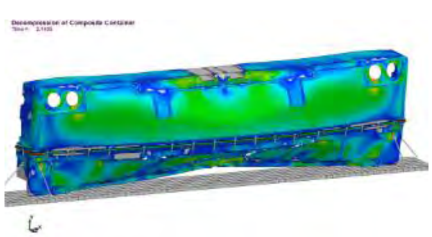
LS-DYNA has been one of Predictive's core analysis tools pretty much since we got started in 1995. It is an amazing numerical workhorse from the basic linear mechanics (think ANSYS or Nastran) to simulating well nigh the impossible. At least that is the way I feel at times when the model is not solving 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.

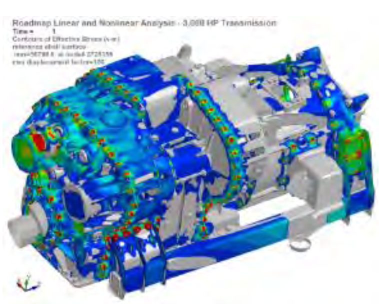
View our portfolio

FEA, CFD and LS-DYNA consulting projects

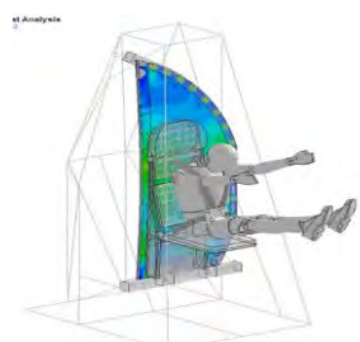
Composite Engineering



Nonlinear Dynamics



Aerospace



Contact:

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

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

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.

Rescale hacks its way into a fully distributed company culture

July 30, 2020
Culture at Rescale, Engineering,English
Garrett VanLee

Hack day events have long been part of Rescale's culture of breaking out of patterns to pursue creative problem solving. Whether intended to drum up new product ideas or encourage the cross-pollination of ideas between different teams, interdepartmental hackathons give employees the opportunity to collaborate and learn from each other. Earlier this year at Big Compute we even saw how hackathons are a great way to foster community around the question of "what problems could we solve if compute power was virtually unlimited?".

Judging hackathon presentations at [Big] Compute 20 Clash hosted by Rescale

This summer Rescale tried something new – Instead of a single day dedicated to this creative collaboration, we dedicated a full week to hacking – and we did it as a distributed team.

Similar to many other technology and cloud-based organizations, 2020 has meant transitioning Rescale employees to a fully distributed collaboration model. And we're happy to report that the first ever Rescale Hack Week, based on a first ever fully distributed Rescale team, has been nothing short of an exciting success!

With the goal of unleashing disruption, this summer's Rescale Hack Week focused on brainstorming, collaboration, and innovation, without constraints on how work or teams should be structured. Nearly 40 different project proposals were submitted, with 12 making the cut for teams to double down on. Most of these ideas were inspired by the needs of our customers or novel ideas from our engineers looking at problems with fresh eyes. Hack week teams were comprised of Rescalers from engineering, product, design, security, and HPC teams all working together to build features that have the potential to create 10 times more value for the customer. Mixing up teams sparked new conversations, challenged assumptions, and changed up routines which generated promising new solutions and ideas.

"This was an inspirational event that challenged everyone's creativity," said Romain Klein, Technical Direct of Rescale's EMEA team and hack week participant. "It's important to collaborate on ideas outside of the norms of formal account requests. This way we can consider solutions that the customer may not have thought to request of yet."

Rescale has talent in many corners of the globe, many of whom previously worked in an office with teammates and frequently spent time on-site with customers to understand their challenges. Hack day-like events are critical to bridging the divide of our home office spaces and invigorate the way we work.

Serge Sidorov, Rescale Application Engineer and member of this hack week's winning team leveraged the visualization technology of a small Norwegian company to enhance Rescale's visualization capabilities. Unique insights like this, paired with reimagining the user experience can lead to exciting things. "During my first week at Rescale it occurred to me that our product could be more transparent and interactive and ultimately give users insight and catch errors faster," Serge said. He didn't expect to win, but hoped his idea would gain some traction eventually.

Without regular customer interaction, you have to work harder and smarter to stay connected to the user experience. Without regular side conversations passing through hallways, you have to put in extra effort to ensure that valuable anecdotal feedback is captured and shared, not lost in the crossfire of ceaseless chat notifications. Once product roadmaps are set, should we put blinders on in separate teams to sprint through a roadmap of set requirements? Of course not! Our hypotheses need to be tested, teams shuffled, constraints removed, and ideas refreshed on a continuous basis. Hack Week reminds us why agility and customer focus sometimes require a break from the norm.

Rescale front-end engineer, Steven Snyder, found that the inaugural hack week delivered both internal and external value. "We have to have unique processes to tease out important ideas," he said, "and having a week gave us enough time to bring the best ones closer to fruition."

In the end, three winning teams took the podium, which means their ideas will quite possibly be woven into Rescale's product feature roadmap. Not only are engineer ideas being recognized across the company, but they will start to show up in the very product updates rolled out to customers in the future. This is no surprise, as many Rescalers first started using the Rescale platform as engineers working for other organizations.

It wouldn't be a hackathon without some downtime for fun, so midweek the team got together for a virtual baking class to make dumplings from scratch.

With such strong participation in this year's Rescale Hack Week, this will not be the last. In fact, the spirit of this event has sparked other internal programs encouraging rotating collaboration and mentorship across Rescale. This can only contribute to the resilience of the company and adaptation to a new working style that is likely here to stay. We are excited to see the fruits of these programs.

Rescale is committed to hiring the most talented and curious minds around the globe who care about the future of computational problem solving. We are constantly growing our now distributed team and invite anyone interested in our careers to apply to join our team here. We look forward to meeting you and hope to see your bright ideas entered into future hackathon events!

In the end, a company is only as good as its people, and we're grateful to work amongst great people.

Hack week not only showed us that we don't have to be working in the same office to do something great as a team, but by empowering our engineers to be creative and innovative with their own ideas, we can become even greater.

Read from website

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 Presented at China Automotive Seating Summit 2020

The 2nd China Automotive Seating Summit was successfully held in Shanghai on 30th -31th, July. There're more than 200 experts, scholars and engineers from various universities and industries attend this conference. As one of the sponsors, Mr. Yongzhao Zhang from Shanghai Fangkun gave a report on "The Application of Ansys & LS-DYNA in Seat Simulation" at the conference which grabbed a lot of attentions. Shanghai Fangkun Sales Manager Nianwei Niu presided the 2nd day of the conference. As LS-DYNA has been widely used in China, customers have visited our booth to learn about the latest developments in LS-DYNA at the site.

Beside, many LS-DYNA users are very interested in the training plan and they are welcomed to attend various activities organized by Shanghai Fangkun. For more information please follow our official Wechat Account below. Contacts:training@lsdyna-china.com.

Contacts:
Tel.: 021-61261195 54152972
Email: marketing@lsdyna-china.com
Wechat ID "LSDYNA"
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

Terrabyte

www.terrabyte.co.jp/english

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 viscoelasticitiy 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 aerocraft 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.




The All-New 2021 Sienna is Already Winning Awards

August 05, 2020

Altair Engineering Recognizes Toyota Seat Design with Lightweighting Award
ANN ARBOR, Mich. (August 5, 2020) – Even though the 2021 Toyota Sienna has yet to go on sale, the innovative engineering work for the new minivan conducted at Toyota Motor North America's Research & Development Center in Michigan is already garnering awards.

Altair Engineering has presented Toyota Motor North America with its prestigious Enlighten award. The award recognizes Toyota's work, with the support of supplier partner BASF, in substantial lightweighting of Sienna's folding third-row seats.

The lightweighting effort was lead by Toyota Senior Principal Engineer for Body Design, Todd Muck. Working with BASF, Todd and his team reduced the heavy, 15-piece steel seat frame to a new one-piece resin seatback. The industry-first seatback is lighter, easier to assemble, and less expensive to produce. While all of the improvements are important, it is the seat's lower weight that provides the most direct benefit to the customer.

"Reducing the seatback's mass (weight) provides the customer with several benefits," Said Muck. He continued, "Less weight can improve fuel economy. Or, we can use that saved weight in other areas, such as adding new features like the built-in refrigerator."

However, Muck says the most apparent benefit is the reduced effort it takes for customers to raise folded third-row seats to their upright position. "Our new design has made lifting the seats much easier," he said. "With the previous design, it would take more than 24-kilograms (53 pounds) of force to raise the seat. The new design requires less than 9-kiograms (19 pounds) of force."

The all-new Sienna was designed and engineered in Ann Arbor, Michigan, and is manufactured in Princeton, Indiana. It goes on sale later this year.

Read and watch videos from website

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/mailinglist

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

Cross-platform Co-simulation for Vehicle Safety Analysis

Xiaomeng Tong, Isheng Yeh

Livermore Software Technology, an ANSYS Company

Abstract

Cross-platform co-simulation is gaining more popularity nowadays for vehicle safety analysis. Essential elements, such as ADAS (advanced driver-assistance system) sensors, vehicle dynamics, occupant posture, and controller, can be individually solved in each software and effectively connected to the toolchain. The concept of co-simulation well suits the vehicle integrated safety analysis, which consists of both (1) the active safety features, such as autonomous emergency braking, lane keeping, etc., and (2) the passive safety features, such as the airbag, seatbelt pretensioner, etc. The co-simulation also extends the vehicle safety analysis from the traditional in-crash to a more comprehensive inclusion of pre-crash so as to evaluate the dummy posture and injury more precisely. To achieve this purpose, LS-DYNA develops a co-simulation feature based on the Functional-Mockup-Interface (FMI), which allows LS-DYNA to remotely exchange data with any 3rd party software supporting this standard. Two cases are demonstrated hereby: the first is a passive safety co-simulation between LS-DYNA and MATLAB, where MATLAB controls the seatbelt pretension force, timing and the airbag deployment in LS-DYNA; the second case is the integrated safety case focusing on the active seatbelt control, where ANSYS VRX Driving Simulator solves the vehicle dynamics, and MATLAB provides the controller of braking/acceleration in VRX as well as the seatbelt/airbag in LS-DYNA. Both cases reveal that a more accurate occupant posture and significant improvement of occupant injury can be achieved by optimizing the active/passive safety features through the co-simulation.

Introduction

Modern vehicles are increasingly equipped with more safety features, including both the passive restraint system, such as seatbelts, airbags, etc., and the active safety system with ADAS (advanced driver-assistant system) sensors. The integrated safety system, i.e., the combined passive and active system, could significantly improve vehicle safety and reduce the occupant injury during the vehicle crash. The classical restraint systems, including airbags, pretensioners and load limiters, are not adaptive to occupants and crash scenarios, hindering their effectiveness in the safety improvement. A fully adaptive restraint system, which can analyze sensors from both the pre-crash and in-crash stages and can dynamically adjust the seatbelt load, seat position, airbag ventilation, etc., shows enormous potential. In 2013, TRW's Active Control Retractor became the first commercially available active seatbelt system, which used an electric motor to change the pretension force [1]. Paulitz et al. showed that the adaptive seatbelt system could reduce the pelvis, chest, and head accelerations by more than 50%, and the peak lap belt force by 60% for the frontal crash cases, by adaptively controlling the seatbelt force to be a constant [1]. Holding et al. studied the effect of a moving seat through a series of physical testing and found that a 30% reduction of neck moment and 26% reduction of pelvis acceleration could be observed compared with a static seat [2].

With the equipment of ADAS sensing technology, more active safety systems are introduced for frontal collision avoidance, including collision imminent braking (CIB), autonomous emergency braking (AEB), as well as lateral collisions, such as the lane departure warning and lane keeping. These systems use sensors like radars, lidars and cameras to control the braking/acceleration, and assist the drivers for decision making to avoid collision and mitigate injury when crashes are unavoidable. To avoid occupant being out of position in the emergency braking, the seatbelt pretension is activated in time to hold the occupant in position. Tijssens et al. [3] compared the passive only system with the integrated AEB system in dozens of simulation cases and found that the majority of the injuries improved due to the pre-crash braking. Moreover, without proper seatbelt pretension, the occupant posture could be changed, leading to the change of injury mechanism. All these indicate that the crash avoidance countermeasures should be well designed to fit in the pre-crash stage, not simply the classical in-crash analysis. Parameters in the integrated safety systems should be optimized to adapt to various driving scenarios by taking sensor inputs, and can smartly adjust the seatbelt force, emergency-braking, seat position during the pre-crash, and the airbag deployment and seatbelt load limiter/force during the in-crash.

The complexity of the integrated safety system demands a more comprehensive design and optimization process in the respective software. Essential elements of the multi-physics problem often require each sub-domain to be individually solved in different software and exchange data by co-simulation. For instance, Cresnik et al. used LS-DYNA to predict the occupant injury and MATLAB to design controllers to dynamically adjust the seatbelt limiter [4]. Lee et al. investigated the AEB influence through the co-simulation of MATLAB, CarSim and PreScan in the pre-crash analysis [5]. The cross-platform co-simulation is capable to connect all software to provide a more comprehensive multi-physics toolchain. With this motivation, the co-simulation feature of LS-DYNA is developed based on the popular functional-mockup-interface (FMI) 2.0 standard [6], which is extensively supported in more than 100 engineering software. Users are allowed to import and export variables from LS-DYNA to co-simulate with any 3rd party software, which supports the FMI feature. Since the communication is based on the TCP socket, remote co-simulation across various platforms is allowed, provided that computers are in the same private network.

Co-simulation Mechanism in LS-DYNA

The co-simulation feature is implemented based on the FMI 2.0, which was released in 2014 after updated from the previous version. The FMI is a free standard that wraps a combination of XML files, binaries and C code into a single FMU (functional-mockup-unit) for model exchange and co-simulation. Currently, only co-simulation is supported in LS-DYNA, which allows the generation of FMU to co-simulate with any 3rd party software supporting the FMI standard. Users need to specify input and output variables through keywords in LS-DYNA, and the IP address of the DYNA computer if the co-simulation is remote, i.e., if the other software runs on a different machine. The co-simulation feature is currently supported in the lastest DYNA developer version as well as R12 for SMP/MPP, Single/Double, Windows/Linux version.

Since the FMU is based on C instead of Fortran, a plugin “FMU Manager” is delivered to assist the FMU generation and co-simulation in DYNA. Users can download the toolbox from [7] and find plentiful examples inside the toolbox. Depending on the operating system, a C compiler should be installed and configured to generate an FMU with the instructions detailed in the toolbox. The co-simulation is designed to be cross-platform, indicating that multiple software is allowed to run on the same/different computer with the same/different operating system, provided that both are in the same private network, i.e., the IP starts with 192 or 10 or other same numbers. The platform-independence is extremely helpful for large problems when LS-DYNA usually runs on HPC clusters with the Linux system, and the other computer could be a Windows PC. The hardware setup helps to understand the difference between the LS-DYNA explicit time step Δt1 and the co-simulation time step Δt2. Note that Δt2 is the time interval for data exchange between DYNA and other software and Δt2>Δt1. The greater Δt2 is, the less frequent the data exchange will be. Δt1 is controlled in DYNA and can be set through *CONTROL_TIMESTEP, while Δt2 is independently set in the other software, for instance, MATLAB, according to each simulation scenario.

A dual-step procedure is followed to implement the DYNA co-simulation. (1) FMU generation. Users properly define the imported and exported variables through *COSIMULATION_FMI_INTERFACE, and specify the settings in *COSIMULATION_FMI_CONTROL, such as IP of the DYNA computer, the FMU mode, where 'G' is for generation, 'C' is for co-simulation. A new FMU file will be generated after running the input file with DYNA. (2) FMU co-simulation. Users import the FMU into another software, such as MATLAB and properly configure the co-simulation time step, termination time, and prepare the input file for this software. Back to the LS-DYNA machine, users should switch the FMU mode from 'G' to 'C' for co-simulation in *COSIMULATION_FMI_CONTROL, and then run DYNA, which will wait for the connection from the other software. Subsequentially run another software and let it connect to LS-DYNA automatically to start the co-simulation. A more detailed workflow can be found in [8] and the "FMU Manager" toolbox [7] with multiple examples for practice.

Two cases are presented in the current publication to demonstrate the co-simulation application in the integrated safety analysis, especially for Case 2, where DYNA interacts with MATLAB and ANSYS VRX Driving Simulator, covering both the pre-crash and in-crash stage. Case 1 involves DYNA and MATLAB, and focuses on the seatbelt control of the passive safety analysis. The complexity steps up from Case 1 to Case 2 for users to catch up with the workflow and co-simulation scheme.

Application

Case 1: Passive Safety (LS-DYNA and MATLAB/Simulink)

Case 1 demonstrates how to optimize the restraint features and reduce the occupant chest injury through co-simulation between DYNA and Simulink. A simplified sled model with an LST hybrid III 50th rigid dummy is utilized in DYNA for the demo purpose. The crash pulse is pre-calculated from a Yaris-Pole frontal crash at 35 mph and imposed on the sled model through *LOAD_BODY. During the co-simulation, Simulink receives the nodal acceleration, velocity, and displacement from DYNA, which serves the inputs of Simulink controllers. Meanwhile, Simulink sends out signals to change the pretension force, seat velocity, and *sensor, which activates the retractor, the pretensioner as well as the airbag in DYNA. Each sensor changes its status by comparing a curve value with a predefined threshold 0.5 in DYNA, and the curve can be dynamically modified through the co-simulation with Simulink, from 0 to 1 to trigger the sensor. Likewise, the pretension force (type 4 pretensioner) and the seat velocity are also modified in the time domain by Simulink through the curve value to achieve the control purpose.

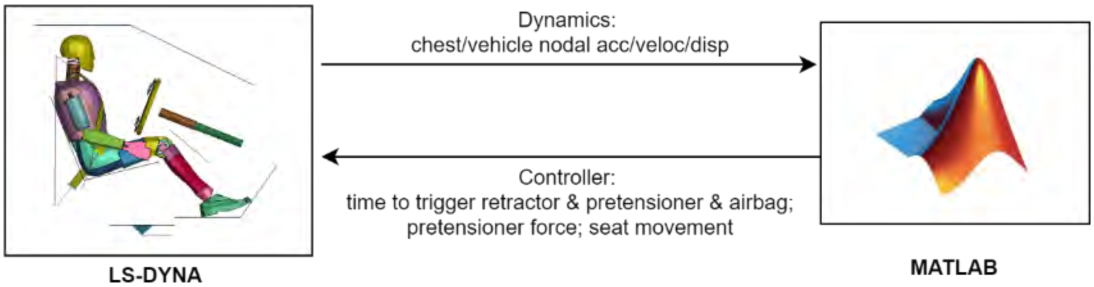


Fig. 1 Co-simulation structure of Case 1

The interface variables in DYNA are defined in Fig. 2. Note that the first 3 variables are to be exported from DYNA local coordinate, where the 1st one is the x acceleration of the rigid chest part, the 2nd and 3rd are the chest nodal velocity and displacement. All the other variables are imported from Simulink to change the specified curves, which are referred to by *element_seatbelt_pretensioner to transiently alter the pretension force, by *boundary_prescribed_motion_rigid to change the seat velocity, and by *sensor to switch the airbag from rigid to deformable bodies, to deploy the airbag, and to activate the pretensioner and the retractor.

```
*SENSOR_SWITCH
         1                 1GT               0.5         0       0.0
*SENSOR_DEFINE_MISC
        1CURVE             0    3080014        0         0         0         0
*COSIMULATION_FMI_INTERFACE
$#              appid
                 SAFE
$#  impexp     regtyp     regid     field      init     ratio      coor       ref
       EXP       PART   1000013      ACCX         0         1   1000068         1
       EXP       NODE   1001787        VX         0         1   1000068         1
       EXP       NODE   1001787        DX         0         1   1000068         1
       IMP       CURV   3080013     Pcurv         0         1         0         0
       IMP       CURV   3080004     SEATV         0         1         0         0
       IMP       CURV   3080014     SNSR1         0         1         0         0
       IMP       CURV   3080015     SNSR2         0         1         0         0
       IMP       CURV   3080016     SNSR3         0         1         0         0
       IMP       CURV   3080017     SNSR4         0         1         0         0
```

Fig. 2 Interface variables of Case 1

The FMU is then imported into Simulink for the controller design and co-simulation with DYNA, following the first step, i.e., "generation" of FMU, and a schematics of the Simulink diagram is shown in Fig. 3. Note that it is used for demonstration purposes with less focus on the complexity of the control system itself. The FMU block is marked by "LSTC", note that the interface variables on the left are to be sent to DYNA including the pretension force and four sensors, and the variables on the right are imported from DYNA, including the chest acceleration, velocity and displacement to design the controller. The co-simulation time step is set to be 0.01 ms in the Simulink before the co-simulation (double click the FMU block to set this value), and the smallest DYNA time step is 3.4E-3 ms by checking the d3plot after the co-simulation. Note that the co-simulation time step is much larger than the DYNA explicit time step.

Fig. 3 Controller demo in Simulink of Case 1

The crash is assumed to occur at t=200 ms, v= 35 mph before the vehicle brakes for a duration of 200 ms with an acceleration of 0.5g. The uncontrolled case has the seatbelt retractor activated at t=200 ms and the pretentioner at 210 ms, with its force vs time curve predefined in DYNA. In the controlled case, the ADAS sensors are capable to detect the unavoidable crash in an early stage (assumed, not modeled) and thus activate the pretensioner at t=20 ms, exerting a low-level force to hold the occupant in position and preventing it from sliding forwards due to the vehicle brake. The seatbelt force can dynamically alter its level to accommodate the occupant and vehicle motions, aiming to reduce the seatbelt force and occupant chest injury. The results are shown in Fig. 4, note that the seatbelt starts to exert forces during the pre-crash stage, i.e., t<200ms. Also, the occupant's chest compression has dramatically reduced from around 60 mm to 40 mm with a static seat, indicating that the chest injury is effectively reduced by optimizing the seatbelt force controller. The chest compression decreases to less than 30 mm if the seat is allowed to move backwards to increase the safety space between the occupant and the steering wheel.

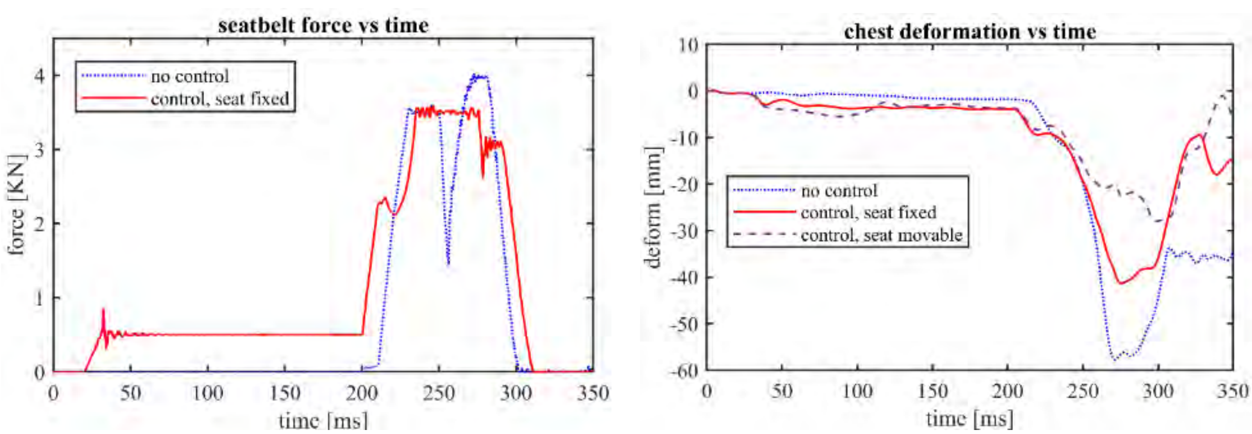


Fig. 4 Seat belt force and chest deformation of Case 1

Case 2: Integrated Safety (LS-DYNA, Simulink and ANSYS VRX Driving Simulator)

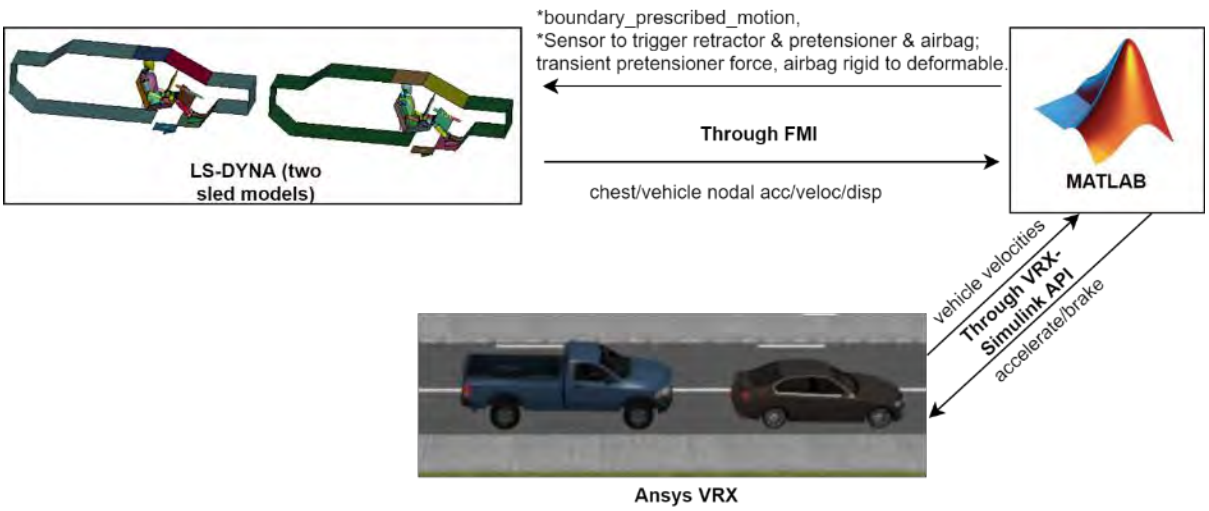


Fig. 5 Co-simulation structure of Case 2

Case 2 intends to demonstrate a more comprehensive workflow involving DYNA, Matlab and Ansys VRX driving simulator, with double sleds in DYNA to model the crash scenario. VRX can effectively assist engineers to set up a realistic simulation for autonomous vehicles with millions of driving scenarios including traffic, weather, physical sensors [9]. Through the co-simulation with Simulink, VRX can take advantage of the extensive control features in Simulink and the physical ADAS sensors in VRX itself to more realistically predict the vehicle motions before the collision occurs. For instance, Simulink can control the vehicle braking/acceleration in VRX after performing the sensor fusion. In Case 2, VRX also passes the vehicle dynamics to DYNA through Simulink to prescribe the vehicle velocity with *boundary_prescribed_motion, as shown in Fig. 5, recall that Simulink can dynamically modify the curve value in DYNA, hence, changing its velocity. To save the execution cost, the vehicle and airbag models in DYNA are initially rigidized in the pre-crash stage and are switched to deformable bodies when the crash is about to occur. The vehicle and occupant dynamics are collected from DYNA and sent to the Simulink to control the *sensor in DYNA to active the pretensioner, airbag, etc., and to dynamically alter the seatbelt force level. Once the vehicle distance is close to zero, i.e., the crash is about to occur, the *boundary_prescribed_motion is turned off in DYNA, and the simulation moves from the pre-crash to the in-crash stage seamlessly. After this moment, VRX will be disconnected from the co-simulation toolchain, leaving only DYNA and Simulink to play an active role. Recall that in Case 1, the crash pulse is pre-calculated and imposed through *load_body, and hereby Case 2 demonstrates a more complete toolchain of the integrated safety analysis since the crash is implemented through the physical contact of two sleds. Replacing the sleds with full-vehicle models is feasible but could be extremely time-consuming with the current strategy and will be discussed in the last section.

Besides the interface variables defined in Case 1, additional variables are listed in Fig. 6 to generate the FMU. Note that the six translational and angular velocities are imported into DYNA and imposed as velocity boundary conditions on the vehicle sled model. Additional *sensor is needed in DYNA to turn off the velocity boundary conditions when the crash is about to occur. During the pre-crash stage, the six velocities are actually sent out by VRX to DYNA through Matlab, considering that DYNA can only co-simulate with one software currently, i.e., only one single FMU is supported. Since Matlab is already involved here, VRX thus plays a trick to let Matlab deliver its message to DYNA. The multi-FMU capability is in progress and will be delivered in a future release. The Simulink model is demonstrated in Fig. 7, note that the speeds of both vehicles are acquired in Simulink from VRX, and are sent to DYNA together with the pretension force and sensors, etc. DYNA outputs occupant chest acc/v/s to Simulink for control purposes. Based on the data collected from VRX and DYNA, Simulink will output brake/acceleration command to control the VRX vehicles in the pre-crash stage, such as the AEB. Note that the presented control diagram focuses on the demonstration of the workflow and users may implement their own controller in a more complex way.

The crash scenario is as follows: the initial speed of the ego and front vehicle is 65 kph and 25 kph, respectively, and the vehicle gap is 5.6 m at t=0 ms. By detecting that the crash is unavoidable, Simulink sends out the emergency braking signal to VRX, and the ego car brakes to 47 kph at t=660 ms before it hits the front car, which maintains a constant speed of 25 kph. In the controlled case, controllers in Simulink activate the pretensioner at t=0 ms and start to exert a low-level force on the seatbelt to hold the dummy in position before collision, and the uncontrolled case disables such feature. Fig. 8 compares the occupant posture with/without control in the pre-crash stage, i.e., t=420 ms, and the in-crash stage, i.e., t=720 ms, where "red" is the uncontrolled result. It is observable that without pretension force exerted in the pre-crash stage, the occupant tends to slide/tilt forwards due to the emergency braking, which adversely decreases the safety distance between the occupant and the steering wheel.

```
*BOUNDARY_PRESCRIBED_MOTION_RIGID_ID
         1
   3000081         1         0   3080004       1.0        01.00000E281.00000E-4
                         (followed by other 5 DOF velocities)
*SENSOR_CONTROL
        15PRESC-MOT          1         0         0BEAM
ON                15         0         0         0         0         0         0
                         (followed by other 5 sensors for 5 DOFs)
*COSIMULATION_FMI_INTERFACE
$#             appid
                SAFE
$#  impexp    regtyp     regid     field      init     ratio      coor       ref
       IMP      CURV   3080004       VX1         0         1         0         0
       IMP      CURV   3080005       VY1         0         1         0         0
       IMP      CURV   3080006       VZ1         0         1         0         0
       IMP      CURV   3080007    OMEGX1         0         1         0         0
       IMP      CURV   3080008    OMEGY1         0         1         0         0
       IMP      CURV   3080009    OMEGZ1         0         1         0         0
                            (additional variables in case 1)
*COSIMULATION_FMI_CONTROL
$#             appid   cosim/generate m/s
                SAFE         G         S
<tcp> ip=192.168.0.14,port=39400
<socket> nconnect=20,tdelay=1001,recvtimeout=30001
```

Fig. 6 Co-simulation keyword of Case 2

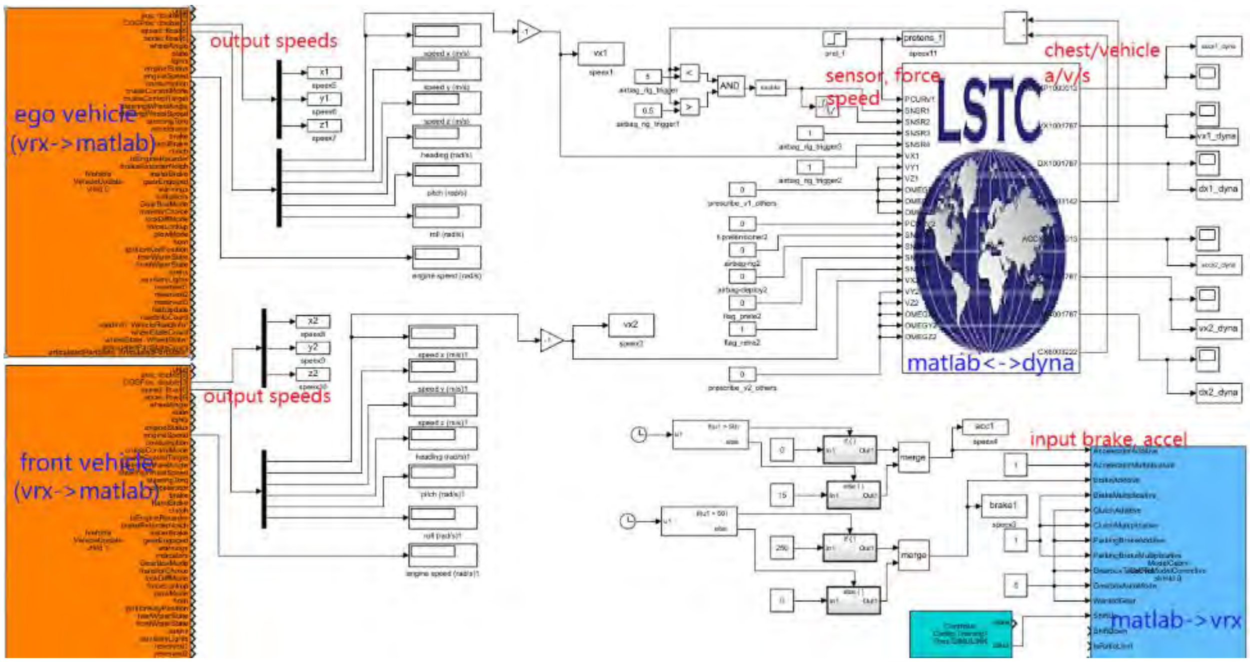


Fig. 7 Simulink control diagram of Case 2

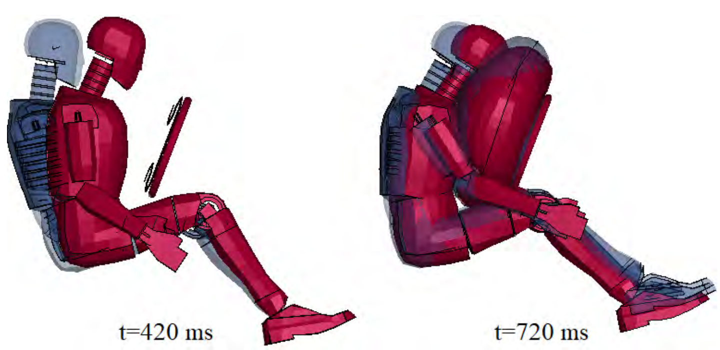


Fig. 8 Comparison of dummy posture with/without the active seatbelt (blue: with, red: wo.)

The dummy chest compression and head acceleration are plotted in Fig. 9. Recall that the crash occurs at t = 660 ms, and in the controlled case, the chest compression is non-zero in the pre-crash stage due to the pretension force from the active seatbelt. The maximum chest compression falls from around 30 to 25 mm compared with the uncontrolled case. The head acceleration also sees a 30% reduction in its peak value, indicating that the occupant suffers less injury with a proper controller implemented through the co-simulation.

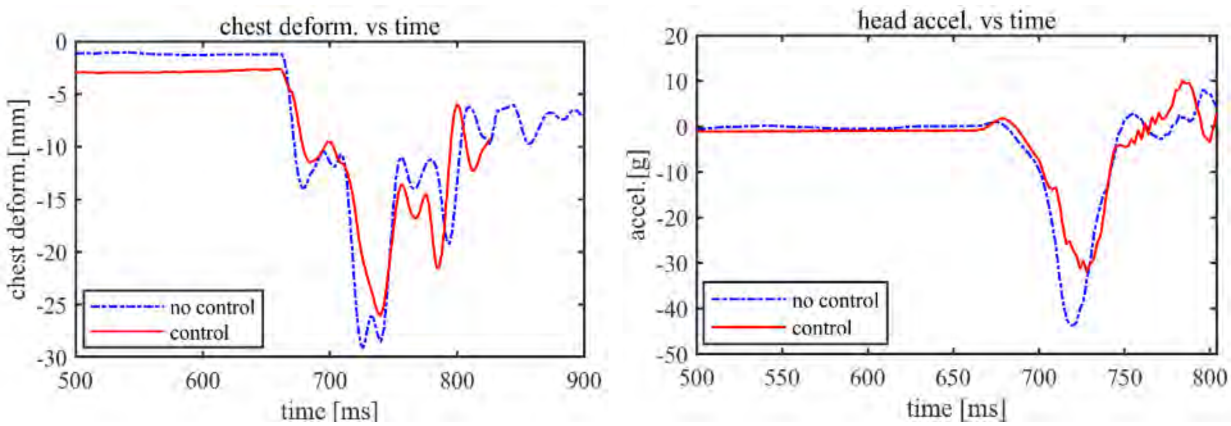


Fig. 9 Comparison of chest deformation and head acceleration in Case 2

Discussion and Future Work

Experienced users of the integrated safety analysis are aware of the much longer duration in the pre-crash stage compared with the in-crash stage. The in-crash typically lasts about 200 ms, while the pre-crash can be as long as several seconds, including the responding time of the drivers, and the vehicle motions, such as the emergency braking, lane changing, etc. To reduce the computational cost in the pre-crash stage, earlier studies [10] adopt a reduced model with only the dummy, seatbelt and necessary seat parts around the dummy, which are similar to the sled model used in this publication. At the end of the pre-crash simulation, necessary node velocities, coordinates, stress of the reduced model are then mapped to the in-crash model, which usually includes a full vehicle and dummy model with millions of DOFs, as initial conditions. The mandatory data mapping due to the model change is very challenging and usually requires to export all results into a DYNAIN file at the end of the pre-crash stage with LS-PrePost and then include it into the in-crash input files. The joint nodes, seatbelt node/element definitions need to be calibrated to avoid errors due to the mismatched joint nodes and seatbelt motion. Using the LS-PrePost to automatically snap these node joints could save lots of effort but still requires a double-check. This strategy is currently achievable within the current DYNA and LS-PrePost capabilities and by exercising caution, however, has several limitations, such as, it cannot consider complex vehicle motions such as dramatic lateral dynamics which may induce vehicle instability, i.e., yawing or even rolling-over of the vehicle.

A more user-friendly and robust alternative would integrate the pre-crash and in-crash in one single run without manual interaction. It is similar to Case 2 in this paper, however with a more realistic full-vehicle model throughout the entire simulation in LS-DYNA. To reduce the computational intensity in the pre-crash stage, the majority of vehicle parts will be rigidized and automatically switched to deformable bodies when the crash occurs. The rigidization process is proposed to be automatically implemented in DYNA, once users specify the desired part set ID in the keyword file, or spell out which part should be left for deformable. This strategy requires no intermediate files such as DYNAIN or manual interaction to snap the joint nodes or correct the seatbelt settings, and is dedicated by DYNA developers in the future release.

References

[1] Paulitz, T.J., Blackketter, D.M. and Rink, K.K., 2005, June. *Fully-adaptive seatbelts for frontal collisions*. In Proceedings of the 19th International Technical Conference on the Enhanced Safety of Vehicles (ESV) (Vol. 127, pp. 6-9).

[2] Holding, P.N., Chinn, B.P. and Happian-Smith, J., 2001. *An evaluation of the benefits of active restraint systems in frontal impacts through computer modeling and dynamic testing* (No. 2001-06-0094). SAE Technical Paper.

[3] Tijssens, M., Bosma, F. and Kietlinski, K., 2015. *A Methodology and Tool Chain to Develop Integrated Safety Systems*. In 24th International Technical Conference on the Enhanced Safety of Vehicles (ESV) National Highway Traffic Safety Administration (No. 15-0329).

[4] Cresnik, R., Rieser, A. and Schluder, H., 2009. *Dynamic simulation of mechatronic systems*. In 7th European LS-Dyna Conference, Graz, Austria.

[5] Lee, J.K., Chu, H.J. and Hurh, K.R., 2017. *A Development of the CAE Process for the AEB-Occupant Integrated Safety System*. In 25th International Technical Conference on the Enhanced Safety of Vehicles (ESV) National Highway Traffic Safety Administration.

[6] FMI Version 2.0, *FMI for Model Exchange and Co-Simulation*, http://www.fmi-standrd.org

[7] http://ftp.lstc.com/anonymous/outgoing/xiaomeng/deliver/FMU_Manager_release_note.txt

[8] Dong, K., Tong, X. and Yeh I., 2020, Coupled Crash Live Development Simulation using LS-DYNA Functional Mock-up Interface, In 16th International LS-DYNA User Conference.

[9] https://www.ansys.com/products/systems/ansys-vrxperience/vrxperience-capabilities#cap1

[10] Öztürk, A., Mayer, C., Kumar, H., Ghosh, P., Mishra, A., Chitteti, R.K. and Fressmann, D., *A Step Towards Integrated Safety Simulation Through Pre-Crash to In-Crash Data Transfer*, In Proceedings of the 19th International Technical Conference on the Enhanced Safety of Vehicles (ESV).

BETA CAE Systems. www.beta-cae.com

BETA CAE Systems - ANSA

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

BETA CAE Systems μETA

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

Solutions for:

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

ETA – Engineering Technology Associates www.eta.com
etainfo@eta.com

Inventium Suite™

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

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

PreSys

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

VPG

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

DYNAFORM

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

get it right®

ESI Group www.esi-group.com

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

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

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

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

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

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

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

JSOL

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

HYCRASH

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

JSTAMP/NV

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

JMAG

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

LST

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.

恒士达科技

Hengstar Tech.

Shanghai Hengstar **www.hengstar.com**

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

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

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

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

Consulting

As a consulting company, Hengstar 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 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 Based Virtual Engineering Solutions

www.esi-group.com

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

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

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

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

Virtual Performance Solution:

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

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

The benefits of VPS hybrid on ESI Cloud include:

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

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.

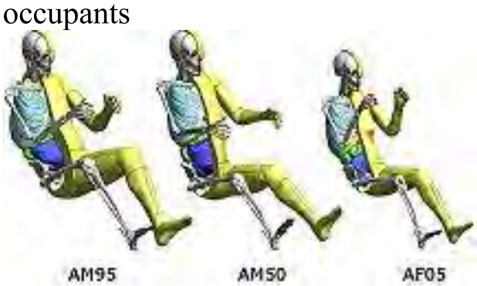
Key collaboration capabilities:

- 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

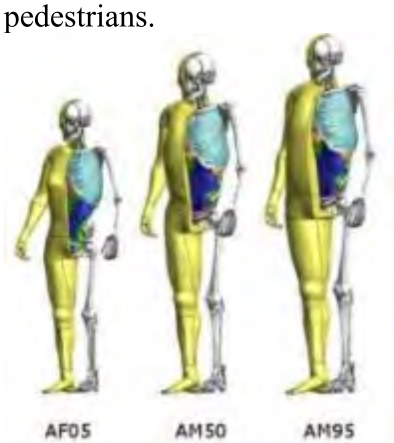
TOYOTA - Total Human Model for Safety – THUMS

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

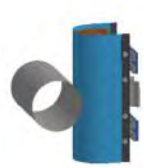
Models In Development

- 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.

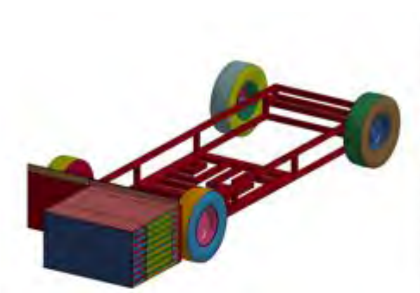
LSTC offers several Offset Deformable Barrier (ODB) and Movable Deformable Barrier (MDB) models:

- 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
CADFEM
ESI Group

TWITTER

BETA CAE Systems
ESI Group
ETA
CADFEM

LINKEDIN

BETA CAE Systems
CADFEM
DYNAmore Nordic
ETA
ESI Group

YOUTUBE

YOUTUBE Channel	WebSite URL
BETA CAE Systems	www.beta-cae.com
CADFEM	www.cadfem.de
ESI Group	www.esi-group.com
ETA	www.eta.com
Lancemore	www.lancemore.jp/index_en.html

GOOGLE+

BETA CAE Systems