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Ansys LST

Issue 7, July

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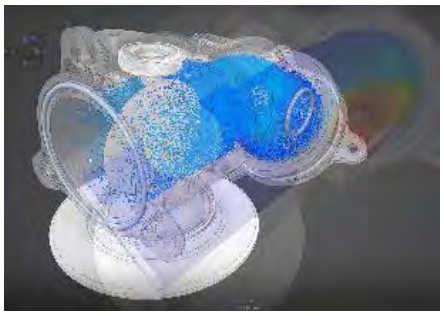

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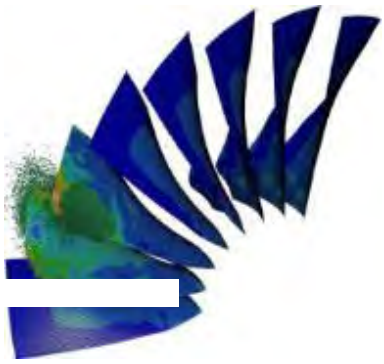

OASYS

LS-DYNA New Feature and Application

LS-DYNA® material model 263 and its application to earing predictions in cup-drawing

FEA Information Engineering Solutions

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The focus is engineering technical solutions/information.

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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

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Platinum Particpants

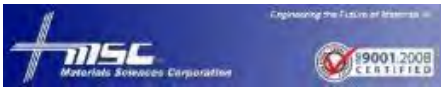


Table of contents

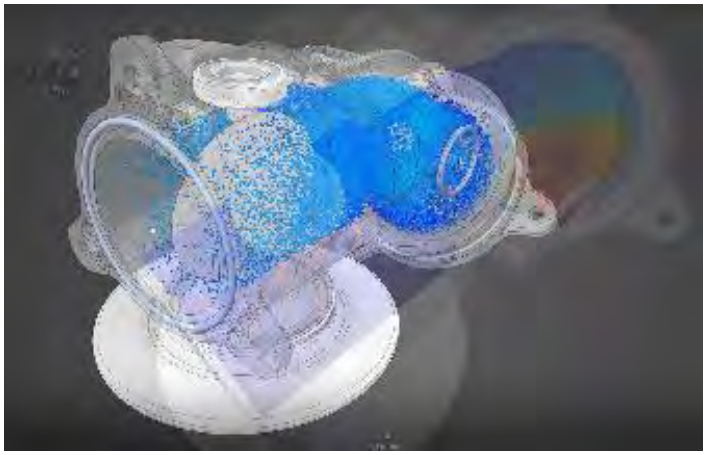
About ANSYS, Inc.

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.

Published on July 9, 2020
by Justin Hendrickson
3D Design, Ansys Discovery Live

Top 5 Reasons to Get Excited for the All-New Ansys Discovery

The new Ansys Discovery will provide engineers with an easy-to-use, fast and powerful 3D simulation tool that will aid in the conceptualization, evaluation and refinement of next-generation products. Read on to explore the top five reasons to sign up for the Ansys Discovery virtual product launch on July 29, 2020 and see firsthand how the all-new Discovery will revolutionize product development.



Click to ANSY blog website to watch video:
Get a sneak peek of the new Ansys Discovery.

This reimagining of the Discovery line of products aims to maximize ease of use, speed and accuracy across thermal, structural, fluids and multiphysics simulation all from within a single consistent user interface (UI).

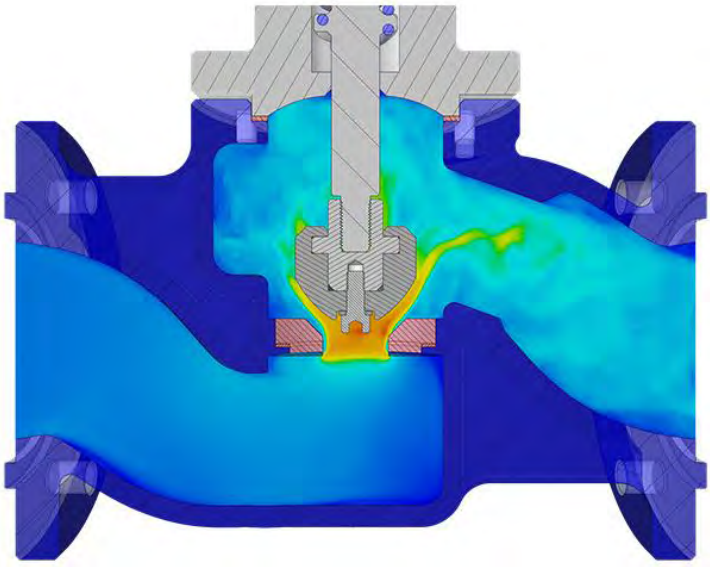
Traditionally, simulation has been used during later stages of design when making corrections can be costly and time consuming. However, with the new Ansys Discovery, every engineer will be able to leverage simulation early during concept evaluation as well as during design refinement and optimization. This means that they will be able to optimize products and workflows faster and on a tighter budget.

The new Ansys Discovery will also provide tighter interoperability with other Ansys flagship simulation tools in an effort to increase collaboration and model re-use within simulation workflows.

Effectively, engineers will be able to expand from simulation-driven validation and toward simulation-driven design. So, without further ado, let's go over the reasons to get excited for the all-new Discovery.

1. Speed and Accuracy

First and foremost, the new Discovery will offer engineers a design tool that includes both speed and accuracy. When rapid ideation and fast exploration of design alternatives is required, Ansys' proprietary real time simulation technology delivers unprecedented speed and flexibility. Later, when a promising design is identified for deeper study, proven high-fidelity simulation using Ansys flagship solvers can be used to provide the accuracy and confidence needed to optimize or submit for physical testing . Best of all, Discovery provides a seamless transition between simulation approaches matching the fluidity of most design processes.



2. Diverse physics

Secondly, Discovery will offer multiple and multiphysics functionality. Not only will engineers be able to assess the structural, fluid and thermal performance of their designs, but they will also be able to couple these models into a multiphysics simulation. Simulating behavior across multiple domains leads to deeper product insight and higher confidence.

3. New User Interface

The third exciting change coming to Discovery is its brand-new user interface. The interaction and experience has been redesigned from the ground up with a focus on speed, interactivity and feedback of information during the simulation process. A new contact review tool, smart automated meshing, contextual overlay help and interactive tutorials are a few examples of how the new Discovery makes it possible to setup and run a simulation faster and easier than ever before.

Structural analysis of Advenchair assembly within Ansys Discovery. Courtesy on Onward Project LLC

4. Improved Interoperability Between Ansys Applications

Another improvement is Discovery's connection to flagship Ansys technologies. With the appropriate license, engineers will be able to access high-fidelity solvers such as Fluent and Mapdl within the Discovery UI for performing basic structural and fluids simulations. If they need to simulate more complex physical behaviors or add more detailed refinements, they can export the current simulation and open it directly in either Ansys Fluent or Ansys Mechanical. Geometry, materials, boundary conditions, meshing and solutions controls will all transfer, allowing engineers to pick up right where they left off.

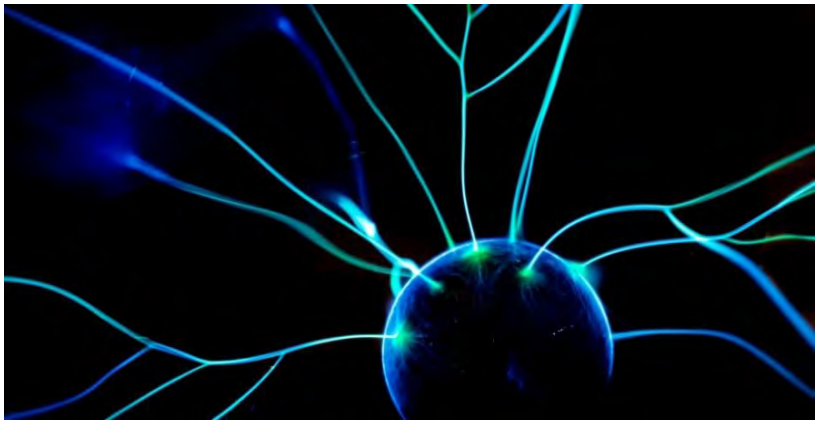
5. Access more of what Ansys has to offer

The final reason for excitement is that this new product increases access to the Ansys portfolio of technologies. Granta MDS provides access to a diverse set of materials and material properties from within the Discovery application. Ansys Learning Hub can be used to get detailed training and sample walkthroughs to make sure engineers are getting the most out of Discovery. Lastly, existing Ansys HPC and Elastic Licensing can be used to scale up compute resources for larger simulation jobs or provide flexible access for multiple users on an as-needed basis.

We have a lot more planned and in development for future Discovery releases!

For many more reasons to get excited, sign up for the Ansys Discovery virtual product launch on July 29, 2020.

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



BETA CAE Systems announces the release of the v7.0 of its License Manager

June 18, 2020

About this release

BETA CAE Systems announces the release of v7.0 for BETA License Manager, with extended capabilities and highly anticipated features.

Note that some of the implemented new features are dependent to the version of the BETA CAE Systems software products. This means that they are compliant only with specific versions of the software of BETA, as marked in the documentation accordingly.

However, all previous software versions will continue working either with BETA LM v6.4 or v7.0.

There are many new things to look forward to in this new version:

Contents

Enhancements

The capability to filter the licensed features, so as to idle, limit, allow or deny their usage, based on user, group of users, IP address or hostname, has been introduced.

The new time-based licensing scheme offers flexibility through a time-based batch credit system, designed to serve a huge number of small jobs (e.g. ANSA/META scripts in a DOE study).

New potential arises with the Virtual Machine support – as well as with the teamed network interface support.

Abundant developments took place providing enhanced performance, better stability and enriched reporting, such as: BETA software suite version & GPU, as well as detailed shared BETA software suite information in beta_lm_stat, total clients connected and total/average waiting time in beta_lm.log and many more.

For more details about the new software features, enhancements and corrections please, refer to the Release Notes document.

Known issues resolved

Communication with License Manager

BETA suite would fail to cycle through all the available License Servers, when trying to re-acquire license credits.
On top of that, as far as the Idle User Timeout is concerned, ANSA would fail to turn in Idle Status, while remaining in Launcher window mode.

Network Interfaces

When switching network interfaces, the Shared Licensing feature would not always be respected.
Moreover, BETA License Manager might fail to generate a valid host key, in case of teamed network interfaces.
For more details about the new software features, enhancements and corrections please, refer to the Release Notes document, as well as the Setup Guide.

Compatibility

In principle, BETA LM Tools 7.0 does not require a new license file. Existing license files are compatible with the new license manager unless the existing license file had been issued for a Virtual Machine.
The new version is compatible with all the previously released BETA CAE Systems software.
Future versions of BETA CAE Systems software will continue to be compatible with the previous version of BETA LM Tools.
Improvements apply to all versions of BETA CAE Systems software with performance being further increased for software released after the 14th of September 2015.

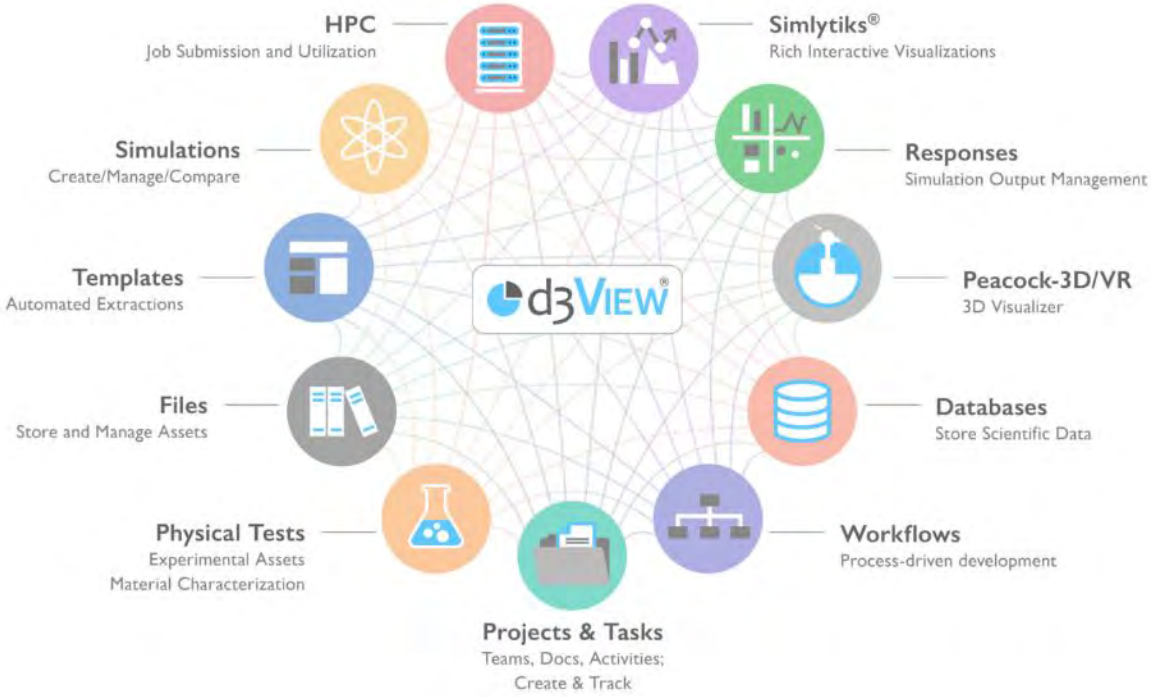
Download

Where to download from

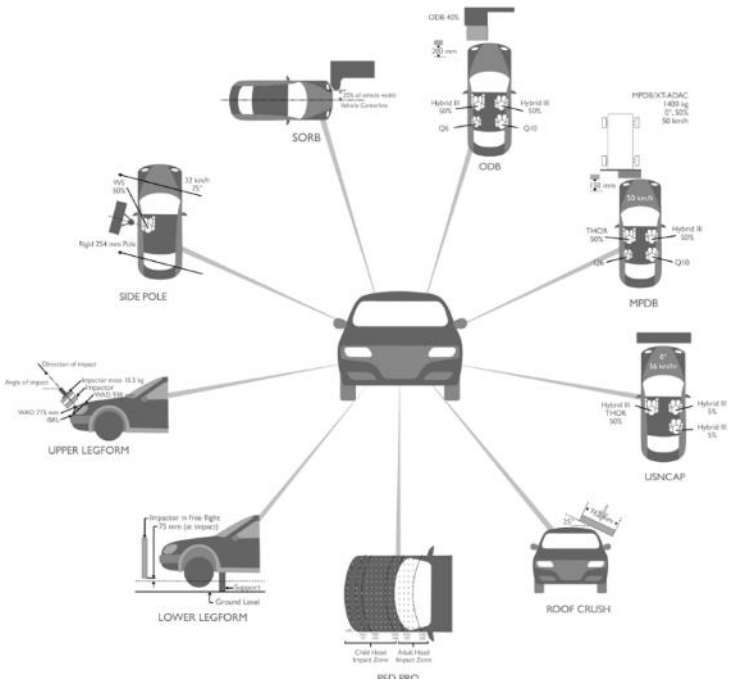
Customers who are served directly by BETA CAE Systems, or its subsidiaries, may download the new software, examples and documentation from their account on our server. They can access their account through the "sign in" link at our web site.
Contact us if you miss your account details. The Downloads menu items give you access to the public downloads.
Customers who are served by a local business agent should contact the local support channel for software distribution details.

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

d3VIEW Platform Components



d3VIEW Built-In Automotive Templates



www.d3view.com.

For more information email info@d3view.com

Author: Christian Frech christian.frech@dynamore.de

Online training offers

More information: www.dynamore.de/seminars

DYNAmore Express webinar series

The free webinars of the „DYNAmore Express“ series last about one hour and are held by experienced DYNAmore engineers and external tutors. They inform about current topics and trends in LS-DYNA. You can find the dates and the registration on our website at www.dynamore.de/ex2020-e.
The webinars already held are available on our YouTube channel at https://bit.ly/3bqPb2A.

Duration: approx. 1 hour
Dates: regularly
Fee: none
Registration: www.dynamore.de/ex2020
Youtube: https://bit.ly/3bqPb2A
(Playlist DYNAmore Express)

Webinar Series „LS-DYNA Compact“

The webinars of our series „LS-DYNA Compact“ take up the topics of our on-site seminars and offer a compact summary of the most important points. Scope and contents vary and are adapted to the respective webinar topic. Usually the single modules last about two hours. You can find a complete overview on our website at www.dynamore.de/compact.

Duration: approx. 2 hours per unit
Dates: regularly
Fee: 200 Euro plus VAT per unit
Registration: www.dynamore.de/compact

DYNAmore Video-Seminars

Our convenient video-seminars allow you to take part at our courses on your own computer and according to your own time preferences. The trainings are video recordings of the on-site seminars and correspond exactly to these in terms of content and scope. Please register via our website at www.dynamore.de/seminars.

Introduction to LS-DYNA

Scope: corresponds to 3 seminar days (11 chapters and 11 exercises)
Lecturers: Dr. Maik Schenke, Dr. Steffen Mattern (DYNAmore)
Date: anytime
Fee: 1,575 Euro plus VAT
Registration: www.dynamore.de/c2076e

Crashworthiness Simulation with LS-DYNA

Scope: corresponds to 4 seminar days (15 chapters)
Lecturer: Paul Du Bois (Consultant)
Date: anytime
Fee: 2,400 Euro plus VAT
Registration: www.dynamore.de/c2011

Contact

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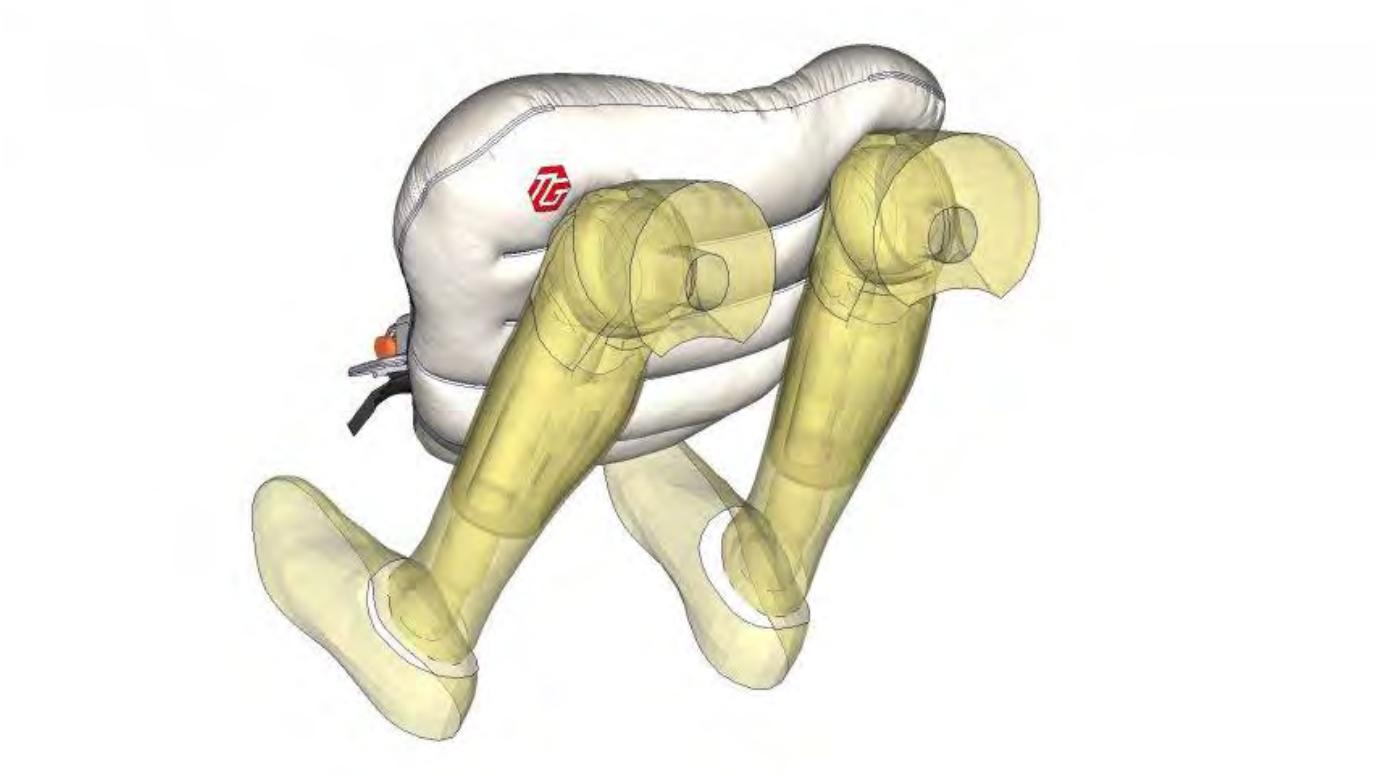
Tel. +49 (0) 7 11 - 45 96 00 - 0
E-Mail: info@dynamore.de
www.dynamore.de

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.

Toyoda Gosei Europe Cuts Lead Times in Half Using Virtual Prototyping

Constant changes to automotive safety regulations put pressure on suppliers to build better products with shorter lead times. For Toyoda Gosei Europe, the lead time to build Complex Folded Knee Airbag models (KnAB) became a big challenge. Keep reading to see how they solved their problem.

Thursday, June 25, 2020 By Natasha Baccari



The Story

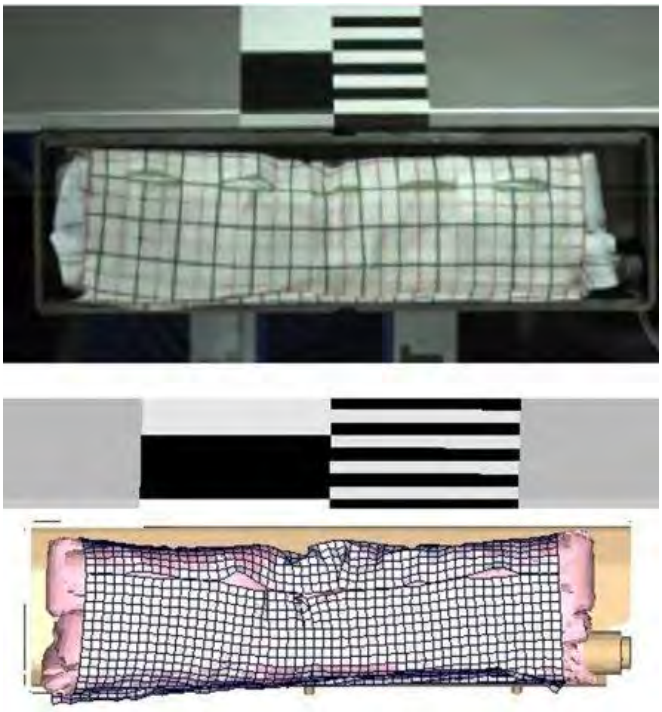
Ever-changing automotive safety regulations constantly put pressure on suppliers to build better products within shorter lead times. For Toyoda Gosei Europe (TGE), faced with the challenge of shortening the lead time to build Complex Folded Knee Airbag models (KnAB), they turned to Virtual Prototyping to optimize their airbag. This virtual prototype had to account for manufacturing by virtually modeling the airbag's folding and sewing processes.

By using ESI Virtual Performance Solution's airbag module for airbag folding and sewing, the accuracy and lead time for developing complex Knee Airbag (KnAB) have improved drastically. Besides the advanced and user-friendly software products, ESI's outstanding support allowed Toyoda Gosei Europe to further improve our simulation-driven development process significantly.

Alexander Diederich Group Leader CAE Toyoda Gosei Europe

Initially, TGE was creating their models using various simulation codes, which resulted in long lead times because they had to conduct iterations with code modifications and model exchanges. Additionally, they were not using the same tools as their colleagues overseas and therefore had to deal with time-consuming communication and multiple data exchange.

Using ESI Virtual Performance Solution (VPS), TGE built a detailed KnAB model with high accuracy and in less time, accounting for the airbag folding process. They were able to provide their customer with predictable simulation models for various types of crash simulations, even for Out-of-position (OOP) scenarios. Additionally, TGE investigated the robustness of the complete KnAB module as well as the robustness of single parts within the KnAB assembly early in the developmental state. This level of prediction of the simulation model has been the basis for several product decisions and improvements at TGE since the deployment of VPS.



Robustness study of protection cloth; physical test (left); with ESI Virtual Performance Solution (right)

Proven by CT scans, the accuracy of the models exhibits the high-quality achieved by the newly implemented modeling process and confirms the capabilities of VPS. Besides reducing their costs – by limiting the number of physical prototypes, increasing the accuracy of their models, and by implementing a new assembly procedure – using the VPS airbag module allowed TGE to cut the time needed to build complex folded KnAB by half, while at the same time increasing the quality of their product. The team can now allocate more time to tasks that are important to their customers rather than struggling to exchange data between departments or countries.

For more information visit Future of Mobility

Learn more about Toyoda Gosei

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.

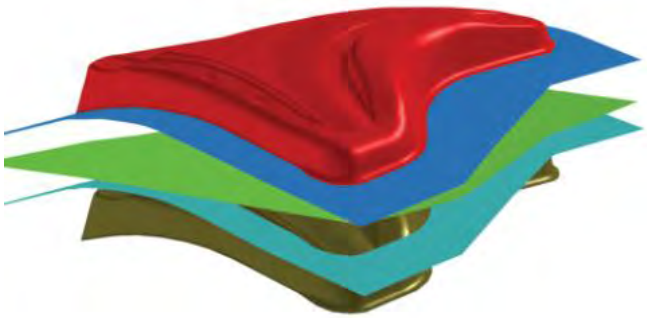
DYNAFORM

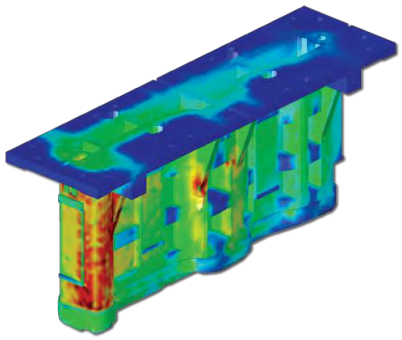
DYNAFORM is a simulation software solution, which allows organizations to bypass soft tooling, reducing overall tryout time, lowering costs, increasing productivity & providing complete confidence in die system design. It also allows for the evaluation of alternative and unconventional designs & materials.

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, 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 07/20/2020 - First - head on over to Art's blog. Yes, you have to pay for coffee even though he's my brother! No, he won't pay for your coffee. NOW, below is why I don't put your coffee in glass bottles! OH Okay, I will discount your coffee this week five cents - yes, that was only five cents.

Glass Bottle Breaking using| ANSYS LS-DYNA

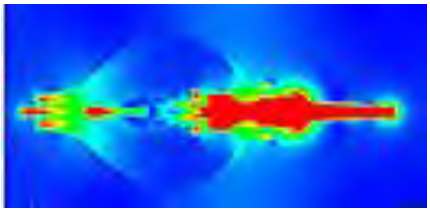
SVS FEM

Monday 07/13/2020 - And it is coffee day! Well, to me, every day is coffee day. I can't have sloshing in any cup or the coffee pot. OH WAIT - let's take our coffee to YouTube and see their sloshing.

Tank slosh - LS-Dyna Coincident Node FSI

Vortex Engineering Group

Monday 07/06/2020 - Sitting drinking my cafe chocolate ala supreme chocolate (just made that long name up) I was wondering about a cavitation bubble inside a coffee drop - Don't I sound impressive? Okay, I was really wondering about how many calories I put into this coffee with the chocolate! SO on to YouTube where the engineers have the real simulations and don't count the calories.



Cavitation bubble behavior simulation inside a water drop using Structured ALE metho

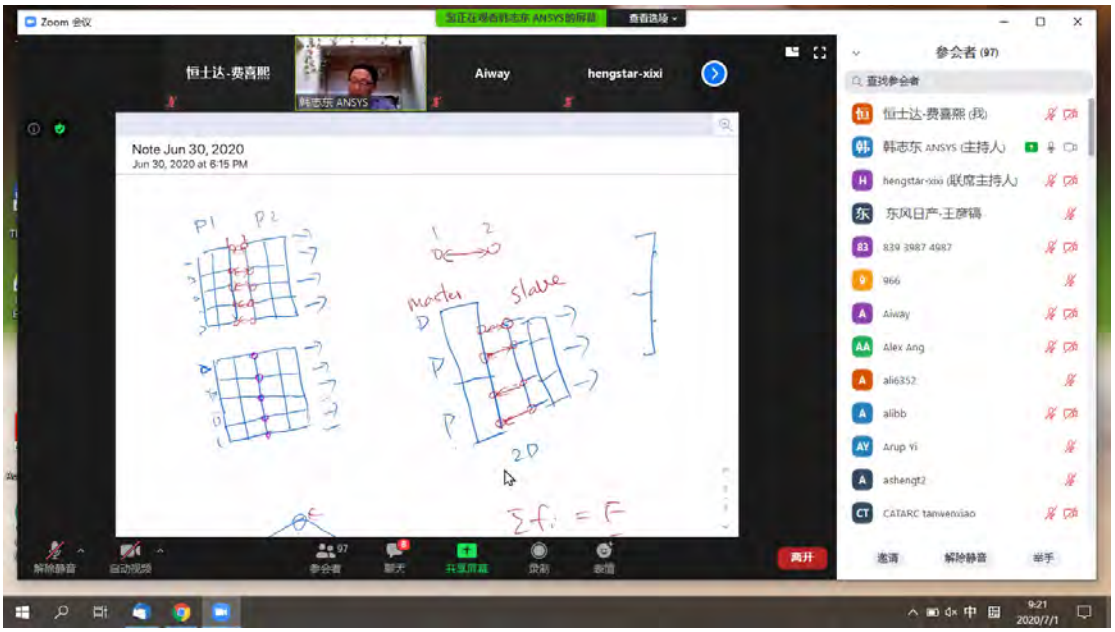
Shanghai Hengstar & Enhu Technology sells and supports LST's suite of products and other software solutions. These provide the Chinese automotive industry a simulation environment designed and ready multidisciplinary engineering needs, and provide a CAD/CAE/CAM service platform to enhance and optimize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

恒士达科技 Hengstar Tech.

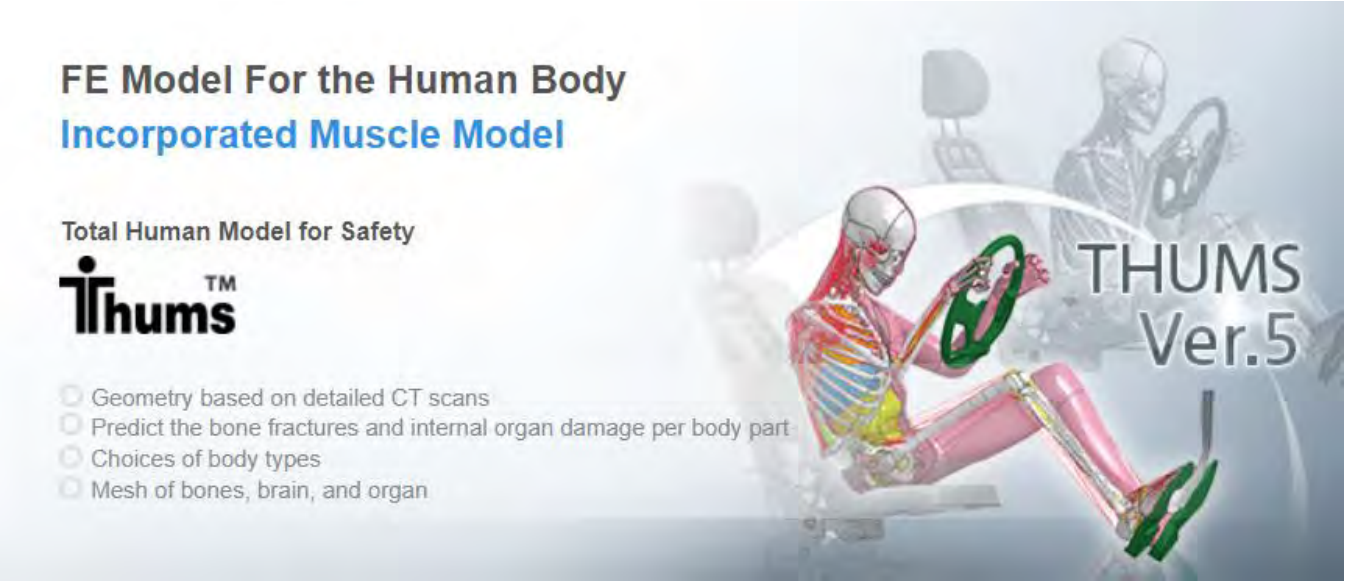
ENHU

Online Seminar On Contact Technology in LS-DYNA

Shanghai Hengstar Technology & Ansys China organized an open online seminar for CAE engineers in China about ” Contact Technology In LS-DYNA” on July 1-2. This seminar was provided by Dr. Zhidong Han,from LST Ansys. This course introduces the main three types of contact in LS-DYNA with the tied contact, the penalty contact, and the constraint contact. For MPP calculation, Dr. Han made a detailed description from the aspects of MPP contact block, MPP contact algorithm, MPP contact calculation efficiency, MPP contact workflow, etc. Finally, the engineering application cases were used to explain the contact coefficient setting up, the model debugging, contact stuffiness, which makes the attendees have a deep understanding of contact technology in LS-DYNA. More than 100 CAE engineers attended this online workshop, and we got a very nice feedback from this impressive and successful seminar.



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.

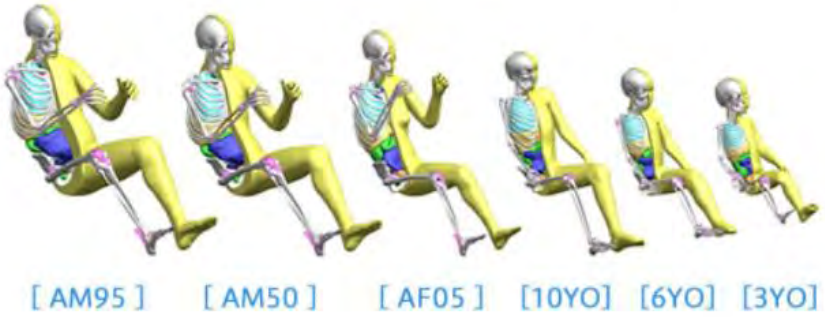


THUMS Features

Use the FE model representing the complex structure of a human body to calculate the behavior and damage due to an impact

Total Human Model for Safety ("THUMS ") is a human body model for injury analysis. It is a Finite Element model (FEM) jointly developed by Toyota Motor Corporation and Toyota Central R&D Labs., Inc.The model aims to simulate "human body kinematics" and "injury on human body" in response to a large impact in a car crash and so on. The geometries of the structurally complex human body parts including the head, torso, joints and organs are represented by FE meshes.

Their material properties refer the list in papers or documents and are compared with component tests listed in papers or documents for validation.THUMS is used by engineers the world over and contribute to the safety improvement of human body.



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.

KAIZENAT Keep Improving

Kaizen-DYNA App

- "Kaizen-DYNA" is a mobile and web based application which is built by Kaizenat Technologies Private Limited (KTPL) to help LS-DYNA users across the world.
- This powerful application helps LS-DYNA users across the world to stay connected and also help each other by sharing their knowledge.
- The key feature of this application is QUERY and RESPONSE. Where a user can post and respond to queries. The best response for each query will be rewarded with a Kaizen score.
- This application also gives an opportunity for the employers to float their LS-DYNA job openings and alert its user's base with a notification.
- "Kaizen-DYNA" quiz program can help LS-DYNA users to update their knowledge score and trend top in the job seekers list.
- It also gives an opportunity for new users to learn LS-DYNA with training materials FAQ modules.
- This application also brings latest news about LS-DYNA and some useful general information.

Android App

iPhone App

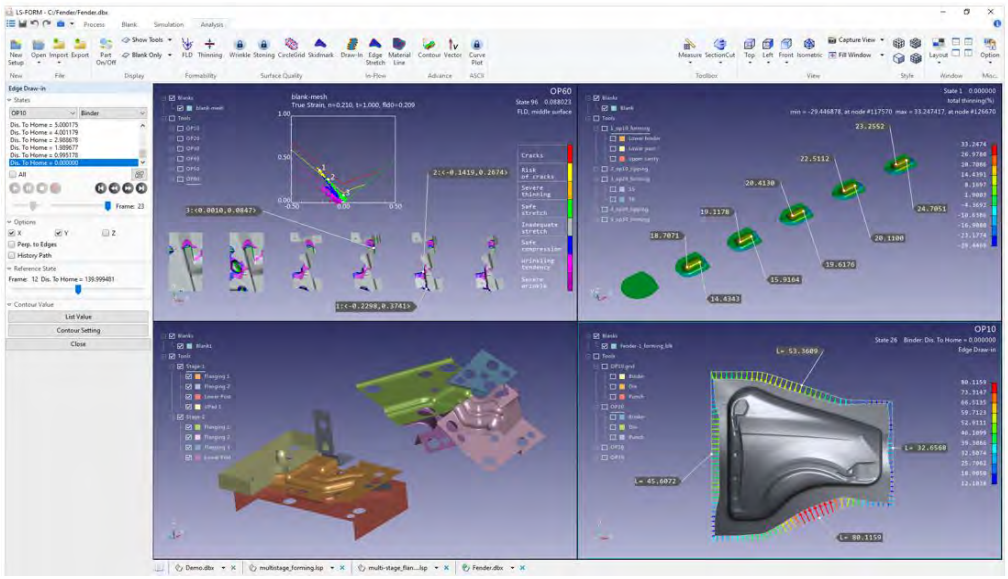
Web App

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

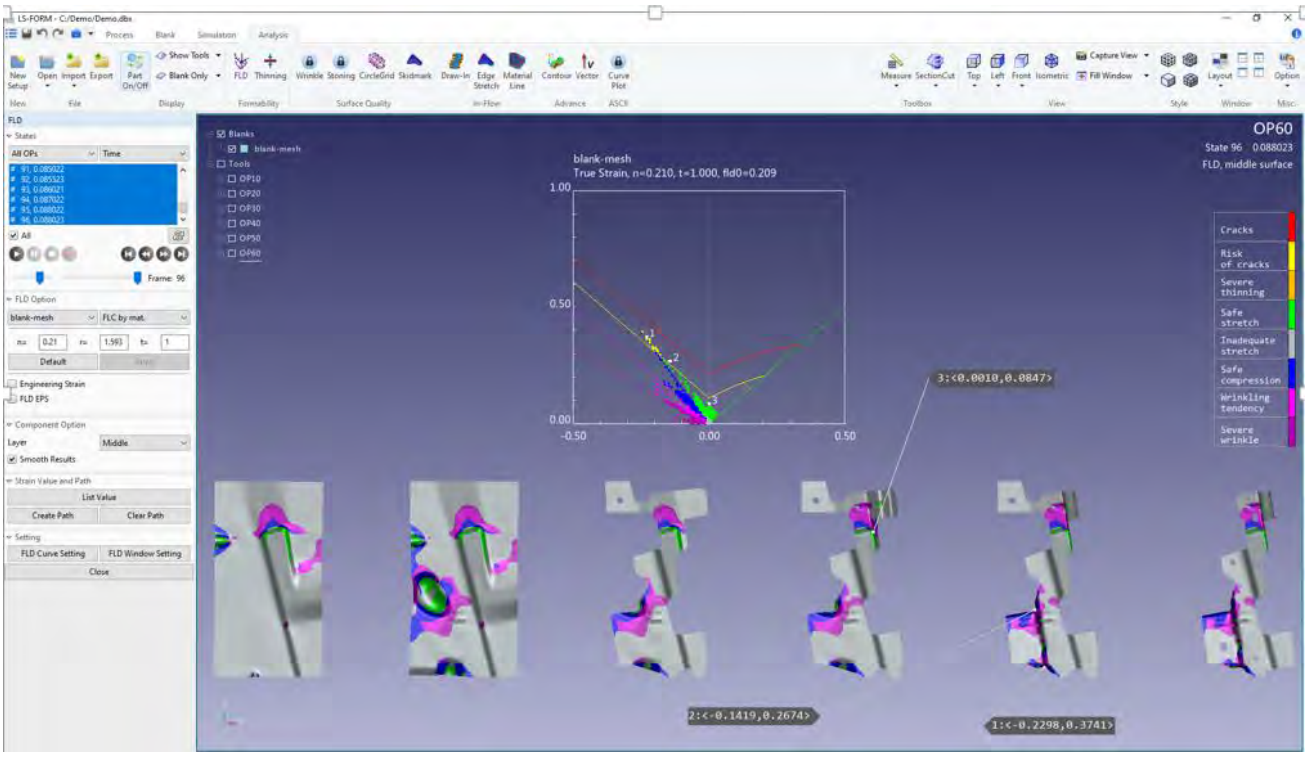
A team of engineers, mathematicians, & computer scientists develop LS-DYNA, LS-PrePost, LS-OPT, LS-TaSC, and Dummy & Barrier models, Tire models.

Introduction to LSFORM

LSFORM started at the beginning of 2018, and it is a dedicated user interface for stamping application. It is an integrated package for pre and post processing, and it provides a process platform integrated with LSDYNA, with a newly implemented key module: Multi-Stage Stamping Simulation. It can allow user seamless set up input, submit the job, and post-process it.



- User-friendly GUI design
- Simplified access to functions
- Integrated post-processing of multi-stage jobs
- Easy multiple-window management
- Up-to-date graphic rendering
- High software stability



LS-DYNA® Computational and Multiscale Mechanics

Intelligent Manufacturing, Advanced Material Design & Integrated Structural Analysis

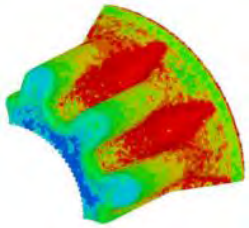
LS-DYNA® integrates advanced finite element and meshfree methods for solving some of the most challenging multiscale problems in manufacturing processes, material design, and structural analysis. Such problems typically involve large deformation, material failure and separation, and/or crack propagation phenomena. The materials covered in these applications could be brittle (glass), semi-brittle (concrete), ductile (metal), rubber / plastics, and composites. These methods can also be coupled with thermal, fluid, and electro-magnetic solvers in LS-DYNA to perform multi-physics analysis as needed.

Methodologies

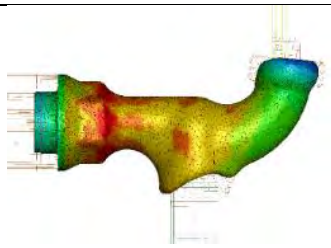
- Adaptive Finite Element Method (AFEM)
- Deep Material Network (DMN)
  - Mechanistic Machine Learning (MML)
- Element Free Galerkin (EFG)
  - Adaptive EFG (AEFG)
- eXtended Finite Element Method (XFEM)
- Meshfree Enriched FEM (MEFEM)
- Peridynamics (PERI)
- Representative Volume Element (RVE)
- Self-consistent Clustering Analysis (SCA)
- Smoothed Particle Galerkin (SPG)
  - Immersed SPG (ImSPG)
  - Incompressible SPG (ISPG)
  - Momentum Consistent SPG (MCSPG)
- Smoothed Particle Hydrodynamics (SPH)
  - Adaptive SPH (ASPH)
- Two-Scale Co-Simulation (TSCS)

Applications: non-failure

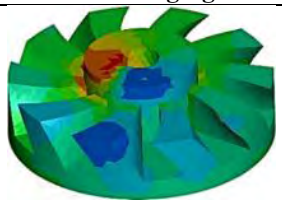
- Manufacturing: forging, extrusion, 3D printing, compression molding
  - AFEM, AEFG, ImSPG
- Material design: unidirectional composites, particle reinforced polymer, polycrystalline
  - RVE, SCA, DMN/MML



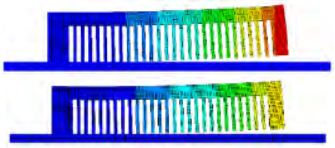
Gear forging



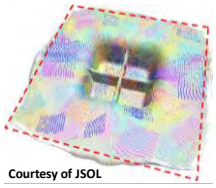
Extrusion of plastics



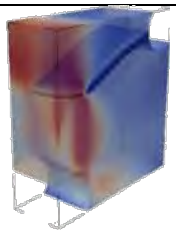
3D printing



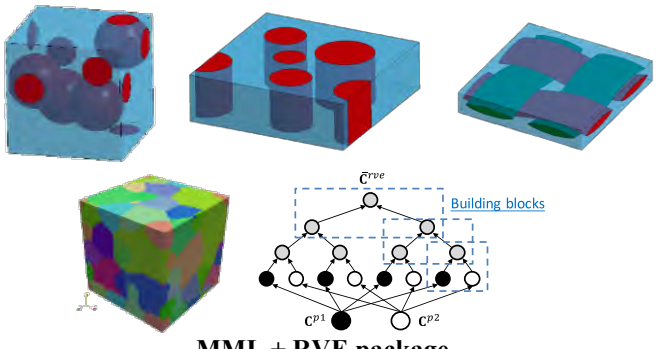
Distorsion prediction of 3D printed components



Compression molding of FRP



Crack in double-notched coupon using SCA



MML + RVE package

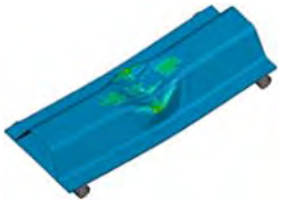
Group Website:
https://www.lstc-cmmg.org

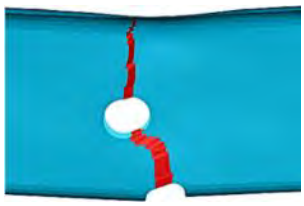
Applications: failure

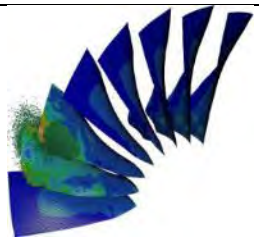
- Crack propagation: brittle (glass, composite) and ductile (metal) materials
  - PERI, XFEM
- Impact: bird strike, penetration
  - SPH, SPG
- Machining process: blanking, cutting, drilling, grinding
  - SPG, MCSPG, SPH
- Joining process: flow drill screwing (FDS), friction stir welding (FSW), self-piercing riveting (SPR), solder reflow
  - SPG, MCSPG, ImSPG, ISPG, SPH
- Structural failure: crash tube, joint strength
  - TSCS, SPG, MCSPG, ImSPG

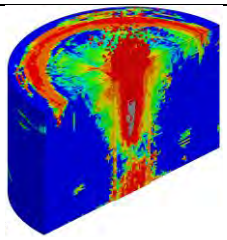
Features

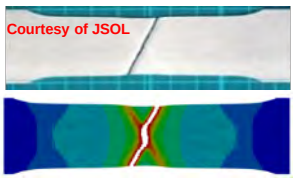
- Element formulations
  - Solid: AFEM, EFG/AEFG, MEFEM, PERI, RVE, SPG
  - Shell: EFG, XFEM
  - Mixed: TSCS (solid-in-shell/solid)
  - Discrete: SPH / ASPH
- Explicit and implicit solvers
  - Both: AFEM, EFG/AEFG, RVE
  - Explicit: PERI, SPG, SPH, TSCS, XFEM
- Multi-physics analysis
  - Coupled thermomechanical, fluid structure interaction
- Applicability
  - Small to extremely large deformations
  - Low to very high strain rate loadings
- Material failure and separation
  - Physics-based failure mechanism


CFRP laminate failure

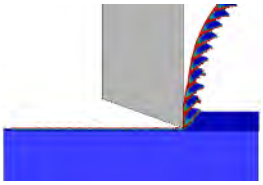

Ductile cracking in shell

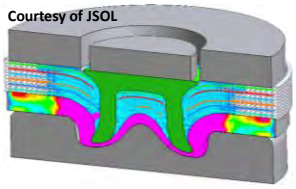

Bird strike


Penetration into concrete

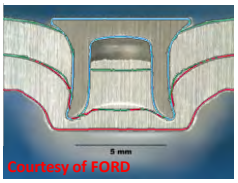


Shear band in uniaxial tension

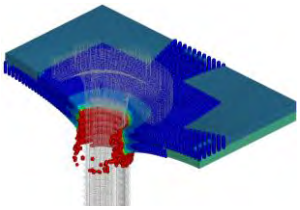

Chip segments in Ti6Al4V cutting

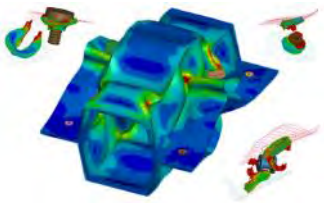


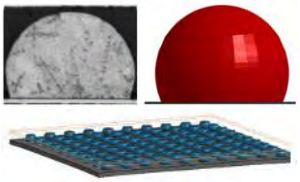
SPR: CFRP to steel

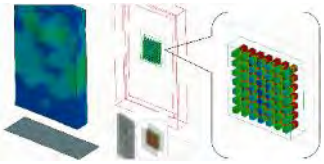


SPR: Al to Al


FDS joining steel plates


Crash tube


Solder reflow


IC drop test

Group Website:

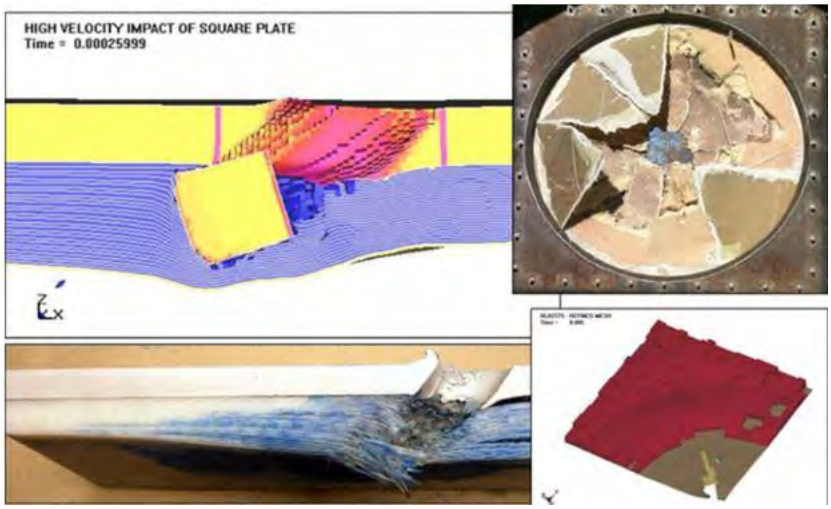
https://www.lstc-cmmg.org

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.

Bottom photos courtesy of TPI Composites, Inc. (left) and Seemann Composites, Inc. (right)

Engineering Services

MSC brings a long-range perspective to its engineering services clients. We understand the history of our core technologies, and can project likely new developments, and seek to provide innovation. A keen appreciation of the materials and structures state-of-the-art gives us the ability to create a development roadmap that efficiently reaches the clients goal, while taking full advantage of what already exists. We have an unusually broad exposure to materials applications; we have been involved with everything from infrastructure applications to spacecraft. This broad perspective allows us to draw on approaches and trends in one application area, and apply it to another. This helps our clients avoid pitfalls, and make exceptionally rapid technological progress. The same broad reach allows us the opportunity to interact with, and evaluate a wide range of suppliers.



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.

Human Body Model Positioning using the Oasys LS-DYNA Environment

This webinar demonstrates how to achieve realistic articulation and positioning of Human Body Models (HBMs) ready for simulation-based dummy positioning analysis in LS-DYNA. We show how positioning of HBM models is possible using Oasys PRIMER-specific dummy trees developed for industry-leading THUMS and GHBMC models.

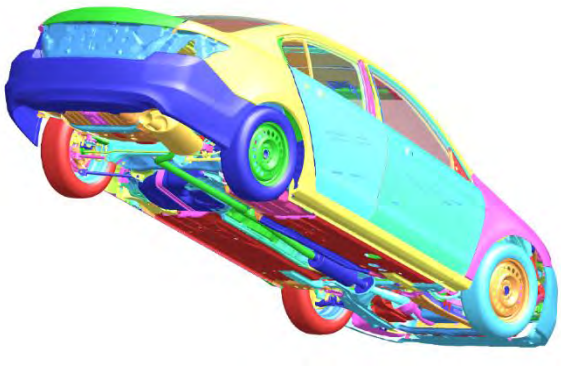
*Image shown above is GHBMC M50-O v5.1.1 model.

View here

Webinar
16th September 2020
12:30 - 01:30 BST

Oasys PRIMER and D3PLOT: composite tools

Register here



Top Tip video:

Oasys PRIMER model navigation

Did you know you can customise and save views in Oasys PRIMER making it easy to navigate around a model?

Click here to view it

Thank you to our +1,000 Subscribers to Oasys LS-DYNA YouTube Channel!

We want to thank you all for subscribing to Oasys LS-DYNA channel. Your support means so much to us and we would not be here without you!

https://www.youtube.com/c/OasysLtd

Contact:

Address:
2512 SE 25th Ave

Phone:
503-206-5571

FINITE ELEMENT ANALYSIS
Predictive Engineering

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

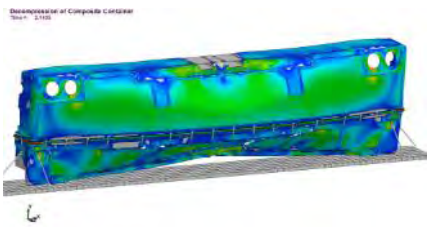
LS-DYNA has been one of Predictive's core analysis tools pretty much since we got started in 1995. It is an amazing numerical workhorse from the basic linear mechanics (think ANSYS or Nastran) to simulating well nigh the impossible. At least that is the way I feel at times when the model is not solving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

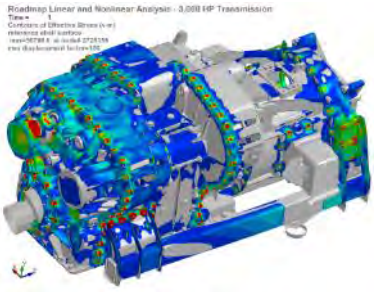
View our portfolio

FEA, CFD and LS-DYNA consulting projects

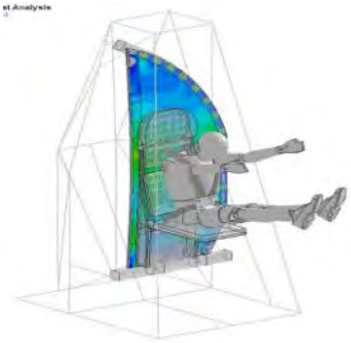
Composite Engineering



Nonlinear Dynamics



Aerospace



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USA

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sales@predictiveengineering.com

ITAR - Data Security For All Our Clients

June 2, 2020 George Laird

We are generalists at Predictive Engineering and it has its pros and cons. We cross-pollinate from medical (orthopedic to endoscopic), rail (transit to heavy locomotives), automotive (electric to Class 8 trucks to school buses), aviation (commercial, supersonic and military), space (hypervelocity missiles to satellites), marine (ships and submarines), civil (hydroelectric turbines to fish ladders to water treatment tanks) and, not to bore you too much, ASME Section VIII, Division 2, "Design-by-Analysis" pressure vessel work (beer kegs to nuclear waste processing vessels under seismic and fatigue). It is a long list and it just continues to grow.

Okay, why all this pre-amble? Our clients' intellectual property (IP) often represents their "crown jewels" and protection of this data is something we take very seriously. Although Predictive is ITAR-Registered, we treat all our clients' data as if it were ITAR data. What does this really mean at the end of the day? It means we use best practices to ensure that no harm comes to any data, for example, using the "Dutch Reach" method when opening a car door to prevent an accident (i.e., data loss) and likewise, being "Safe" with our data and having backups that are under "lock and key". It sounds a bit silly, but good data security is just about best practices and thinking of others, since how would you feel if someone infected you with COVID by not wearing a mask?

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.

Unlocking HPC Cloud Transformation for Enterprises

June 24, 2020
Product Info & Tutorials
Thought Leadership
Edward Hsu

Today I get to share something exciting – something that I believe will be a true enabler for the world of applied science and engineering.

I joined Rescale in part because I strongly related to its mission to accelerate science and engineering innovation by transforming high performance computing (HPC). From battling pandemics, to addressing climate change, solving the world's hardest science and engineering challenges require HPC. It's also everywhere – HPC enables nearly every physical product we use today, from the safer cars we drive, to the advanced smartphones we use.

Given HPC's pivotal role enabling businesses to commercialize new product innovations, it's striking how slightly this ~$40B market has changed in recent years. Only 20% of HPC workloads are in the cloud, compared to ~80% for general enterprise workloads. Today, all major cloud service providers (CSPs) offer specialized HPC infrastructures – great progress, but challenges remain.

The first challenge was turning raw cloud HPC infrastructure into turnkey simulation platforms that engineers find useful – something Rescale is really good at. During my travels late last year to meet and listen to our customers, one comment stood out. "Rescale, you guys make cloud tolerable," said a highly experienced HPC practitioner.

He explained that in his previous job he managed fixed on-premises HPC infrastructures solving for high utilization. But now he works at an engineering-driven company, where his primary responsibility is maximizing engineering throughput. This meant using the cloud (which has the necessary scale and latest HPC architectures), providing a broad simulation software portfolio, staying on budget, and doing it all securely in a highly regulated industry. According to him, without Rescale's automation platform, cloud HPC expertise, and support, this simply would not have been possible. A win for their engineering tea

But there's another challenge that we need to tackle, and that's helping engineering teams and enterprise IT work together. Tension between IT and lines of business (LOBs) is an age-old problem not unique to HPC. IT is charged with an enterprise-wide security, reliability, and efficiency strategy, while LOBs pursue business outcomes. Until recently, most enterprise digital transformation efforts ignored engineering workloads. But this is changing: HPC spend growth rate is twice that of overall IT, and business leaders are starting to pay attention. This is an unprecedented challenge for HPC service owners as the economics of HPC have been historically opaque.

As a former consultant serving business technology leaders, I've seen this movie before. In helping IT organizations improve their interactions with the business, the solution typically included four things: data-driven transparency, clear rules of engagement, a service catalog for the business to make cost/performance tradeoffs, and continuous improvement. It's time to apply this discipline to HPC, particularly since cloud computing is an enterprise-wide CTO & CIO decision.

And so Rescale Insight was created, to deliver data-driven business management for HPC.

And we're just getting started. Today we also announced the industry's first AI engine to match simulation workloads with the best architecture from our multi-cloud infrastructure library. We're putting our eight years of cloud HPC experience into platform intelligence. Now in tech preview, Rescale's coretype AI gives simulation engineers the best of AWS, Azure, and GCP without changing their workflow in any way. All this happens within IT-defined policies on which cloud providers, price points, or pre-defined architectures are enabled.

Rescale Insight provides enterprise IT transparency and control, while empowering engineering teams to drive new product innovations. Simply put, it is a bridge between enterprise IT and LOB engineering teams so that organizations can focus on why they do HPC in the first place:

To accelerate science and engineering breakthroughs.

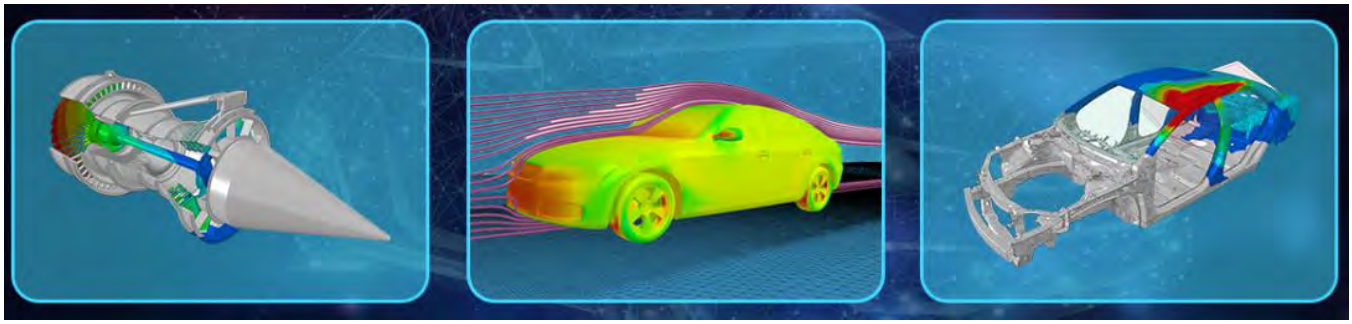
To bring new product innovations to market.

To change the world.

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 Training Courses in 2nd half of 2020



For the first half of this year, Shanghai Fangkun has successfully held several series of LS-DYNA related webinars and training courses. Now Shanghai Fangkun release the online training and webinar plan for the second half this year (as shown in the following table). Please follow us official Wechat "LSDYNA" to get latest information. All LS-DYNA users and those who interested in are welcome to attend. If you have any questions, please contact training@lsdyna-China.com, or dial 18221209107,021-61261195.

Contacts:
Tel.: 021-61261195 54152972
Email: marketing@lsdyna-china.com

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

Training Courses in 2nd half of 2020

Date	Topic	Duratio	Instructor	State
13rd, Jan.	Introduction to MPDB Barrier	3 hours	Zhidan Yuan	Closed
20-21st, Feb.	LS-DYNA Basic Training	2 days	Zhidan Yuan,Yong	Closed
26th, Feb.	Implicit analysis I	2 hours	Yongzhao Zhang	Closed
4th, Mar.	Introduction to ALE analysis I	2 hours	Qiang Wang	Closed
11st, Mar.	ICFD analysis I	2 hours	Zhidan Yuan	Closed
18th, Mar.	Introduction to LS-DYNA submodel	2 hours	Yong Li	Closed
25th, May	Implicit analysis II	2 hours	Yongzhao Zhang	Closed
1st, Apr.	Introduction to ALE analysis II	2 hours	Qiang Wang	Closed
8th, Apr.	ICFD analysis II	2 hours	Zhidan Yuan	Closed
15-16th, Apr.	LS-DYNA composite material model	8 hours	Dr. Al Tabiei	Closed
22nd, Apr.	Introduction to LS-DYNA DEM	2 hours	Qiang Wang	Closed
29, Apr.	Bus performance simulation using LS-DYNA	2 hours	Yong Li	Closed
6th, May	LS-DYNA application in constranit system	2 hours	Yongzhao Zhang	Closed
13th, May	ICFD analysis III	2 hours	Zhidan Yuan	Closed
20th, May	S-ALE analysis in LS-DYNA	4 hours	Hao Chen	Closed
28-29th, May	LS-DYNA Basic Training	2 days	Zhidan Yuan,Yong	Closed
22th, July	Introduction to LS-OPT	2 hours	Zhidan Yuan	Onging
29th, July	Introduction to LS-PrePost	8 hours	Kai Wang	Onging
Aug.	NVH analysis in LS-DYNA	8 hours	Yun Huang	Planning
Aug.	SPG analysis in LS-DYNA	4 hours	Wei Hu	Planning
Sep.	Introduction to Contact in LS-DYNA	8 hours	Zhidong Han	Planning
Sep.	Introduction to LS-Form & Stamp forming	8 hours	Xinhai Zhu	Planning
Sep.	Introduction to LS-OPT	4 hours	Zhidan Yuan	Planning
Oct.	Introduction to LST Dummy & Barrier	2 hours	Yongzhao Zhang	Planning
Oct.	Introduction to EM in LS-DYNA	4 hours	Iñaki Çaldichoury	Planning
Nov.	Introduction to Virtual Proving Ground	4 hours	Zhidan Yuan	Planning
Nov.	LS-DYNA for Crash & Safety	2 days	Paul Du Bois	Planning
Dec.	Simulation of battery abuse in multiphysical	8 hours	Pierre	Planning
Dec.	LS-DYNA user-defined development	8 hours	Zhidong Han	Planning
TBD	LS-DYNA Basic Training	8 hours	Yong Li	Planning
TBD	LS-DYNA Thermal-structural-Coupling and	2 hours	Zhidan Yuan	Planning

Contact: Elva Yu Tel.: 18221209107, 021-61261195 for more detail information
Email: Training@lsdyna-china.com

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

TERRABYTE Co.,Ltd.
Customer Satisfaction by Computer Solution & Computer Simulation

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.

Tesla Semi

The Tesla Semi will deliver a far better experience for truck drivers, while increasing safety and significantly reducing the cost of cargo transport.

Unrivaled Performance

Without a trailer, the Tesla Semi achieves 0-60 mph in five seconds, compared to 15 seconds in a comparable diesel truck. It does 0-60 mph in 20 seconds with a full 80,000-pound load, a task that takes a diesel truck about a minute. Most notably for truck drivers and other travelers on the road, it climbs 5% grades at a steady 65 mph, whereas a diesel truck maxes out at 45 mph on a 5% grade. The Tesla Semi requires no shifting or clutching for smooth acceleration and deceleration, and its regenerative braking recovers 98% of kinetic energy to the battery, giving it a basically infinite brake life. Overall, the Semi is more responsive, covers more miles than a diesel truck in the same amount of time, and more safely integrates with passenger car traffic.

Driver Experience

Unlike other trucks, the Semi's cabin is designed specifically around the driver, featuring unobstructed stairs for easier entry and exit, full standing room inside, and a centered driver position for optimal visibility. Two touchscreen displays positioned symmetrically on both sides of the driver provide easy access to navigation, blind spot monitoring and electronic data logging. Built-in connectivity integrates directly with a fleet's management system to support routing and scheduling, and remote monitoring. Diesel trucks today currently require several third party devices for similar functionality.

Megachargers, a new high-speed DC charging solution, will add about 400 miles in 30 minutes and can be installed at origin or destination points and along heavily trafficked routes, enabling recharging during loading, unloading, and driver breaks.

Safety

The Tesla Semi's all-electric architecture is designed to have a higher safety standard than any other heavy-duty truck on the market, with a reinforced battery that shields the Semi from impact and gives it an exceptionally low center of gravity. Its windshield is made of impact resistant glass. Jackknifing is prevented due to the Semi's onboard sensors that detect instability and react with positive or negative torque to each wheel while independently actuating all brakes. The surround cameras aid object detection and minimize blind spots, automatically alerting the driver to safety hazards and obstacles. With Enhanced Autopilot, the Tesla Semi features Automatic Emergency Braking, Automatic Lane Keeping, Lane Departure Warning and event recording.

Tesla Semi can also travel in a convoy, where one or several Semi trucks will be able to autonomously follow a lead Semi.

Reliability

With far fewer moving parts than a diesel truck – no engine, transmission, after-treatment system or differentials to upkeep – the Tesla Semi requires significantly less maintenance. Its battery is similar in composition to the batteries of Tesla energy products and is designed to support repeated charging cycles for over a million miles, while its motors are derived from the motors used in Model 3 and have been validated to last more than one million miles under the most demanding conditions.

Lowest Cost of Ownership

All-in, the Tesla Semi delivers massive savings in energy costs, performance, efficiency and reliability.

The biggest immediate cost-advantage comes from savings in energy costs: fully loaded, the Tesla Semi consumes less than two kilowatt-hours of energy per mile and is capable of 500 miles of range at GVW and highway speed, accommodating a wide range of shipping applications given that nearly 80% of freight in the U.S. is moved less than 250 miles. Coupled with the low and stable nature of electricity prices – which average $0.12/kWh in the U.S. and can be significantly less for commercial and industrial users, falling to almost nothing when combined with local solar generation and storage – owners can expect to gain $200,000 or more in savings over a million miles based on fuel costs alone.

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

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ATD –DUMMY MODELS

www.dummymodels.com

LSTC ATD MODELS

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AEROSPACE WORKING GROUP

http://awg.lstc.com

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Info Days

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Directory

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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

LS-DYNA® material model 263 and its application to earing predictions in cup-drawing

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1. Introduction

Over the years LS-DYNA® has been making efforts to keep an up-to-date material library to satisfy the ever-growing customers' needs for precise characterization of material behaviors under various loading conditions. This paper focuses on a newly implemented metal forming material model, material type 263 (*MAT_LOU-YOON_ANISOTROPIC_PLASTICITY), based on the anisotropic yield function recently proposed by Lou and Yoon [1]. This yield function extends the original Drucker function into an anisotropic form using a fourth order linear transformation tensor. As a stress-invariant-based yield criterion, the anisotropic Drucker yield function is less computationally expensive compared to the principle-stress-based yield functions, especially in the spatial loading cases. In the meantime, the non-associated flow rule (non-AFR) is applied to accurately characterize both the directional yield stresses and R-values while keeping the model simple and efficient. The anisotropic flexibility of this model can be further improved by summing up more components of the anisotropic Drucker function. Last but not least, the *c*-value in the Drucker function is calibrated for body-centered cubic (BCC) and face-centered cubic (FCC) metals for the first time thereby endowing the function with the identical capability to non-quadratic yield functions to differentiate distinct plastic behaviors between BCC and FCC metals.

This paper gives a brief review on the anisotropic Drucker yield function and its implementation in LS-DYNA®, then a demonstration on how to calibrate the input material parameters using LS-OPT®, followed by a numerical simulation based on the new material model to predict earing during a cup-drawing process. The simulation demonstrates excellent agreement with measured data, especially when paired with LS-OPT® for material parameter calibration.

2. Anisotropic yield criterion based on Drucker function

Drucker proposed a yield function by including the third stress invariant into the classical Von Mises yield function [2]. The Drucker function is extended to an anisotropic form as shown below[1]:

$$\bar{\sigma}_y(\sigma_{ij}) = (J'^3_2 - cJ'^2_3)^{1/6} \tag{1}$$

where J'_2 and J'_3 are the second and third invariants of the linear transformed deviatoric stress tensor $\boldsymbol{s}'$:

$$\boldsymbol{s}' = \boldsymbol{L}'\boldsymbol{\sigma} \tag{2}$$

The fourth order linear transformation tensor $\boldsymbol{L}'$ in equation (2) is given by:

$$\boldsymbol{L}' = \begin{bmatrix} (c'_2+c'_3)/3 & -c'_3/3 & -c'_2/3 & 0 & 0 & 0 \\ -c'_3/3 & (c'_1+c'_3)/3 & -c'_1/3 & 0 & 0 & 0 \\ -c'_2/3 & -c'_1/3 & (c'_2+c'_1)/3 & 0 & 0 & 0 \\ 0 & 0 & 0 & c'_4 & 0 & 0 \\ 0 & 0 & 0 & 0 & c'_5 & 0 \\ 0 & 0 & 0 & 0 & 0 & c'_6 \end{bmatrix} \tag{3}$$

The coefficient c in equation (1) is calibrated to be 1.226 for metals with BCC and 2 for FCC [1]. c'_1, c'_2, c'_3 and c'_6 in equation (3) can be calibrated from uniaxial tensile yield stress along different directions and the balanced biaxial yield stress. On the other hand, c'_4 and c'_5 , which are related to the through-thickness material properties, are very difficult to obtain experimentally and therefore assumed to be identical with c'_6.

The fact that only six anisotropic parameters are to be identified makes the flexibility of equation (1) comparable to Hill48 and Yld91 functions [1]. A way to improve this is to adopt the non-associated flow rule (non-AFR), in which the plastic flow is not required to be aligned with the yield surface normal and the *r*-values are modeled by a different plastic potential as shown in equation (4):

$$\bar{\sigma}_p(\sigma_{ij}) = (\hat{J}^3_2 - c\hat{J}^2_3)^{1/6} \tag{4}$$

where $\hat{J}_2$ and $\hat{J}_3$ are the second and third invariants of the linear transformed deviatoric stress tensor $\hat{\boldsymbol{s}}$:

$$\hat{\boldsymbol{s}} = \hat{\boldsymbol{L}}\boldsymbol{\sigma} \tag{5}$$

with $\hat{\boldsymbol{L}}$ defined as:

$$\hat{\boldsymbol{L}} = \begin{bmatrix} (\hat{c}_2+\hat{c}_3)/3 & -\hat{c}_3/3 & -\hat{c}_2/3 & 0 & 0 & 0 \\ -\hat{c}_3/3 & (\hat{c}_1+\hat{c}_3)/3 & -\hat{c}_1/3 & 0 & 0 & 0 \\ -\hat{c}_2/3 & -\hat{c}_1/3 & (\hat{c}_2+\hat{c}_1)/3 & 0 & 0 & 0 \\ 0 & 0 & 0 & \hat{c}_4 & 0 & 0 \\ 0 & 0 & 0 & 0 & \hat{c}_5 & 0 \\ 0 & 0 & 0 & 0 & 0 & \hat{c}_6 \end{bmatrix} \tag{6}$$

The anisotropic parameters $\hat{c}_1$, $\hat{c}_2$, $\hat{c}_3$ and $\hat{c}_6$in equation (6) can be calibrated with experimentally measured r-values along different directions.

Another approach to improve the flexibility of equation (1) is to sum up n components of the anisotropic Drucker functions as follows [1]:

$$\bar{\sigma}_y(\sigma_{ij}) = \frac{1}{n}\sum_{m=1}^{n}\{[(J_2^{\prime(m)})^3 - c(J_3^{\prime(m)})^2]^{1/6}\} \tag{7}$$

with the integer $n \geq 1$. The same idea can be applied to the plastic potential in the non-AFR approach, as shown by equation (8):

$$\bar{\sigma}_p(\sigma_{ij}) = \frac{1}{n}\sum_{m=1}^{n}\{[(\hat{J}_2^{(m)})^3 - c(\hat{J}_3^{(m)})^2]^{1/6}\} \tag{8}$$

The accuracy of equations (7) and (8) improves as n increases.

3. LS-DYNA® model implementation and material parameter identification

The material model is implemented as material type 263 in LS-DYNA® material library and can be accessed with the keyword *MAT_263 or *MAT_LOU-YOON_ANISOTROPIC_PLASTICITY. Both AFR and non-AFR options are available. Currently, the allowed number of Drucker functions is limited to one. Various hardening laws are implemented including Swift, Voce, Gosh, and Hocken-Sherby. Alternatively, a customized hardening curve can also be imported to characterize the material's hardening behavior as a function of the effective plastic strain. Details on the card structure of this keyword can be found in the keyword manual of LS-DYNA®.

One essential step to apply this material model to a real analysis is determination of the anisotropic parameters. In the case of one Drucker function, this keyword requires input of a total of 4 anisotropic parameters (c_1', c_2', c_3', c_6') in the AFR case. With the non-AFR option, four more anisotropic parameters ($\hat{c}_1$, $\hat{c}_2$, $\hat{c}_3$, $\hat{c}_6$) are to be defined. As briefly mentioned in section 2, these anisotropic parameters should be calibrated from yield stresses and r-values measured from uniaxial tensile tests loaded at different angles and the balanced bi-axial tensile test. However, the procedures of identifying these parameters from measured data are not standardized across the industry. As the key idea is to find the best parameter set that reproduces the material's yield behavior as close as possible, here we use LS-OPT®, a LS-DYNA®-based general optimization program developed by Livermore Software Technology Corporation, to determine the anisotropic parameter set required by material type 263.

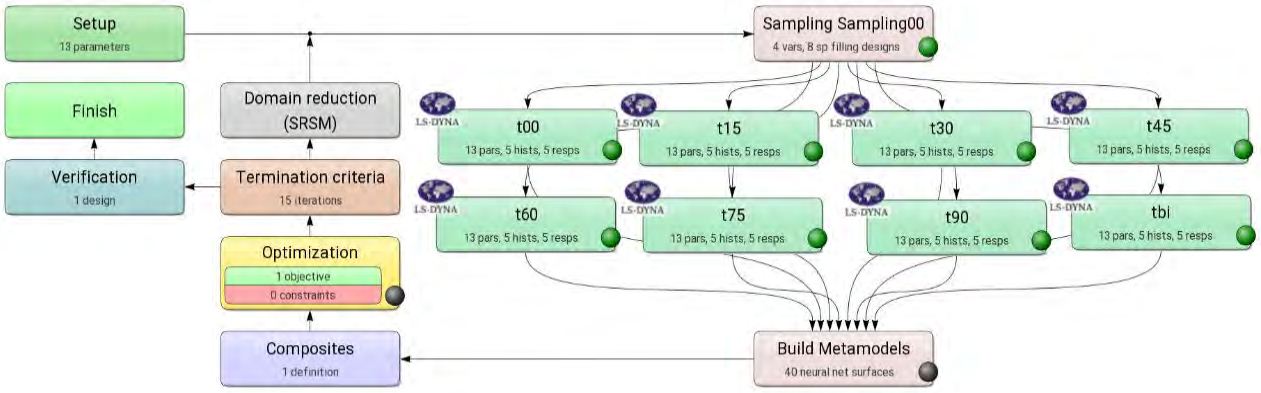


Figure 1 A schematic view of LS-OPT® setup to calibrate anisotropic parameters of material type 263

Figure 1 illustrates the structure of a material parameter identification project built in LS-OPT®. The key steps of setting up this project include: (1) set up the parameters to be identified, and in this case, the anisotropic parameter set (c_1', c_2', c_3', c_6'); (2) set up a series of simulation stages which predicts the material's yield behavior under experimental conditions, and in this case, a total of eight stages, including 7 uniaxial tensile tests, in the direction of 0º, 15º, 30º, 45º, 60º, 75º and 90º respectively, and one balanced bi-axial tensile test, are set up in the project; (3) set up the optimization objective, which is to minimize an error function (termed as composite in LS-OPT®) which measures the differences in yield stresses predicted by the model and observed from experiments. The definition of the error function is given by equation (9):

$$\mathrm{F} = \sum_{\theta=0}^{90}\left(\frac{\sigma_\theta}{\sigma_\theta^{pred}} - 1\right)^2 + \left(\frac{\sigma_b}{\sigma_b^{pred}} - 1\right)^2 \tag{9}$$

where σ_θ and σ_b are yield stresses obtained from uniaxial and biaxial tensile tests, and σ_θ^{pred} and σ_b^{pred} are LS-DYNA® predicted values using material model 263. Note that the finite element model used in these simulation stages contains only one single element to accelerate the optimization process. This particular optimization project is set up to identify the anisotropic parameters of an aluminum alloy 2008-T4, which is known as an FCC material with moderate anisotropy. Accordingly, c is set to 2 in the anisotropic Drucker function. The experimental yield stresses for this material can be found from the literature and are listed in Table 1.

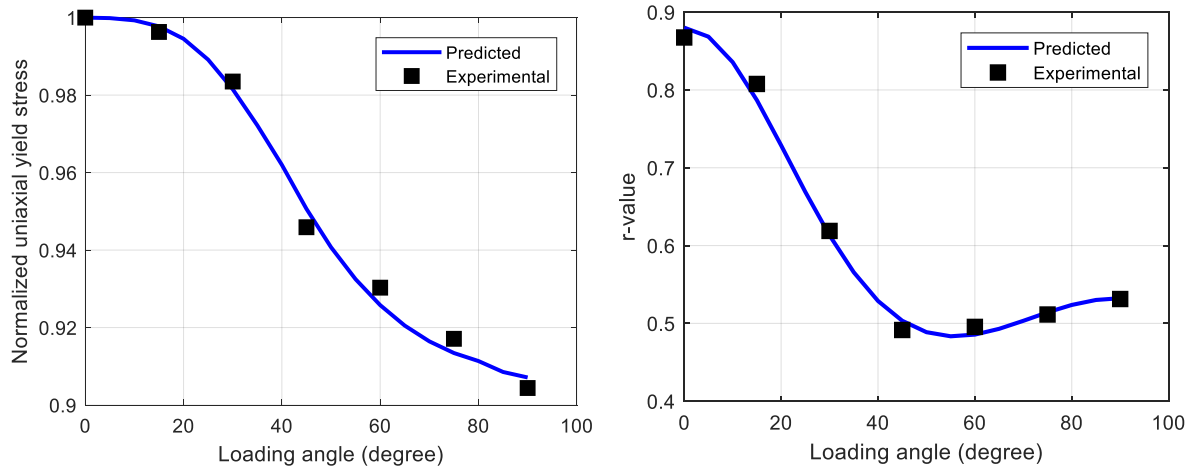
The parameter set (c_1', c_2', c_3', c_6') optimized by LS-OPT® is listed in Table 2 and the predicted yield stresses based on this parameter set are compared with experimental values in Figure 2(a).

Table 1 Experimental yield stresses and *r*-values of AA2008-T4 [3]

σ_0/σ_0	σ_{15}/σ_0	σ_{30}/σ_0	σ_{45}/σ_0	σ_{60}/σ_0	σ_{75}/σ_0	σ_{90}/σ_0	σ_b/σ_0
1.0000	0.9963	0.9835	0.9459	0.9303	0.9171	0.9044	0.9010
r_0	r_{15}	r_{30}	r_{45}	r_{60}	r_{75}	r_{90}	r_b
0.8674	0.8077	0.6188	0.4915	0.4955	0.5114	0.5313	1.0000

Table 2 LS-OPT® optimized anisotropic parameter values and parameter values found from the literature [3]

	c_1'	c_2'	c_3'	c_6'	$\hat{c}_1$	$\hat{c}_2$	$\hat{c}_3$	$\hat{c}_6$
By LS-OPT® (case I)	2.2511	1.8141	1.7885	1.8005	2.0505	1.7656	1.7095	1.6955
From literature [3] (cases II and III)	2.2190	1.8448	1.8282	1.9082	2.1913	1.8729	1.7995	1.7829



(a) yield stresses at different loading angles

(b) *r*-values at different loading angles

Figure 2 Yield stresses and *r*-values predicted by LS-DYNA® as compared to experimental data

In a similar manner, we can setup another optimization project to identify the values of ($\hat{c}_1$, $\hat{c}_2$, $\hat{c}_3$, $\hat{c}_6$) by turning on the non-AFR option of material type 263. In this case, the optimization goal is to minimize an error function that evaluates the differences between predicted and measured *r*-values at different loading conditions, as shown in equation (10):

$$F = \sum_{\theta=0}^{90}\left(\frac{r_\theta}{r_\theta^{pred}} - 1\right)^2 + \left(\frac{r_b}{r_b^{pred}} - 1\right)^2 \qquad (10)$$

The values of ($\hat{c}_1$, $\hat{c}_2$, $\hat{c}_3$, $\hat{c}_6$) after LS-OPT® optimization are listed in Table 2 and Figure 2(b) plots the predicted *r*-values based on the optimized parameter set as compared to the experimental values. As a reference, we also listed the anisotropic parameters for AA2008-T4 found from the literature [3] in Table 2. As expected, the values are close but not identical, due to the fact that (1) results by LS-OPT® are based on LS-DYNA®'s implementation of the theoretical model, i.e., material type 263; (2) different numerical procedures are employed during the optimization process; (3) optimization usually finds a local minimum which is dependent on the search range and initial guess.

4. Application to predict earing during a cup-drawing process

Based on the anisotropic parameter set identified by LS-OPT® in Section 3, a cup-drawing simulation using material type 263 is conducted to predict the final earing profile. The model contains only one quarter section of the cup. Dimensions of the tools and blank are given in detail in Yoon et al. (2006) [4]. The initial blank has a radius of 81 mm and is meshed with 3-dimensional solid elements. Element formulation 2 (with selective reduced integration, see LS-DYNA® user's manual for details) is applied in the analysis. Assuming isotropic hardening, the Voce hardening law is used to characterize the material's hardening behavior after yielding, as shown by equation (11):

$$\sigma_y = 408 - 175e^{-6.14\epsilon_p} \qquad (11)$$

where ϵ_p stands for the effective plastic strain. Figure 3 shows the deformed cup shape after fully drawn with the contour of ϵ_p being plotted.

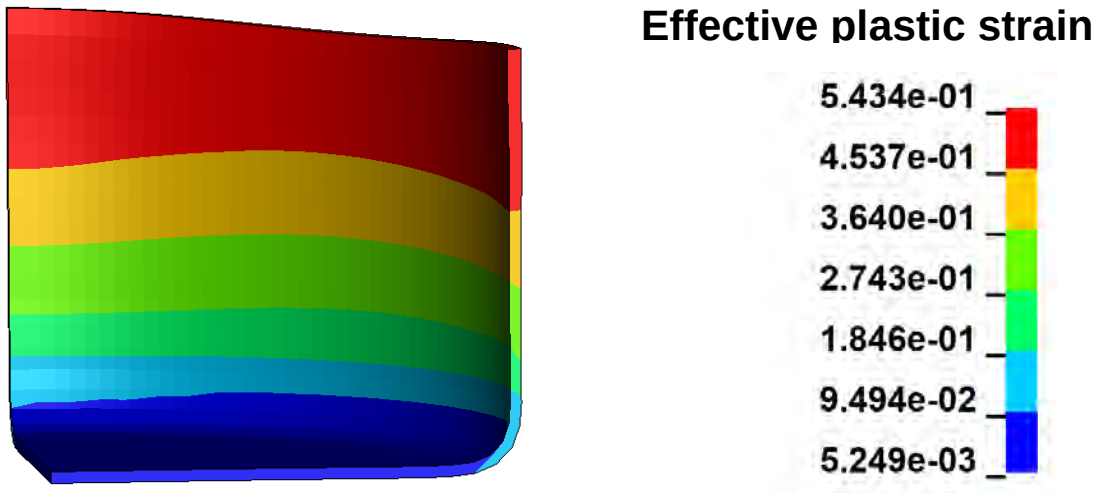
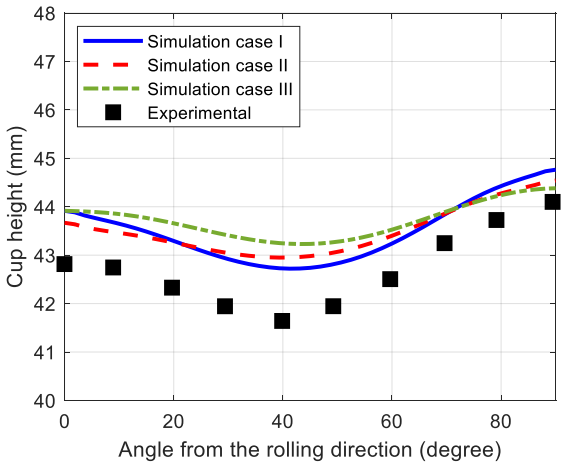
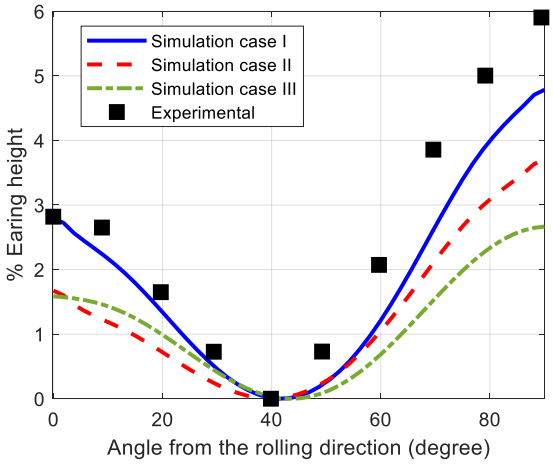


Figure 3 Simulated cup deformation after fully drawn with the contour of effective plastic strain



(a) Cup height after fully drawn



(b) Normalized earing profile

Figure 4 Simulation-predicted earing profile as compared to experimental results

To show how the model prediction correlates to experiments, Figure 4(a) compares three cases of simulated cup height as a function of the angle from the rolling direction along with the experimental data. Case I is obtained by using LS-DYNA® with the anisotropic parameters identified by LS-OPT® as listed in Table 2 (1st row). Case II is also calculated by LS-DYNA® but with the anisotropic parameters taken from the literature, which are also listed in Table 2 (2nd row). As a reference, another simulated profile, which is based on the same model with the same set anisotropic parameters as case II but uses a different numerical implementation [3], is included as case III. To better observe the variation of cup height, Figure 4(b) compares the % earing height of all three cases with the experimental data, where % earing height is calculated by equation (12):

$$\%\ \text{earing height} = \frac{Cup\ height - minimum\ cup\ height}{minimum\ cup\ height} \times 100 \qquad (12)$$

As illustrated by Figures 4(a) and (b), all three simulated cases are able to capture the general features of the overall earing profile. The differences between case II and case III are considered to be due to differences in the details of numerical implementation of the same theoretical model, as well as different element formulations, contact assumptions, etc.. On the other hand, the differences between case I and II are solely caused by different sets of anisotropic parameters being used in the simulations. Case I, which uses the LS-OPT® identified parameters matches the experimental data better in terms of both the cup height values and the overall earing profile. The reason is considered to be the fact that the numerical algorithm used in the material parameter identification process and the cup-drawing analysis are consistent with each other. In case I, the LS-OPT® identification procedure serves as a "training" process that makes the material model 263 "learns" the best set of anisotropic parameters that matches the real material behavior. The numerical consistency between the identification process and simulation process leads to the overall improvement of earing prediction.

5. Conclusion

A new metal forming material model is implemented in LS-DYNA® material library as material type 263, accessed by the keyword *MAT_LOU-YOON_ANISOTROPIC_PLASTICITY, based on the theoretical model proposed by Lou and Yoon in 2018. The yield criterion of this model uses the stress-invariant-based Drucker function and the flexibility can be easily extended with the non-AFR option and/or further addition of Drucker components. The general procedures of using LS-OPT® to identify the anisotropic parameter set used as the model input are outlined. The model is then subject to a deep cup-drawing analysis on an aluminum alloy 2008-T4 blank and the prediction on the final earing profile is in good agreement with experimental results, especially when the analysis is paired with LS-OPT® identified anisotropic parameters.

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BETA CAE Systems. www.beta-cae.com

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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

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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.

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

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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
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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.

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

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

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

MSC/LS-DYNA Composite Software and Database -

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

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

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

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

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

Oasys PRIMER

Key benefits:

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

www.oasys-software.com/dyna

Oasys D3PLOT

Key benefits:

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

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..

Cloud - HPC Services - Subscription JSOL

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

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

JSOL Corporation is cooperating with chosen cloud computing services

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

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

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

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

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

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

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

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

Platform Computation Cloud - CreDist.Inc.

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

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

Cloud - HPC Services - Subscription RESCALE

www.rescale.com

Rescale: Cloud Simulation Platform

The Power of Simulation Innovation

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

Using the power of cloud technology combined with LS-DYNA allows you to:

- Accelerate complex simulations and fully explore the design space
- Optimize the analysis process with hourly software and hardware resources
- Leverage agile IT resources to provide flexibility and scalability

True On-Demand, Global Infrastructure

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

Rescale has strategic/technology partnerships with infrastructure and software providers to offer the following:

- Largest global hardware footprint – GPUs, Xeon Phi, InfiniBand
- Customizable configurations to meet every simulation demand
- Worldwide resource access provides industry-leading tools to every team
- Pay-per-use business model means you only pay for the resources you use
- True on-demand resources – no more queues

ScaleX Enterprise: Transform IT, Empower Engineers, Unleash Innovation

The ScaleX Enterprise simulation platform provides scalability and flexibility to companies while offering enterprise IT and management teams the opportunity to expand and empower their organizations.

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

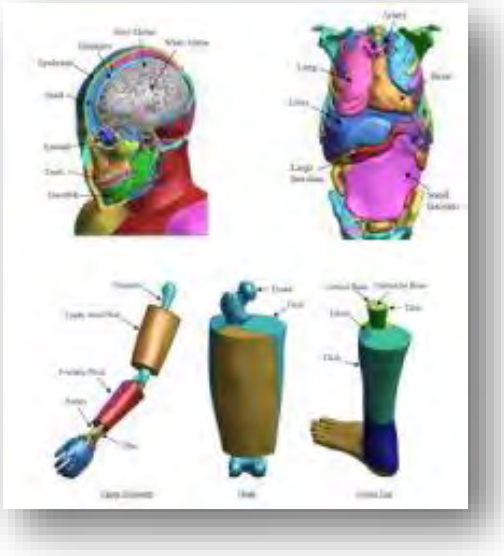
Collaboration

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:

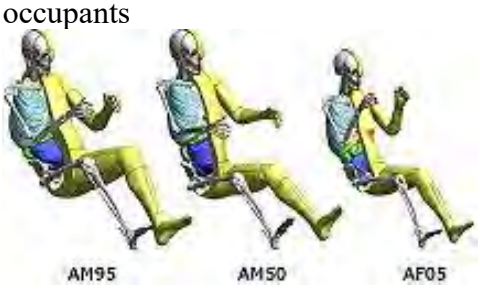
- Data, workflow or project asynchronous collaboration
- Multi-user, browser based collaboration for CAD, geometry, mesh and results models
- Real-time design review with notes, annotations and images archiving and retrieval
- Email invite to non ESI Cloud users for real time collaboration

TOYOTA - Total Human Model for Safety – THUMS

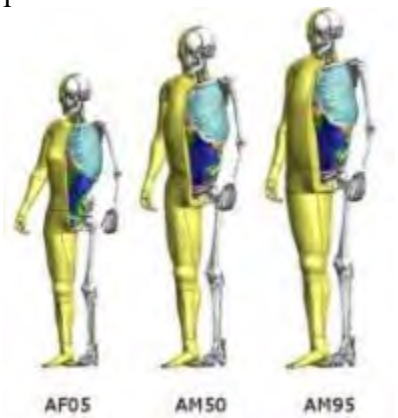


The Total Human Model for Safety, or THUMS®, is a joint development of Toyota Motor Corporation and Toyota Central R&D Labs. Unlike dummy models, which are simplified representation of humans, THUMS represents actual humans in detail, including the outer shape, but also bones, muscles, ligaments, tendons,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

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

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

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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