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COVER STORY

Moldflow

An Interface

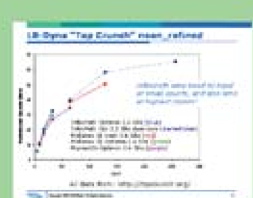
to LS-DYNA®

PRODUCT SPOTLIGHT

Pathscale

Software and Hardware

for linux clusters



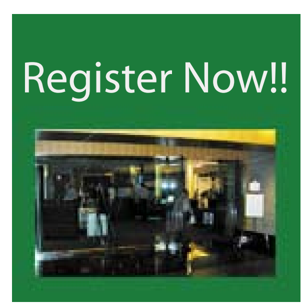
SERVICES SPOTLIGHT

LSTC

9th International

LS-DYNA Users Conference

June 4-6, 2006 Dearborn, MI



FEA INFORMATION RESOURCE MAGAZINE

FEA Information Worldwide Participants

Contents

Editor: **Trent Eggleston** **Managing Editor:** **Marsha Victory** **Technical Editor:** **Art Shapiro** **Graphic Designer:**	**Technical Writers:** **Dr. David Benson** **Uli Franz** **Dr. Ala Tabiei** **Suri Bala** **Technical Consultants:** **Steve Pilz**

FEA Information Announcements

HP Utility Services

Due to time constraints this article will appear in the March Issue.
LS-DYNA will be offered on the HP Utility Service.

FEA News Updates

The Resource Section has updated information on:

- EASi-CRASH DYNA
- SGI

9th International LS-DYNA Users Conference - June 4-6, 2006

- Papers are listed
- FEA Information Participant Conference Sponsors are listed
- Registration Form is available to print and fax

LSTC Announcement from Russell Sims, sims@lstc.com

LS-DYNA®, LS-OPT®, and LS-PrePost® are now registered tradmarks of Livermore Software Technology Corporation.

When LS-DYNA, LS-PrePost or LS-OPT are used in published material (posters, brochures, published price lists, etc) for the purposes of promoting LSTC's products and services to the public, you are required to inform the reader that these words are registered trademarks of LSTC. This can be accomplished by either using the ® symbol if these words will only be used a limited number of times in a letter, for example, OR if in the case of a manual where these words may appear throughout, you can print a statement at the beginning or end of the document stating that "LS-DYNA, LS-OPT, and LS-PrePost are registered trademarks of Livermore Software Technology Corporation."

Sincerely,
Trent Eggleston & Marsha Victory

Material model for TRIP-steels

www.dynasupport.com LS-DYNA Support Site

Following is a description of the *MAT_TRIP material model for TRIP-steel. For a description of the keyword card format please consult the LS-DYNA 971 keyword user's manual.

Overview

In materials with TRIP-effect (TRIP - TRansformation Induced Plasticity), a phase transformation from austenite to martensite occurs during forming that significantly affects the hardening behavior. The effect is sensitive to the amount of straining as well as the temperature. The hardening is more severe at low temperatures, e.g. 0C, than at high temperatures, e.g. 100C.

The material model has been implemented in LS-DYNA® 971 as *MAT_TRIP

Forming

Applications of the material model include forming operations such as deep drawing, stretching, and hydroforming.

The modeling approach can be outlined as follows for a stamping operation. A standard element for stamping such as the Belytschko-Tsay shell element is used both for tools and blank. The tools are rigid. In short the modeling can be done following standard practice for stamping simulation with the following exceptions:
.

- Thermo-mechanical solution.
- Thermal contacts allowing heat transfer between tools and blank.
- TRIP material model.

Preferable thick thermal elements THSELL=1 on CONTROL_SHELL are used for the tools.
The thermal solver in LS-DYNA is implicit and a much larger, e.g. 100 times, time-step can often be used in the thermal solver than in the mechanical part of the simulation. In combination with the efficient iterative thermal solver this means that the run time is often only slightly increased compared to a standard forming simulation.

Forming Effects In Crash

The material model can also be used for crash simulations where forming effects are taken into account. In a crash simulation the TRIP material model does not need to be run with the thermal solver activated, instead the temperatures are calculated using an adiabatic temperature calculation approach

Theory

The *MAT_TRIP material model uses the von Mises yield surface in combination with isotropic hardening and is taken from Hänsel et al. [1]. The hardening is temperature dependent and therefore this material model must be run either in a coupled thermo-mechanical solution, using prescribed temperatures or using the adiabatic temperature calculation option. Setting the parameter CP to the specific heat Cp of the material activates the adiabatic temperature calculation that calculates the temperature rate from the equation

$$\dot{T} = \frac{\sigma \cdot D^p}{\rho C_p},$$

where the nominator is the plastically dissipated heat. Using the Kelvin scale is recommended, even though other scales may be used without problems.

The hardening behavior is described by the following equations. The Martensite rate equation is

$$\frac{\partial V_m}{\partial \bar{\varepsilon}^p} = \begin{cases} 0\text{, if } \varepsilon < E_{0(mart)} \\ \frac{B}{A}\exp\left(\frac{Q}{T - T_{A0}}\right)\left(\frac{1\text{-}V_m}{V_m}\right)^{(B+1)/B} V_m{}^p \frac{1}{2}\left(1 - \tanh\left(C + D \cdot T\right)\right)\text{, if } \bar{\varepsilon}^p \geq E_{0(mart)} \end{cases},$$

where

- $\bar{\varepsilon}^p$ = effective plastic strain and
- T = temperature.

The martensite fraction is integrated from the above rate equation:

$$V_m = \int_0^{\bar{\varepsilon}} \frac{\partial V_m}{\partial \bar{\varepsilon}^p} d\bar{\varepsilon}^p.$$

It always holds that 0.0< V_m<1.0. The initial martensite content is V_{m0} and must be greater than zero and less than 1.0. Note that V_{m0} is not used during a restart or when initializing the V_m history variable using *INITIAL_STRESS_SHELL.

The yield stress σ_y is

$$\sigma_y = \left\{B_{HS}\text{-}(B_{HS}\text{-}A_{HS})\exp\left(-m\left[\bar{\varepsilon}^p + \varepsilon_0\right]^n\right)\right\}(K_1 + K_2 T) + \Delta H_{\gamma\to\alpha'} V_m,$$

The parameters p and B should fulfill the following condition

(1+B)/B<>

if not fulfilled then the martensite rate will approach infinity as $\bar{\varepsilon}^p$ approaches zero. Setting the parameter ε_0 larger than zero, typical range 0.001-0.02 is recommended.

Identifying Material Parameters

Material parameters can for austenitic stainless steels be determined using the following procedure. The methodology worked out by Hänsel et al. can be used [1]. It is comprised by tensile testing of standard tensile test specimens at a constant strain rate to a preset strain level and then unloading. The temperature and martensite content are recorded during the whole tensile test, including unloading. The martensite content is recorded with a ferritoscope mounted on the specimen and the temperature is measured using e.g. a thermocouple fixed to the tensile sample.

A number of tension tests must be performed with varying strain rate and starting temperature. Different histories of temperature, martensite volume fraction, and true stress as a function of plastic strain are obtained from these tests. The material parameters in the material model are identified through a least squares fit of the true stresses predicted by the material model to the true stresses measured in the tension tests.

Example Material Parameters

Material parameters from Schedin et al. [2] are given in the two tables below for austenitic stainless steel HyTensX, Outokumpu Stainless, with a very pronounced TRIP-effect. The parameters were obtained using the approach described above.

A	B	C	D [1/K]	p	Q [K]
0.32	0.226	-2.173	0.0084	6.25	1379.4
ε_0	A_{HS} [N/mm^2]	B_{HS} [N/mm^2]	m	n	$\Delta H_{\gamma\to\alpha'}$ [N/mm^2]
0.002	318.2	2170	2.94	1.39	414.7
K_1	R-value	K_2	V_{m0} [%]		$E_{0(mart)}$
1.0	1.10	0.0	0.01		0.0

Density	7800 kg/m^3
Young's modulus	210 GPa
Poisson's ratio	0.3
Heat capacitivity	460 J/(kg K)
Thermal conductivity	25 W/m^{2}K

References

[1] C. Hänsel, P. Hora, and J. Reissner, "Model for the kinetics of strain-induced martensitic phase transformation at isothermal conditions for the simulation of sheet metal forming processes with metastable austenitic steels," Simulation of Materials Processing: Theory, Methods, and Applications, Huétink and Baaijens (eds), Balkema, Rotterdam, (1998).
[2] E. Schedin, L. Prentzas, and D. Hilding, "Finite Element Simulation of the TRIP-effect in Austenitic Stainless Steel," presented at SAE 2004, SAE Technical paper 2004-01-0885, (2004).

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An Interface From Moldflow to LS-DYNA®

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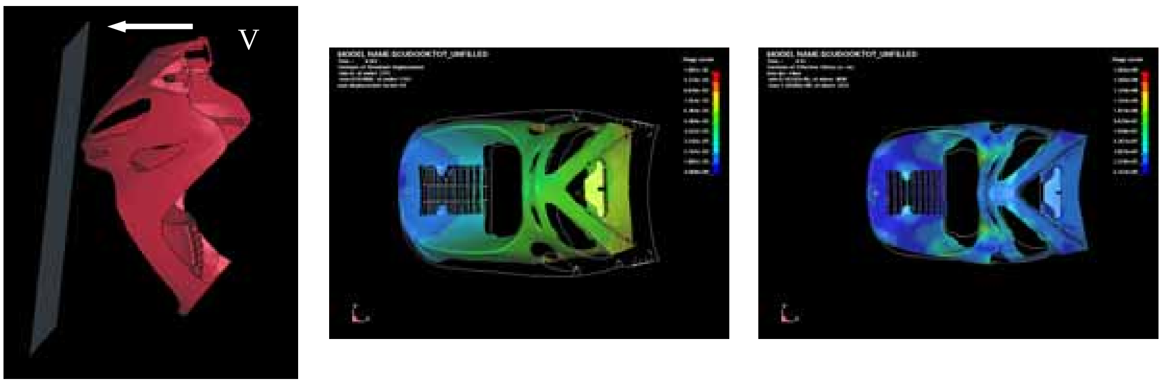
A friendly interface from MPI (Moldflow Plastics Insight) to LS-DYNA® has been developed to accurately account for the effects of injection molding process-induced residual stress and material property distribution in plastic parts. The interface from MPI makes application-specific data, including layer-based, short-fiber-filled composite material properties and flow-induced residual stresses, available as the input to LS-DYNA. LS-DYNA provides an accurate simulation for predicting the warped shape of the injection molded plastic part with an implicit analysis, then followed by the further analysis with the service loading.

Nowadays, many parts that traditionally have been made of metals are now being made of plastic materials enhanced with short fibers. These parts are injection molded so that complicated geometric features can be made easily. Moldflow software simulates the injection molding process with flow, fiber orientation and solidification analyses so that the structural behavior and performance can be accurately captured. Differential shrinkage, differential cooling and differential property distribution are the three causes of molded-in residual stresses. The two most important data sets passed from MPI to LS-DYNA are the residual stress (given by the initial stress card) and the anisotropic property distributions (given by the material card and the shell integration card).

LS-DYNA's comprehensive library of material models and large element library make it suitable to accurately simulate the effects of the injection molding process on the molded plastic parts. Users can export the detailed thermo-mechanical properties from Moldflow to LS-DYNA by choosing MAT_002, MAT_022, MAT_023 or MAT_116. The angles of the local material axes are specified from layer to layer in the *SECTION_SHELL, and the material constants can be changed from integration point to integration point through *INTEGRATION_SHELL. The plastic part typically undergoes post-molding deformation due to molded-in residual stresses. Thus the configuration of the part as manufactured may differ from the original CAD model geometry. To take the effects of post-molding deformation and residual stress into account during the structural analysis, a simulation with a static analysis followed by a dynamic analysis can be performed by LS-DYNA.

The interface from MPI to LS-DYNA ensures that structural analyses of injection molded plastic parts are conducted with the thermo-mechanical properties, fiber orientation and residual stress data based on grade-specific plastic material data and injection molding process conditions. An example, shown in Fig.1 (a), demonstrates the effectiveness of the interface from MPI to LS-DYNA in analyzing the structural properties of the front cover of helmet during impacting with a rigid wall. The post-molding deformation of the front cover of helmet is shown in Fig. 1(b) with an implicit analysis. Considering the post-molding deformation and the molded-in residual stress, the final distribution of von Mises stress in the front cover after impacting with the rigid wall is shown in Fig. 1 (c).

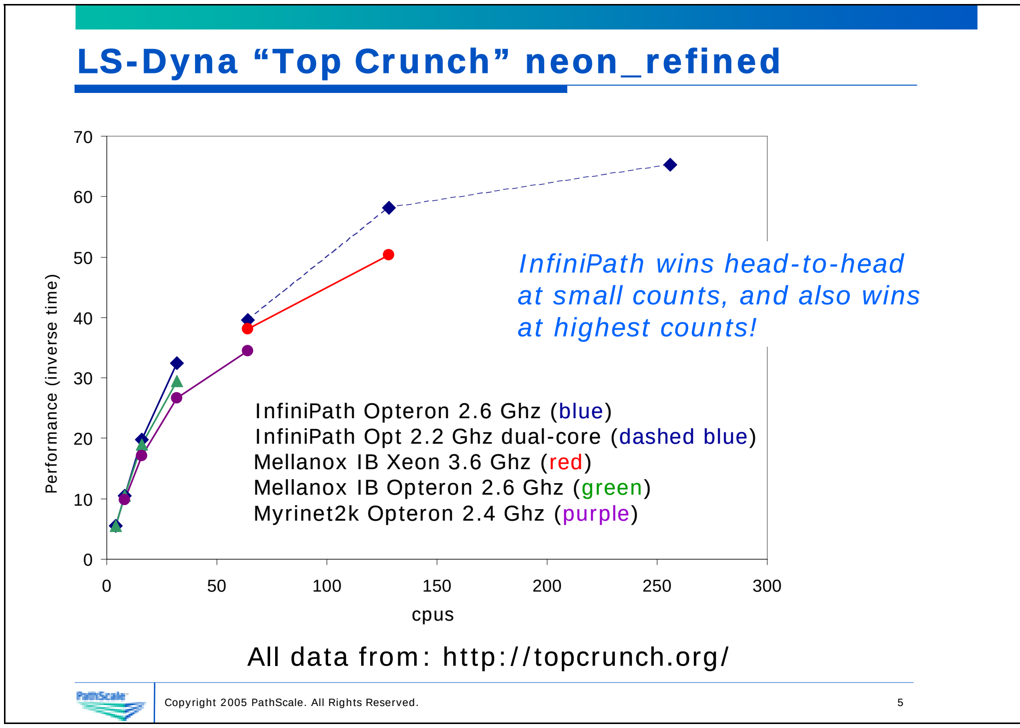


(a) (b) (c)

Figure 1. Simulation of the front cover of helmet in LS-DYNA using data exported from Moldflow Plastics Insight simulation.

(a) Problem description. (b)Deflection in warpage analysis. (c) von Mises stress under the service loading.

Pathscale develops software and hardware solutions that enable linux clusters to achieve new levels of performance and efficiency



LSTC's LS-DYNA® application, when run on a system using PathScale InfiniPath InfiniBand Adapters

The graphic shows results for the "neon refined" test case. All data graphed is available at the "topcrunch" website.

INTRODUCTION

In this information age, supercomputing technologies touch all of our daily lives. They accelerate breakthroughs in science and medicine, improve automobile and aerospace design and safety, and help predict weather patterns and natural disasters. With more and more scientists and engineers, in both the public and private sectors, relying on high performance computing (HPC) systems to perform simulations to validate data, test theories, and design new products, the need for increased computing speed and more efficient use of computing resources is critical. However, as users continue to develop more complex applications, today's HPC rarely reach their full potential as they often encounter bandwidth and latency constraints. The result? Simulations take longer to perform, slowing down the time-to-results for advanced research and time-to-market for emerging products.

Many customers in the HPC community are now migrating from large symmetrical multiprocessing systems (SMPs) and modern supercomputers to more cost-effective Linux® clusters. This trend is being driven by a growing demand from end-users for practically unlimited scalability from their HPC systems, as well as a need to reduce the cost of system purchases and operational expenses. Today, the price of most large-scale SMPs poses a major challenge to budget-conscious organizations—such as academic institutions and government agencies—that are looking to deploy large simulation or modeling applications. By contrast, Linux clusters, which are comprised of commodity servers tied together into one system, can provide a more efficient means to tackle large applications for a fraction of the cost of modern supercomputers. Of course, scaling clusters to performance levels equivalent to modern supercomputers is not guaranteed. It requires the right mix of processors, development tools, and high-speed interconnect technologies. Enter PathScale, a developer of innovative software and hardware solutions to accelerate HPC and enable breakthroughs in science and engineering.

THE PATHSCALE SOLUTIONS

PathScale InfiniPath InfiniBand Adapter

The PathScale InfiniPath InfiniBand Adapter helps deliver on the promise of InfiniBand and Linux cluster computing by significantly lowering communications latency, increasing effective bandwidth and eliminating the bottlenecks that slow down complex applications. InfiniPath leverages the InfiniBand architecture to maximize application scaling and performance on InfiniBand-interconnected Linux clusters and storage systems. In fact, only InfiniPath can scale applications deployed on commodity servers to supercomputer performance levels, enabling end-users to rely less on high-priced, proprietary supercomputing suppliers.
Today, users can now leverage AMD Opteron and Intel Xeon-based Linux clusters and the InfiniPath interconnect to build cost-effective systems for their most demanding applications. The InfiniPath technology is enabling scientists, engineers, and researchers to more cost-effectively solve a whole new class of computational challenges with Linux clusters.

InfiniBand is quickly becoming the networking architecture of choice for organizations that are looking to deploy large clusters of commodity servers. The PathScale InfiniPath Adapter uses standard InfiniBand switching to improve the communication between processors, enabling them to operate more effectively. InfiniPath yields the lowest MPI and TCP latency and the highest effective bandwidth of any cluster interconnect available today. InfiniPath eliminates work, reduces CPU utilization, and provides the industry's highest message transmission rate. When compared to traditional large-scale SMPs, clusters powered by InfiniPath offer superior scalability at a significant cost savings. Users benefit from a lower total cost-of-ownership, reduced time-to-application deployment and faster time-to-results. In essence, PathScale is redefining how HPC is done. For the first time, end-users can deploy and run large applications that were originally designed for supercomputers on affordable, 64-bit clusters.

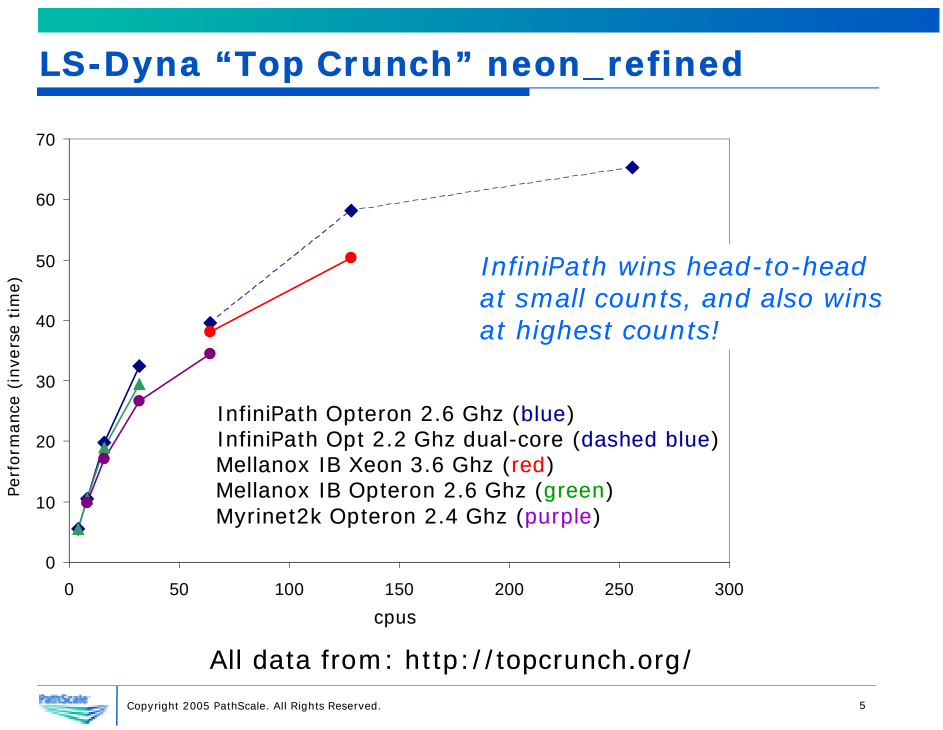
Since shipping in July 2005, the InfiniPath Adapter has shattered performance records on the HPC Challenge, Pallas and TopCrunch benchmarks, outperforming all other cluster interconnects and much larger supercomputers. In fact, InfiniPath enabled AMD's Dual Core Opteron™ Emerald Cluster to scale up to 576 CPUs, achieving 2.1 TFLOPs on the Linpack benchmark. Located at the AMD Developer Center in Sunnyvale, Calif., the Emerald Cluster is one of the world's largest Dual Core Opteron InfiniBand clusters, and is one of the 350 largest supercomputers in the world.

Real Application Performance with PathScale InfiniPath InfiniBand Adapters

Below is an example of the performance gains that can be achieved using InfiniPath. The graphic illustrates the performance of the leading crash simulation solution on the market today, LSTC's LS-DYNA application, when run on a system using PathScale InfiniPath InfiniBand Adapters.

The website http://topcrunch.org/ contains benchmark results for several problems. The graphic shows results for the "neon refined" test case. All data graphed is available at the "topcrunch" website.

As you can see, the graph shows the InfiniPath-equipped cluster winning at both small and large sizes, versus both Myrinet and Mellanox-based Opteron & Xeon clusters. Due to these outstanding results, LSTC has recently announced support of the InfiniPath Infiniband interconnect.



PathScale EKOPath Compiler Suite

The award-winning PathScale EKOPath Compiler Suite offers the industry's highest-performance C, C++, and Fortran 9X compilers for 64-bit Linux-based computer systems. It has been optimized for both the AMD64 and EM64T architectures and has the world's most sophisticated optimization infrastructure. Unlike other compiler products that deliver functionality to a single type of application, the PathScale EKOPath Compiler Suite provides superior performance across both floating-point and integer-intensive applications. Application developers targeting 64-bit servers will see immediate performance benefits when compiling with EKOPath.

Today, EKOPath is the performance compiler of choice for industry leaders such as AMD, HP, IBM, Linux Networx, Fujitsu-Siemens, and Sun. It is the winner of HPCWire's 2005 Reader's Choice and Editor's Choice as the software product offering the best price performance, and also was selected by Supercomputing Online as its Product of the Year. More than 1,000 sites around the world have deployed EKOPath compilers.

COMPANY BACKGROUND

PathScale was founded in 2001 by a group of technology pioneers with backgrounds in computer architecture, high-performance compiler development and high-speed networking. The company's roots were formed more than 20 years ago at the Lawrence Livermore National Laboratory in Northern California, where four of the PathScale founders collaborated to build the S1 supercomputer in the early '80s. Today, the PathScale team develops innovative technologies that are designed to maximize the performance of computer systems, enabling breakthroughs in science, engineering and business. The company's two primary product lines, the PathScale InfiniPath™ InfiniBand Adapter and EKOPath™ Compiler Suite, are designed to improve performance and application scaling in Linux clusters. The result is a cluster computing system that scales higher and runs faster, for a fraction of the cost of large-scale SMPs and supercomputers. This enables leading scientific and engineering organizations to run complex simulations faster and more efficiently.

PathScale customers and partners include many of the most prestigious corporations, research facilities, academic institutions and government agencies in the world. The company's investors include Adams Street Partners, Charles River Ventures, Enterprise Partners Venture Capital, CMEA Ventures, Growth Fund Private Equity, Chevron Texaco Technology Ventures and the Dow Employees Pension Plan.

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2006

Vendor/Submitter Org.	Computer/Interconnect	Processor	#Nodes x #Processors per Node x #Cores Per Processor = Total #CPU	Time (Sec)	Benchmark Problem	Submission Date
Appro/Level 5 Networks	1122Hi-81/Level 5 Networks - 1 Gb Ethernet NIC	Opteron 275	16 x 2 x 2 = **64**	492	neon_refined	01/18/2006
Appro/Level 5 Networks	1122Hi-81/Level 5 Networks - 1 Gb Ethernet NIC	Opteron 275	16 x 2 x 2 = **64**	5356	3 Vehicle Collision	01/26/2006

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ANSYS NonLinear Functions Applied in Automotive Brake Pedal Design and Manufacture

Jessika Song, GHSP – Shanghai, China;

Randy Phinney – GHSP – Grand Haven, Michigan US

Abstract

A finite element model for a unique automotive pedal beam production process was developed. Tooling and pedal beam design is improved through the simulation.

Introduction

Conventional high volume pedal beams are manufactured using a progressive stamping operation. The nature of progressive stamping results in a relatively high material scrap rate for many pedal beam designs. The unique manufacturing process modeled here trims and bends a narrow strip of steel into a pedal beam thereby greatly reducing the material scrap rate.

The design of the bend tooling and bend geometry are our concerns. There are both geometric and strength requirements for the pedal beam. In addition, strength requirements of the bend tooling must be considered.
CAE tools find wide application in mechanical and electrical mechanism design. We simulate the whole bending process after stamping using ANSYS. The simulation is nonlinear, includes material nonlinearities, large deformation and contact. Figure 1 shows the bender bend heads and sweeps.

LSTC Training Classes - 2006

LSTC Training Classes:

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Training Coordinator
LSTC California & Michigan
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Tel: ***925-449-2500***

Training Class	US $	Livermore, CA	Detroit, M
Introduction to LS-DYNA®	$750	· Feb. 07-10 · May 02-05 · Aug. 01-04 · Nov. 14-17	· Jan. 16-19 · April 25-28 · July 25-28 · Dec. 11-14
Advanced LS-DYNA in Impact Analysis	$950	· June 27-30 · Sept 26-29	Not Scheduled at this time
Advanced Option in LS-DYNA	$750		· Feb 21 - 22
Material Modeling Using LS-DYNA User Defined Options	$750	· June 13-14	· Not Scheduled at this time
LS-DYNA Implicit	$750	· June 15-16	· Sept. 07-08
Introduction to LS-OPT	$750	· May 16-19 · Nov. 07-10	· Not Scheduled at this time
ALE/Eulerian & Fluid/Structure Interaction in LS-DYNA	$750	· Feb. 15-17	· Not Scheduled at this time

Concrete and Geomaterial Modeling with LS-DYNA	$750	· Oct 24-25	· Not Scheduled at this time
MESH Free Methods in LS-DYNA (SPH-EFG)	$750	· Feb. 01-03	· Not Scheduled at this time
LS-DYNA Composite Materials	$750	· March 30-31 · Sept. 14-15	· Not Scheduled at this time
LS-DYNA for Heat Transfer & Thermal-Stress Problems	$500	· Not Scheduled at this time	·· Not Scheduled at this time
Contact in LS-DYNA	$750	· March 28-29 · Sept. 12-13	· June 22-23

LOCATIONS:

California Location

LSTC California
7374 Las Positas Road
Livermore, CA 94551

Michigan Location

LSTC Michigan
1740 W. Big Beaver Rd
Suite 100
Troy , MI 48084

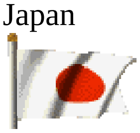
Participant Distribution & Consulting Channels

Sales – Support –Training – Benchmark – Consulting.
Listed are only a few of their many services

Australia 	**Leading Engineering Analysis Providers** (LEAP) info@leapaust.com.au	*ANSYS *ANSYS/LS-DYNA *LS-DYNA

Germany 	**CAD-FEM GmbH** lsdyna@cadfem.de	*LS-DYNA *LS-POST *LS-OPT *ANSYS

Italy 	**Altair Italy** sales@altairtorino.it	*LS-DYNA *HYPERWORKS *HYPERMESH *HYPERFORM *HYPERGRAPH *HYPERVIEW *MOTIONVIEW *OPTISTRUCT

Japan 	**Fujitsu Limited** dyna@strad.se.fujitsu.co.jp	*LS-DYNA *FEMB *DYNAFORM *VPG

EVENTS – 2006

If you want your event listed please send the information to:
mv@feainformation.com

2006	
April 24-26	**MSC.Software 2006 Americas VPD Conference,** Detroit, MI - US
May 02-04	**2006 International ANSYS Conference** Pittsburgh, PA - US
June 04-06	**9th International LS-DYNA Users Conference** Dearborn, MI - US -**Registration and Hotel available on line**
July 02-06	**ICSV13 Vienna** Vienna, Austria
July 5-7	**HEAT TRANSFER 2006** Ninth International Conference on Advanced Computational Methods and Experimental Measurements in Heat and Mass Transfer The New Forest, UK
Sept 19-20	**JAPAN LS-DYNA Users Conference 2006** Tokyo, Japan Hosted by JRI
Oct 12-13	**LS-DYNA Users Meeting in Ulm.** Hosted by DYNAmore
Oct 25-27	**2006 CADFEM Users Meeting** International Congress on FEM Technology Stuttgart area - Germany
Nov 14- 16	**Aerospace Design Expo 06** Anaheim, CA - US

LS-DYNA Resource Page

Interface - Hardware - OS And General Information

Participant Hardware / OS that run LS-DYNA (alphabetical order).

LS-DYNA has been fully QA'd by Livermore Software Technology Corporation for All Hardware and OS listed below.

TABLE 1: SMP
TABLE 2: MPP Interconnect and MPI

TABLE 1: SMP - Fully QA'd by LSTC	
AMD Opteron	Linux
CRAY XD1	Linux
FUJITSU Prime Power	SUN OS 5.8
FUJITSU VPP	Unix_System_V
HP PA-8x00	HP-UX 11.11 and above
HP IA-64	HP-UX 11.22 and above
HP Opteron	Linux CP4000/XC
HP Alpha	True 64
IBM Power 4/5	AIX 5.1, 5.2, 5.3
IBM Power 5	SUSE 9.0
INTEL IA32	Linux, Windows
INTEL IA64	Linux
INTEL Xeon EMT64	Linux
NEC SX6	Super-UX
SGI Mips	IRIX 6.5 X
SGI IA64	SUSE 9 with ProPack 4 Red Hat 3 with ProPack 3

LS-DYNA Resource Page

MPP Interconnect and MPI

FEA Information Inc. Participant's (alphabetical order)

Fully QA'd by Livermore Software Technology Corporation

Vendor	O/S	HPC Interconnect	MPI Software
AMD Opteron	Linux	InfiniBand (SilverStorm), MyriCom	LAM/MPI, MPICH, HP MPI, SCALI
CRAY XD1	Linux		
FUJITSU Prime Power	SUN OS 5.8		
FUJITSU VPP	Unix_System_V		
HP PA8000	HPUX		
HPIA64	HPUX		
HP Alpha	True 64		
IBM Power 4/5	AIX 5.1, 5.2, 5.3		
IBM Power 5	SUSE 9.0		LAM/MPI
INTEL IA32	Linux, Windows	InfiniBand (Voltaire), MyriCom	LAM/MPI, MPICH, HP MPI, SCALI
INTEL IA64	Linux		LAM/MPI, MPICH, HP MPI
INTEL Xeon EMT64	Linux	InfiniBand (Topspin, Voltaire), MyriCom	LAM/MPI, MPICH, HP MPI, INTEL MPI, SCALI
NEC SX6	Super-UX		
SGI Mips	IRIX6.5		
SGI IA64	Altix/Prism		

LS-DYNA Resource Page

Participant Software Interfacing or Embedding LS-DYNA

Each software program can interface to all, or a very specific and limited segment of the other software program. The following list are software programs interfacing to or having the LS-DYNA solver embedded within their product. For complete information on the software products visit the corporate website.

ANSYS - ANSYS/LS-DYNA
www.ansys.com/products/environment.asp

ANSYS/LS-DYNA - Built upon the successful ANSYS interface, ANSYS/LS-DYNA is an integrated pre and postprocessor for the worlds most respected explicit dynamics solver, LS-DYNA. The combination makes it possible to solve combined explicit/implicit simulations in a very efficient manner, as well as perform extensive coupled simulations in Robust Design by using mature structural, thermal, electromagnetic and CFD technologies.

AI*Environment: A high end pre and post processor for LS-DYNA, AI*Environment is a powerful tool for advanced modeling of complex structures found in automotive, aerospace, electronic and medical fields. Solid, Shell, Beam, Fluid and Electromagnetic meshing and mesh editing tools are included under a single interface, making AI*Environement highly capable, yet easy to use for advanced modeling needs.

ETA – DYNAFORM
www.eta.com

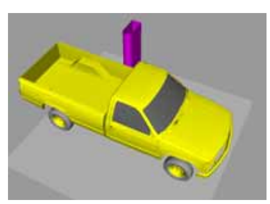
Includes a complete CAD interface capable of importing, modeling and analyzing, any die design. Available for PC, LINUX and UNIX, DYNAFORM couples affordable software with today's high-end, low-cost hardware for a complete and affordable metal forming solution.

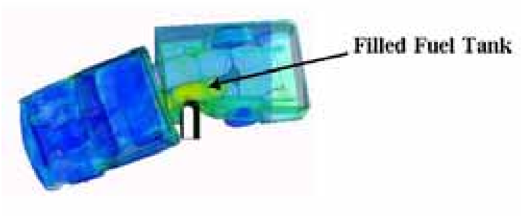
ETA – VPG
www.eta.com

Streamlined CAE software package provides an event-based simulation solution of nonlinear, dynamic problems. eta/VPG's single software package overcomes the limitations of existing CAE analysis methods. It is designed to analyze the behavior of mechanical and structural systems as simple as linkages, and as complex as full vehicles

MSC.Software “MSC.Dytran LS-DYNA”
www.msc.software.com

Tightly-integrated solution that combines MSC.Dytran's advanced fluid-structure interaction capabilities with LS-DYNA's high-performance structural DMP within a common simulation environment. Innovative explicit nonlinear technology enables extreme, short-duration dynamic events to be simulated for a variety of industrial and commercial applications on UNIX, Linux, and Windows platforms. Joint solution can also be used in conjunction with a full suite of Virtual Product Development tools via a flexible, cost-effective MSC.MasterKey License System.





Side Impact With Fuel Oil Inside

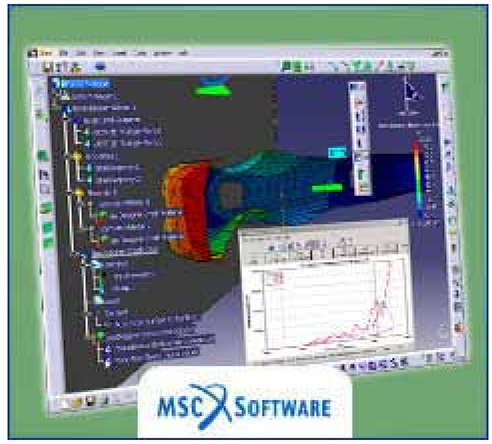
MSC.Software - MSC.Nastran / SOL 700

The MSC.Nastran™ Explicit Nonlinear product module (SOL 700) provides MSC.Nastran users the ability access the explicit nonlinear structural simulation capabilities of the MSC.Dytran LS-DYNA solver using the MSC.Nastran Bulk Data input format. This product module offers unprecedented capabilities to analyze a variety of problems involving short duration, highly dynamic events with severe geometric and material nonlinearities.

MSC.Nastran Explicit Nonlinear will allow users to work within one common modeling environment using the same Bulk Data interface. NVH, linear, and nonlinear models can be used for explicit applications such as crash, crush, and drop test simulations. This reduces the time required to build additional models for another analysis programs, lowers risk due to information transfer or translation issues, and eliminates the need for additional software training.

MSC.Software – Gateway for LS-DYNA

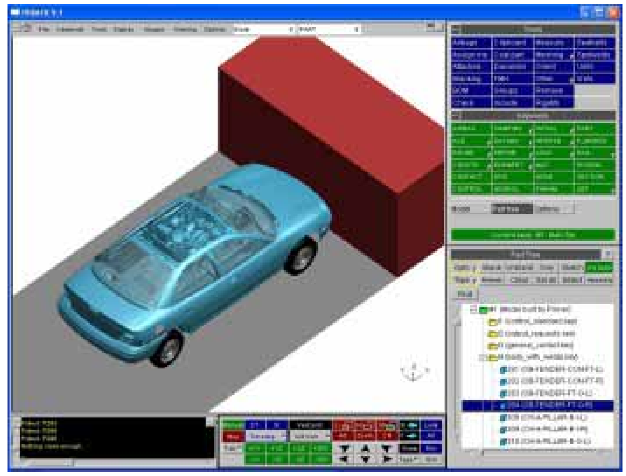
Gateway for LS-DYNA provides you with the ability to access basic LS-DYNA simulation capabilities in a fully integrated and generative way. Accessed via a specific Crash workbench on the GPS workspace, the application enhances CATIA V5 to allow finite element analysis models to be output to LS-DYNA and then results to be displayed back in CATIA. Gateway for LS-DYNA supports explicit nonlinear analysis such as crash, drop test, and rigid wall analysis.



Gateway products provide CATIA V5 users with the ability to directly interface with their existing corporate simulation resources, and exchange and archive associated simulation data.

Oasys software for LS-DYNA
www.arup.com/dyna

Oasys software is custom-written for 100% compatibility with LS-DYNA. Oasys PRIMER offers model creation, editing and error removal, together with many specialist functions for rapid generation of error-free models. Oasys also offer post-processing software for in-depth analysis of results and automatic report generation.



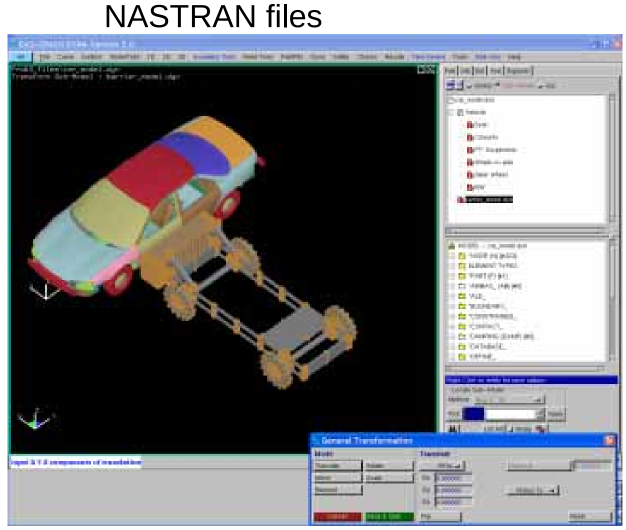
EASi-CRASH DYNA
http://www.esi-group.com/SimulationSoftware/EASi_CRASH-DYNA/

EASi-CRASH DYNA is the first fully integrated environment for crashworthiness and occupant safety simulations with LS-DYNA, and covers the complete CAE-process from model building and dataset preparation to result evaluation and design comparisons.

EASi-CRASH DYNA can be used for concept crash, FE crash and coupled rigid body/FE crash simulations in conjunction with MADYMO.

EASi-CRASH DYNA's main features include:

- Support of all keywords of LS-DYNA 970/971
- Powerful mesh editing features, such as automesh and remesh
- LS-DYNA/MADYMO coupling capabilities for pre- and post processing (support of MADYMO format till version 6.2.2)
- Model Assembler for organizing the model through sub assembly/sub models and included files
- Enhanced Weld tools for manipulation of connections and Weld comparison
- Simple dummy positing and seat belt routing
- Pre and Post processing in same environment
- Superpose and merge multiple models
- Animation and plotting
- Process compatible
- Full capability to handle IGES, CATIA V4, CATIA V5, UG and NASTRAN files



Hardware & Computing and Communication Products

www.amd.com

www.fujitsu.com

www.hp.com

www-1.ibm.com/servers/deepcomputing

www.intel.com

www.nec.com

www.sgi.com

Software Distributors

Alphabetical order by Country

Australia	**Leading Engineering Analysis Providers** www.leapaust.com.au
Canada	**Metal Forming Analysis Corporation** www.mfac.com
China	**ANSYS China** www.ansys.cn
China	**MSC. Software – China** www.mscsoftware.com.cn
Germany	**CAD-FEM** www.cadfem.de
Germany	**Dyna*More*** www.dynamore.de
India	**GissETA** www.gisseta.com
India	**Altair Engineering India** www.altair-india.com
Italy	**Altair Engineering Italy** www.altairtorino.it
Italy	**Numerica SRL** www.numerica-srl.it
Japan	**Fujitsu Limited** www.fujitsu.com
Japan	**The Japan Research Institute** www.jri.co.jp
Japan	**CRC Solutions Corp.** www.engineering-eye.com
Korea	**Korean Simulation Technologies** www.kostech.co.kr
Korea	**Theme Engineering** www.lsdyna.co.kr

Software Distributors (cont.)

Alphabetical order by Country

Netherlands	**Infinite Simulation Systems B.V** www.infinite.nl
Russia	**Strela, LLC** www.ls-dynarussia.com
Sweden	**Engineering Research AB** www.erab.se
Taiwan	**Flotrend** www.flotrend.com.tw
USA	**Engineering Technology Associates** www.eta.com
USA	**Dynamax** www.dynamax-inc.com
USA	**Livermore Software Technology Corp.** www.lstc.com
USA	**ANSYS Inc.** www.ansys.com
UK	**Oasys, LTD** www.arup.com/dyna/

Consulting and Engineering Services

Alphabetical Order By Country

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Canada Kingston, Ontario www.mfac.com	**Metal Forming Analysis Corporation** Chris Galbraith galb@mfac.com (613) 547-5395
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Italy Firenze www.numerica-srl.it	**Numerica SRL** info@numerica-srl.it 39 055 432010
UK Solihull, West Midlands www.arup.com	**ARUP** Brian Walker brian.walker@arup.com 44 (0) 121 213 3317
USA Austin, TX	**KBEC L.C** Khanh Bui kdbui@sbcglobal.net (512) 363-2739
USA Windsor, CA www.schwer.net/SECS	**SE&CS** Len Schwer len@schwer.net (707) 837-0559
USA Corvallis, OR www.predictiveengineering.com	**Predictive Engineering** George Laird (1-800) 345-4671 george.laird@predictiveengineering.com
USA Neenah, WI www.structuretechnology.com	**Structure Incorporated** Todd L. Peters (920) 722 7060 info@structuretechnology.com

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Italy	Professor Gennaro Mona-celli	Prode – Elasis & Univ. of Napoli, Frederico II
Russia	Dr. Alexey I. Borovkov	St. Petersburg State Tech. University
USA	Dr. Ted Belytschko	Northwestern University
USA	Dr. David Benson	University of California – San Diego
USA	Dr. Bhavin V. Mehta	Ohio University
USA	Dr. Taylan Altan	The Ohio State U – ERC/NSM
USA	Dr. Ala Tabiei	University of Cincinnati
USA	Tony Taylor	Irvin Aerospace Inc.

FEA Information China Participants

Software, Hardware, Training, Consulting, Services

Altair Engineering Software (Shanghai) Co., Ltd.	Herbert Qi Tel: +86 (0)21 5393 0011 Website: www.altair.com.cn Contact: support@altair.com.cn Contact: sales@altair.com.cn)
Ansys-China, Inc.	Tel: 86-10-84085558 Website: www.ansys.com.cn Contact: China@ansys.com.cn
Oasys Software for LS-DYNA	Kimbal Virdi Tel: +86 21 5396 6633 Contact: Kimbal.virdi@arup.com Website: www.arup.com/dyna
Beijing Yuntong Forever CPC. Co. Ltd.	Tel: +86-10-82561200/01/03 Website: http://cpc.ytforever.com Sole Distributor of LINUX NETWORX, INC. (USA) in China Contact: service@ytforever.com
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Hewlett-Packard Asia Pacific Ltd.	Jerry Huang Tel: +86-10-65645261 Contact: J.Huang@hp.com
IBM China	Ms. Ling WANG - Tel: +86-10-6539-1188 x4463 (T/L:901-4463) Website: http://www.ibm.com/cn/ Contact: wangling@cn.ibm.com
MSC. Software Corp.	Tel: +86-10-6849-2777 Website: www.mscsoftware.com.cn Contact: mscprc.contact@mscsoftware.com

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Software, Hardware, Training, Consulting, Services

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Zhongfang Information Technology Ltd	Larry Liang Tel: +86-21-54973162 Website: http://www.cntech.com.cn Contact: info@cntech.com.cn
Zhong Guo ESI Co., Ltd	Yang Xiaojum Phone: +86 (020) 8235 6272 Contact : Yang Xiaojun

Informational Websites

The LSTC LS-DYNA Support site: www.dynasupport.com

LSTC LS-DYNA Support Site	www.dynasupport.com
FEA Informationwebsites	www.feainformation.com
TopCrunch – Benchmarks	www.topcrunch.org
LS-DYNA Examples (more than 100 Examples)	www.dynaexamples.com
LS-DYNA Conference Site	www.ls-dynaconferences.com
LS-DYNA Publications to Download On Line	www.dynalook.com
LS-DYNA Publications	www.feapublications.com
LS-DYNA CADFEM Portal	www.lsdyna-portal.com.

January Highlights from FEA Information Inc.

Website: www.feainformation.com

LS-DYNA and SGI Altix System Bundle

Available in North America Only
SGI® Altix® systems available with 12, 16, 32 and 64 CPUs
Bundled Price starting at $57,400

Structure Incorporated located in Neenah, WI, Structure is a company targeted expressly towards Advanced Analysis, Engineering, and Design. They support the aerospace and industries with expert consulting and contract engineering in the fields of fluid-dynamics, structures, and advanced propulsion. Structure meets the definition of a small business as required for Federal Contracting purposes and particularly specializes in the expert application of NASTRAN and LS-DYNA

ANSYS

2006 International ANSYS Conference to be held from May 2-4, at a new venue this year—the David L. Lawrence Convention Center— with training April 30 – May 1, at the Westin Convention Center in Pittsburgh, Pennsylvania, USA.

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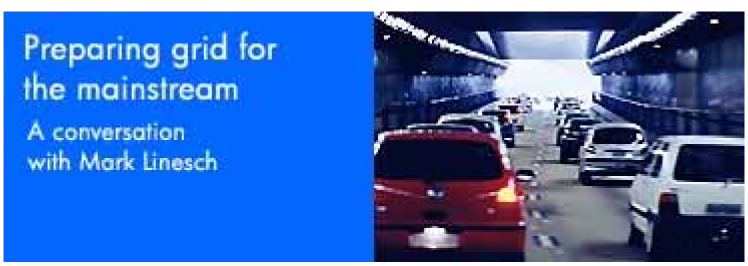

Standards For Grid Computing

www.hp.com/go/cae