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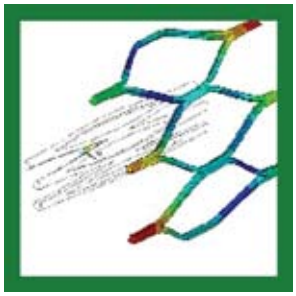
COVER STORY

ANSYS

Challenges in Biomedical

Engineering Analysis



PRODUCT SPOTLIGHT

SGI® Altix® 4000 Platform

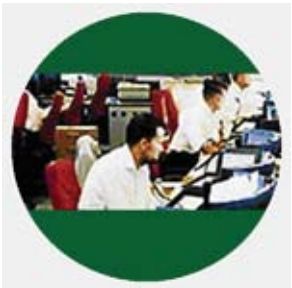
Performance and Flexibility

SERVICES SPOTLIGHT

HP

Flexible Computing Services Deliver IT

Capacity As You Need It



FEA Information Worldwide Participants

Contents

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FEA Information Announcements

Welcome Pathscale. www.pathscale.com

Pathscale develops software and hardware solutions that enable Linux Clusters to achieve new levels of performance and efficiency.

February issue will have information on why users are moving to Linux Clusters

Welcome China Participant:

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Special Notice – We missed posting in December's Issue

CEI Visualization Conference - February 22-23
Disney Coronado Springs Resort
Orlando, Florida USA
Contact: Kristine, CEI
919-363-0883

New Monthly Section through June:

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

Sincerely,
Trent Eggleston & Marsha Victory

Find and remove crossed edges and initial penetrations

Courtesy of LS-DYNA Support Site www.lsdynasupport.com

How to find and remove crossed edges and initial penetrations in a LS-DYNA keyword model using LS-PREPOST 2.0 after 2005-11-05.

What is a penetration?

Crossed edges

The case where an edge of an element crosses another shell element mid surface, or face on a solid element, is not a penetration in a classical sense in LS-DYNA. But these mesh errors might lead to severe problems when running an analysis in LS-DYNA so it is very important that such modeling is avoided. Figure 1 shows a case where two shell element crosses each other. The contact thickness of the elements including the virtual contact cylinders on the edges of the shell is displayed. Crossed edges are shown in red color. This is *not* considered as a *penetration*.

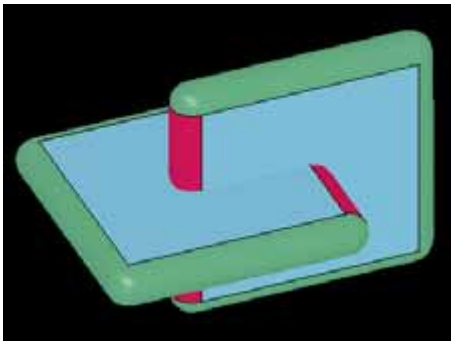


Figure 1. Crossed edges

Node-edge penetration

All *CONTACT_AUTOMATIC contacts in LS-DYNA includes a virtual contact cylinder around each edge. A node can penetrate such virtual contact cylinder. This is considered as a *penetration.*

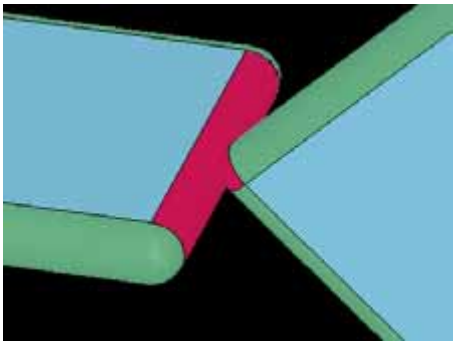


Figure 2: Node penetrating an shell edge

Edge-edge penetration

Some contact definitions in LS-DYNA, such as *CONTACT_GENERAL includes edge to edge contact. For these kind of contacts, the following images shows edge to edge *penetrations*.

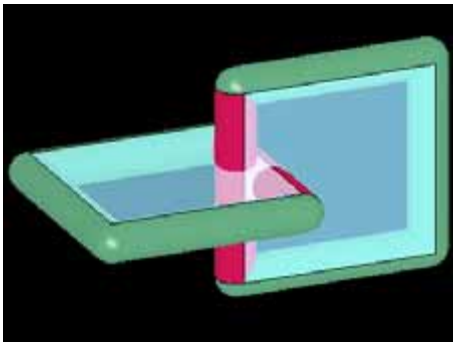


Figure 3: Shell edge to edge penetration (and crossed edge situation)

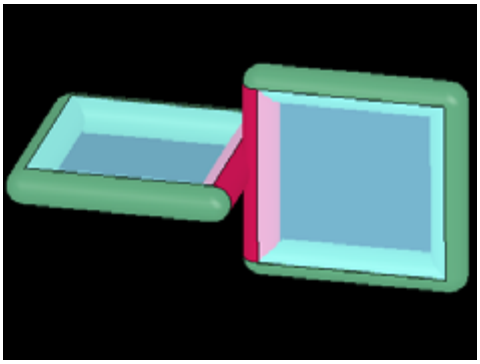


Figure 4: Shell edge to edge penetration (but no crossed edges)

Node-surface penetration

If a node is within contact distance to a shell there is a *penetration*.

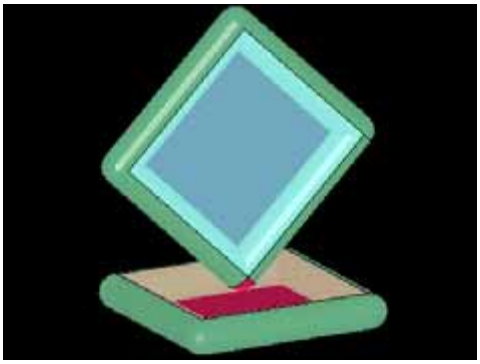


Figure 5: A node is penetrating a shell element

A node inside a solid element is also a *penetration*.

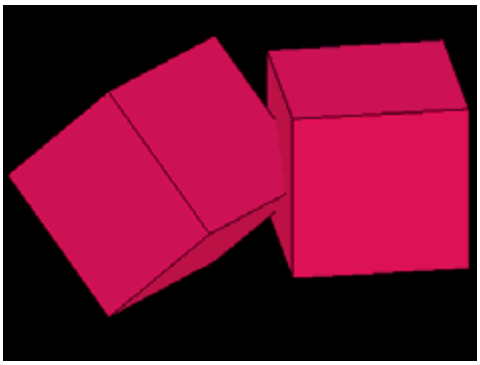


Figure 6: A node penetrating a solid element

Finding crossed edges in LS-PREPOST 2.0

The function to find and remove initial penetrations exist in panel 5, IniPene. The hood on the C2500 NCAC model will be used for demonstrating IniPene functions.

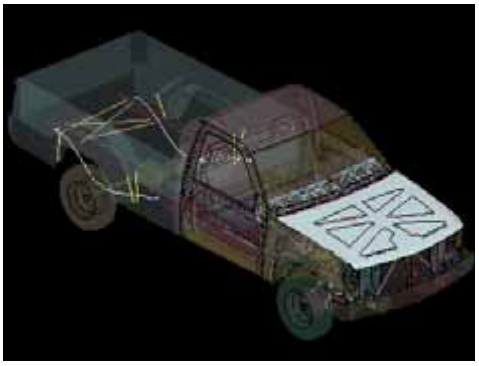


Figure 7: The hood of NCAC C2500 model

Check for crossed edges

The first thing to do is to ensure that no crossed edges exists. This is what is set as default action in the IniPene interface when entering the panel. Select the parts you wish to check for crossed edges and click "Check" at the bottom of the interface.

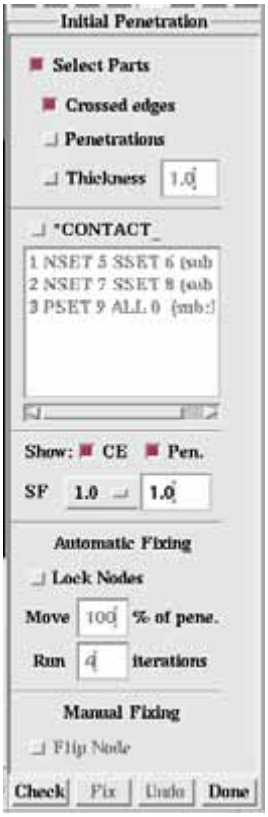


Figure 8: The IniPene interface

Even self intersecting parts will be detected in LS-PREPOST. 21 crossed edges are found on the two parts on the hood. The edges that cross other elements are highlighted, see image below. The highlighted crossed edge can be visually turned off by untoggle "Show: CE" (CE = crossed edges).

Figure 9: Crossed edges on C2500 hood

Remove crossed edges

To remove the crossed edges, toggle the "Flip Node" and pick the nodes that are on the wrong side, here nodes 84462 and node 84464 are shown to be on the wrong side.

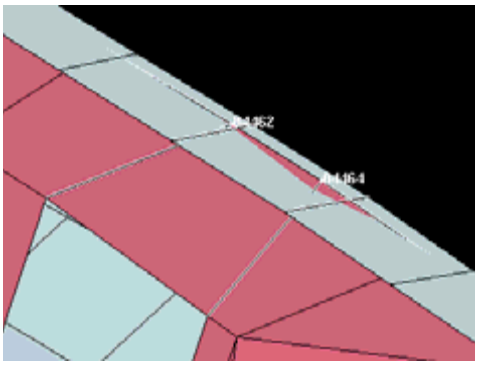


Figure 10: Crossed edges on the front of the hood

When a node is picked in the "Flip Node" mode, it is moved to the other side of the closest *visible* element. It is moved in the direction of the closest point on the closest visible element and moved (t1+t2)/2. past the mid surface.

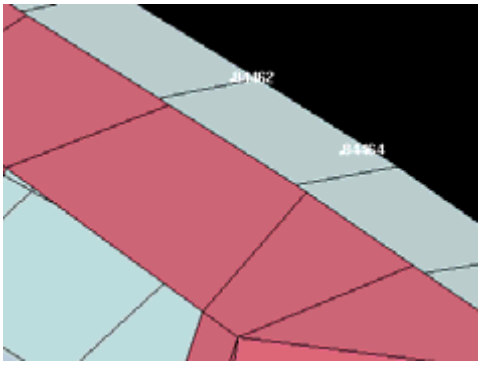


Figure 11: The two nodes at the front have been flipped to the opposite side.

Select all nodes that should be flipped to the opposite side and redo the crossed edge by Selecting Parts and click "Check", to ensure that all crossed edges are removed. The hood is now free from crossed edges.

Penetration check

In LS-PREPOST you can choose to check penetrations on selected parts by toggle the "Select Parts" **OR** you can check existing contact definitions in the keyword file by toggle the "*CONTACT_" and select the contact you wish to check from the list of contacts. Penetrations are checked for shell, beam and solid elements.

Penetration check by "Select Parts"

This option is useful if you not yet have created any contact definitions. Contact thickness for this check is taken from section card data unless the "Thickness" toggle is activated. If "Thickness" is toggled, all shell and beam elements will get the user-specified contact thickness, solid elements have zero thickness. The check that is performed follows the same rules as *CONTACT_GENERAL would do, i.e. it will check for node-to-surface, free_edge-to-free_edge and node to edge penetrations for all parts to all parts (including self contact).

Penetration chek by CONTACT

By selecting a contact from the list of defined contact in the model, the elements included in the contact are displayed and the check is performed by taking care of all parameters that affects the contact thickness (SST, MST, SFST, SFMT, SHLTHK, SLDTHK, SSTHK, OPTT, SFT, TH, TH_SF) and which nodes/elements is to be checked against penetration to which elements.

Penetration check on the hood of C2500 model

Selecting the two parts on the hood and activating the "Penetration" toggle displays penetrating nodes with white squares and arrows proportional to the penetrating distance. 25 node to surface and 12 edge to edge penetrations are reported together with the maximum penetration distance. Nodes on edge to edge penetrations are reported in the same way as a node to surface penetrations. The displayed penetrations can be visually turned off by untoggle "Show: Pen." (Pen. = Penetrations)

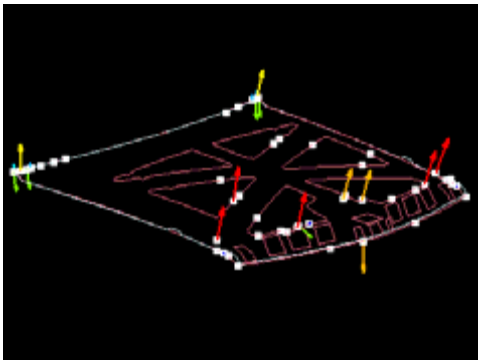


Figure 12: Penetrations on C2500 hood

Removing initial penetrations in LS-PREPOST

Penetrations can automatically be removed by moving the penetrating nodes in the direction *away* from the penetration. In LS-PREPOST you can move the penetrating nodes a percentage of the *per node* penetrating distance. The default is to move 100% of the penetration distance. This will move a node, such as the one shown in Figure 5, exactly out of penetration. No more no less.

But if two shell elements are parallel and penetrating, as shown in Figure 13, and nodes all penetrating nodes are moved 100% of the penetrating distance there will be a gap between the two elements. In this case, moving 50% of the penetra-

tion distance moves the nodes just out of penetration. To be sure that no gap remains after removing penetrations, use "Move **50**% of pene." and let LS-PREPOST iterate until all penetrations are removed.

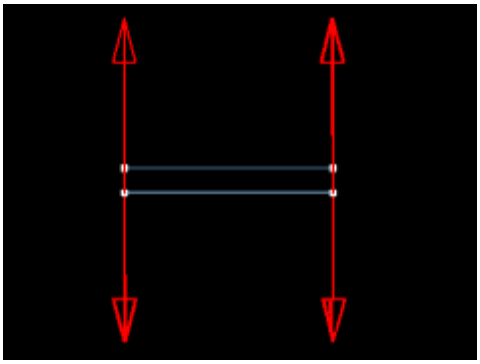


Figure 13: Two parallel shells penetrating each other

Any nodes can be prohibited to move during automatic fixing of penetrations in LS-PREPOST. This is done by toggle the "Lock Nodes" and select the nodes that you don't allow LS-PREPOST to move. These nodes will not be moved by LS-PREPOST. For the hood example, all nodes on the outer part is locked by toggle "Lock Nodes" and select the nodes By Part, pick the part, then click "Fix" and LS-PREPOST will move all penetrating nodes that are not locked out of penetration. The hood is now free from penetrations.

If a node is locked *and* penetrates another element, the nodes on the penetrated element are moved so that the locked node becomes free from penetration. For example, the penetrating node in Figure 14 *is locked* by the user, then all nodes on the lower elements are moved down out of penetration the same distance as the locked node would had been if it was not locked. This is the only case where non-penetrating nodes are moved.

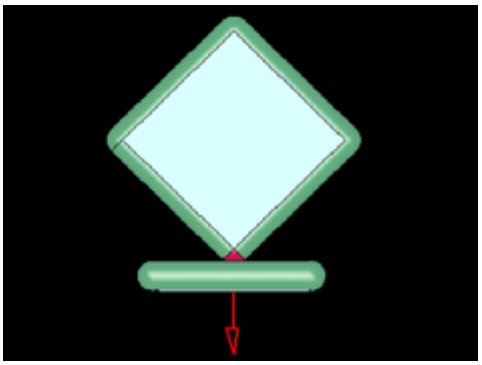


Figure 14: A locked node penetrates a shell element

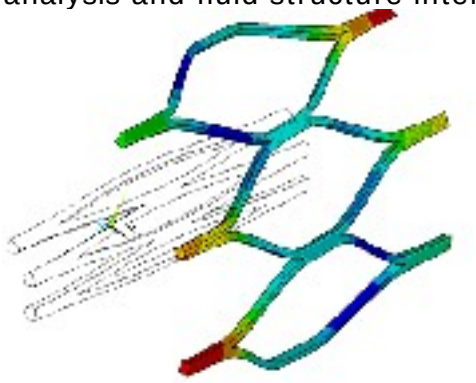
Challenges in Biomedical Engineering Analysis.

ANSYS Solutions find applications in various areas of biomedical engineering.

These applications range from implantable pacemakers, pacing leads, tip anchoring configurations, heart valves, ablative catheters, angioplasty balloons and stents, drug pumps, blood pumps, oxygenators, orthopedic applications, implantable dental prosthesis, and other devices.

These applications typically require modeling of multiple components with nonlinear materials, complex geometries, and surface-to-surface contacts, as well as coupled conditions that may involve simultaneous mechanical, thermal, electromagnetic loading and fluid-structure interaction. In addition biomedical applications have geometries which require advance and robust meshing needs. Biomedical applications also require advance fluid dynamics capabilities to handle fluid and particle flow in devices such as heart pumps, inhalers etc. ANSYS technology offers solutions which meet all these requirements for analysis of biomedical equipment and devices through advance technologies from ANSYS Multiphysics, ANSYS ICEM CFD and ANSYS CFX products.

ANSYS Multiphysics capabilities range from a full complement of nonlinear and linear elements, material laws ranging from metal to rubber, and the most comprehensive set of solvers available. It can handle even the most complex assemblies—especially those involving nonlinear contact and is the ideal choice for determining stresses, temperatures, displacements and contact pressure distributions on all your component and assembly designs. In addition the nonlinear solution capability offers the added advantage of fundamental coupled-field studies involving acoustic, piezoelectric, thermal/structural and thermal/electric analysis and fluid structure interaction.



Analysis of Stent deployment using Shape Memory Alloy Material model in ANSYS

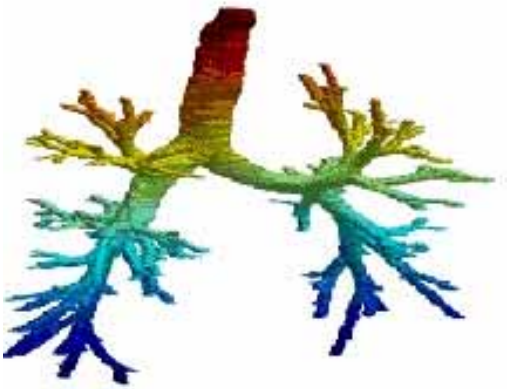
ANSYS ICEM CFD's highly automated mesh generation tools cater to virtually all topologies including all hexahedral, all tetrahedral, hybrid hex/tet element meshes, or Cartesian meshes. Additional elements that can be generated include prism and pyramid cells.

The anatomical complexity and the irregularity of the shapes always make meshing a critical task in the development of models for biomedical applications. Typical objects that are meshed are bones, organs and complex devices. The geometrical data is typically reconstructed based on medical imaging (MRI or CT scans) for some of these applications. Technologies, like the one in ICEMCFD Hexa allows separation of the search for an acceptable meshing topology from the meshing generation itself. Combined with the top - down approach

and easy block editing, it allows one to try various meshing topologies very quickly independently from the mesh density, change the element density easily without changing the topology and use similar blocking for different individuals.

ANSYS CFX technology has been shown to be an important tool in identifying and improving new products in diverse healthcare industries including pharmaceuticals, biomedical, medical equipment, and other "quality-of-life" personal products. ANSYS CFX technology offers advanced modeling and solver capabilities like turbulence models, multiphase flow and mesh morphing to handle flows in these applications.

In addition to the ANSYS Workbench provides a common architecture for all ANSYS solutions and bidirectional associativity with CAD for a parametric analysis during simulation. The ease of use within Workbench allows simulation to be moved up-front in the design process where CAD users can see the results of a simulation and use this knowledge in the CAD design.



ANSYS CFX simulates the 3-D flow of air and drug through the tracheo-bronchial tree during the breathing cycle. CFX's multiphase models predict the motion of aerosol droplets and drug particles and their deposition on the surfaces of the airways.

Case-in-Point 1:

ANSYS helps determine optimal placement of artificial disc and provides valuable insight into spine biomechanics. Researchers at DePuy Spine used ANSYS® Structural™ to model and analyze how well the CHARITÉ artificial disc helps restore motion and how it is affected by its placement relative to the center line of the disc nucleus. To realize their objective, they obtained the contoured geometry of the vertebrae from computer tomography (CT) scans of actual bone structure.

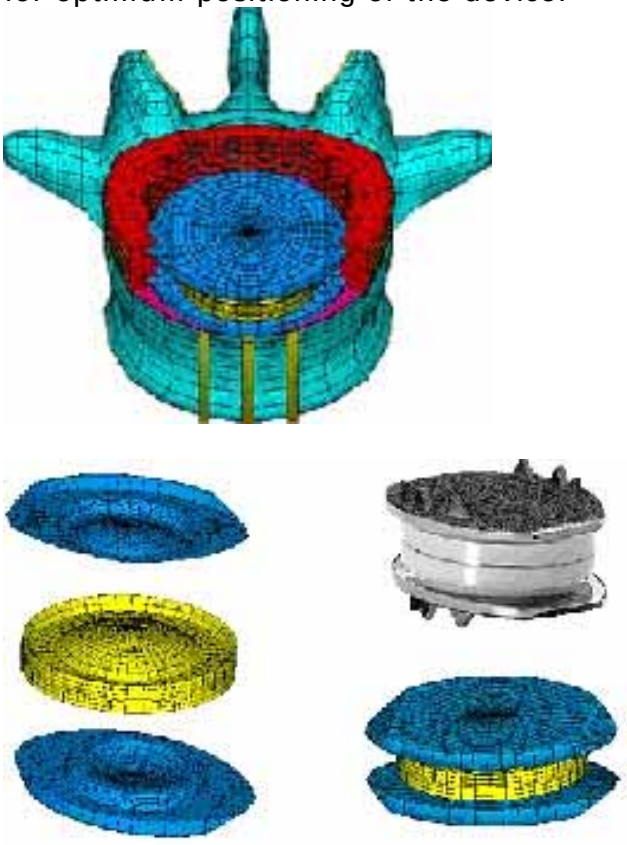
The CHARITÉ artificial disc is designed to eliminate pain and maintain motion of the operative segment. The resulting model was comprised of an assembly of vertebrae, polyethylene core, cobalt chromium endplates, and surrounding tissues such as cartilage, ligaments, and muscle. All parts were modeled using ANSYS standard pre-processing capabilities and analyzed with ANSYS Structural.

The ability of ANSYS to represent the nonlinear material properties of the various components was critical in this study. Moreover, contact representation was aided with ANSYS surface-to-surface contact elements, which automatically detects and adjusts dissimilar meshes instead of requiring users to perform this task manually.

The use of ANSYS simulation enabled researchers at DePuy Spine to determine what constitutes an optimal placement of the artificial disc. The analysis clearly showed that strain and loads on the facets are significantly less with the CHARITÉ artificial disc when compared to a competitive device with a fixed core used for total disc replacement.

Dr. Missoum Moumene who performed this study at DePuy Spine believes this

information will provide valuable knowledge for the continuing development of artificial disc and related technologies. Working with some of the world's most respected spine surgeons, researchers at DePuy Spine are using the results of this study and other simulation-based work to fine-tune procedures and techniques for optimum positioning of the device.



The CHARITÉ artificial disc is the world's first commercially available artificial disc for treating patients with degenerative disc disease. The vertebrae, artificial disc, and surrounding tissue were all modeled using ANSYS standard pre-processing capabilities

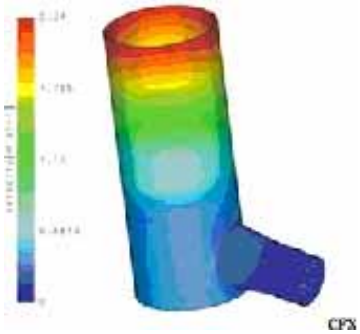
Case-in-Point 2:

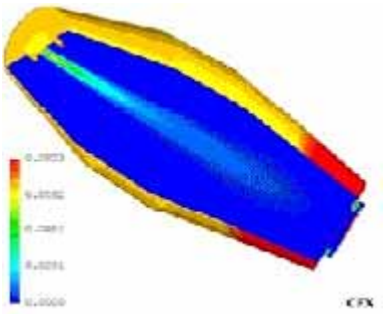
With Asthma on the increase in the developed world, inhalers and spacer devices are becoming more widespread. In order to control dosage, provide optimum benefits and meet regulations, drug companies are using CFX to simulate gas particle flows in a variety of devices in order to study drug trajectories and their deposition characteristics (external and internal flows); optimize existing device dynamics; rapidly prototype new designs; provide support methodologies for regulatory submissions.

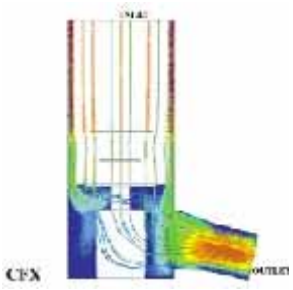
In a recent study, CFX was used to investigate the performance of a Metered Dose Inhaler (MDI). Since flow resistance varies throughout the device and the variation in flow will effect the drug exit profile, CFX was used to predict the flow paths (streamlines) and mouthpiece flow distribution.

Knowing that the final design needed to avoid deposition in the mouth and maximize the drug delivery to the lungs, CFX studied the steady-state air pattern within the inhaler and transport of the drug over a 3-second interval. The final results were obtained within 5 hours (geometry set-up through problem convergence) and showed that the existing design would need to be refined to address mal-distribution. The new design can then be analyzed with CFX providing an optimized design before the costly prototype stage of development.

For children and elderly people who may have difficulties matching their breathing to the MDI, an inhaler spacer device is needed to maximize the dose from their inhaler. Since it is important to know how much of the drug released by the MDI is inhaled by the patient, CFX can be used to model the flow in either steady state or time dependant inhalation cycles. The Lagrangian model was used to track drug particles (in the spacer) with tracers showing the propagation of drug with time. It became evident that restitution and electrostatic effects can be significant.

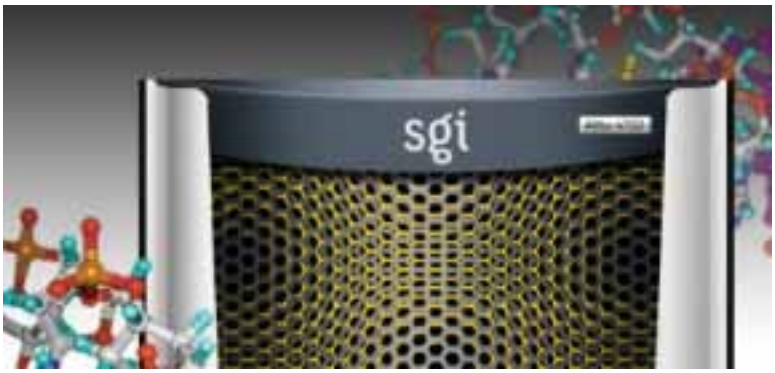






Air Speed and Concentration Profile in a Metered Dose Inhaler analyzed using ANSYS CFX

SGI® Altix® 4000 Platform – Performance and Flexibility



Revolutionary Platform Delivers New Levels of Performance and Versatility in a Blade Design

Revolutionary standards-based design delivers versatile performance for the most demanding HPC workloads and features new technology that will drive future HPC breakthroughs. SGI Altix 4000 features performance density, 'plug and solve' configurability and continues Altix systems' lead in price-performance for high end servers in a blade form factor.

Altix 4700 Advantages

Modular blade design for superior performance density and "plug and solve" configurability

SGI Altix 4700 platform is comprised of modular blades - interchangeable compute, memory, I/O and special purpose blades for 'plug and solve' configuration flexibility. The innovative blade-to-NUMAlink™ architecture enables users to mix and match eight standardized blade choices, for perfect system right-sizing. The compact blade packaging of the Altix 4700 rack also provides excellent performance density.

Designed for future upgrade, expansion and integration of next-generation HPC technologies

Socket-compatible with upcoming single and dual-core Intel® Itanium® 2 processors, SGI Altix 4000 platform offers easy upgrade or expansion of CPU, memory, I/O or visualization capabilities. This flexible growth path makes it possible for customers to adjust system configurations to meet current and changing requirements easily and cost-effectively; minimum risk for maximum productivity.

Scalable system size for simplified programming, low-cost administration and excellent sustained performance for cluster or shared memory applications

SGI Altix 4700 incorporates the shared-memory NUMAflex™ architecture, which simplifies software development, workload management and system administration. It supports up to 512 processors under one instance of Linux and as much as 128TB of globally shared memory. Supporting these powerful capabilities is the NUMAlink™ interconnect, which leads the industry in bandwidth and latency for superior performance on cluster applications. The SGI Altix 4700 represents a versatile solution for shared

or distributed memory applications of any scale.

Step into Multi-paradigm computing - taking HPC beyond the Limits of Moore's Law

SGI Altix 4700 Platform also integrates SGI's Peer I/O technology which enables high-speed access to SGI's large shared memory for all system components. Through peer I/O, SGI Altix 4700 is the first SGI platform designed to support new computing paradigms, such as reconfigurable computing through SGI RASC™ technology, that will take over where Moore's Law leaves off.

Standards-based platform and blade form factor reduces costs while delivering uncompromised performance on Linux

Like its predecessors, the SGI Altix 4700 platform has been designed specifically for technical users based on industry standard CPU's, memory and I/O. This infrastructure is supported by a complete HPC solution stack running on industry standard Linux® operating systems with the choice of Novell® SUSE LINUX Enterprise Server 9 or Red Hat® Enterprise Linux® Advanced Server 4 operating systems. SGI® ProPack™ software provides the tools and enabling applications to optimize performance for Altix systems running SUSE LINUX OS. All of this is supplied and supported by SGI for one-stop support.

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Yahoo Group Yammerings - 3

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This installment of “Yahoo Yammerings” features two questions, with responses from the past month of postings to the LS-DYNA Yahoo Group:

1. *Rigid Body Contact*
2. *SPH and Thermal Analysis*

Question: Rigid Material Contact Problem?

I have a complex drop test model in which there are two small components. To maintain a large time step I have defined them as rigid (MAT020) and assigned a single surface automatic contact to the entire model. However these two rigid components are not obeying the contact definition, what could be the problem?

Response by Steve McDonald:

Here's another thing I learned recently by talking to LSTC support: Although it's nice to use rigid bodies to keep time steps large, you still can't use a really large time step, and you can't let LS-DYNA choose its own time step. You really need to use the LCTM argument on the *CONTROL_TIMESTEP card to point to a load curve where you define the maximum time step LS-DYNA will use during the simulation. Then you need to tweak that value of max time step during contact periods to control penetration. When you have no deformable bodies, LS-DYNA will use whatever time step you tell it to use by this load curve. If it is too big, nodes will move too far during a time step, perhaps right through a contact segment, and then LS-DYNA won't even know that there's been penetration. I would guess that the appropriate times step depends on the impact velocity. Realizing this has been a big help for me, and I've been able to do rigid body simulations with lots of contact pretty successfully, and I use a variety of *CONTACT cards. If I'm lazy and don't care about resolving contact forces on various surfaces, *CONTACT_AUTOMATIC_SINGLE_SURFACE works well, and you don't even have to specify slave and master sets.

Question: Can SPH be used for a coupled structural/thermal analysis?

Can SPH elements be used in a coupled thermal/structural analysis? SPH elements use Johnson Cook material with Gruneisen EOS. We are trying to model temperature-dependent-plasticity.

Response by Rudolf Bötticher:

You cannot have conduction currently. You may test this by making http://www.dynaexamples.com/SPH/SPH/Bar_II/Download/ a thermal deck allow-

ing for plastic heating. “UNCONSTRAINED Thermal Node data” was the error message for the SPH elements/nodes. I know this is only half of the answer, because you possibly did not mean a coupled thermal/structural analysis.

Follow-up by Shekhar Bhojwani:

To further the discussion on this issue, let me also quote from the emails I received from:

J.L. Lacome (LSTC) (SPH examples author dynaexamples.com) “The coupling between thermal and SPH is still under development. I hope finishing this before the end of this year.”

A. Shapiro. (thermal examples author dynaexamples.com) “Coupled thermal-mechanics with SPH is not implemented. However, the Johnson-Cook model allows adiabatic heating without calculating heat conduction.”

LS-DYNA Yahoo Groups

There are over 1600 subscribers from all over the world, and this list seems to grow by a hundred new subscribers ever few months; no small testament to the rapidly growing popularity of LS-DYNA. The group currently averages over 250 message per month, i.e. about 10 message per work day. You can subscribe to the group by sending an email request to LS-DYNA-subscribe@yahoogroups.com or by visiting the Yahoo Groups web site http://groups.yahoo.com

Generally the quickest/best responses are to those questions posed with the most specifics. General questions such as “How do I use XXX feature?” either go unanswered, or are answered by Jim Kennedy with links to appropriate references in the growing LS-DYNA related literature, e.g. see the archive of LS-DYNA Conference proceedings at www.dynalook.com .

Part 1 HP Flexible Computing Services deliver IT capacity as you need it.

For Information Contact: Bennett Bauer +1 (408) 741-1424
Bennett.bauer@hp.com

(Part 2 Feb – LS-DYNA available on HP Utility)

The early years of the 20th century saw a momentous shift in the way large businesses met their electrical-power requirements. Instead of building and operating their own generators as they had traditionally done, they came to recognize that it was more practical and economical to offload this burden to external service providers and purchase power from them as needed.

Today a similar trend is emerging in the IT arena[1]. And the reasons are not far to seek.

As the pace of change quickens, aligning IT supply with business demand becomes more difficult. On the one hand, there's the risk of costly, resource-wasting over-provisioning and underutilization. On the other, there's the risk of running short of compute cycles during peak periods.

Small wonder, then, that many enterprises are beginning to consider alternatives to outright ownership of large IT infrastructures. Increasingly, they're finding that it can be more efficient and economical to complement their internal capabilities by accessing data center compute capacity as an externally provided "service" they can dial up or down as requirements fluctuate.

HP's Flexible Computing Services are designed to help you take full advantage of this cost-saving approach to enterprise-scale IT. As with public gas and electrical utilities, you pay only for the resources you use, only as you use them. Dedicated computing capacity is centrally supplied from HP data centers and delivered to you on a cost-per-unit basis.

Highly available data center capacity…proven management know-how…strong security safeguards

HP's Flexible Computing Services let you augment your existing infrastructure to provide for predictable usage peaks, accommodate unexpected demand spikes, and handle exceptionally compute-intensive tasks. And you can do so without large upfront capital expenditures or resource commitments, but with confidence that your infrastructure stays secure and the integrity of your confidential data is preserved.

HP's data centers are administered and managed by HP Services specialists. These experienced professionals apply a tested methodology to implement a reliable solution that accommodates your specific needs. Adherence to IT Service Management (ITSM) best practices helps drive delivery of consistently high service levels.

Protective measures at the HP data centers include 24x7 staffing by specially trained security personnel, extensive video monitoring, access controls, advanced intrusion detection and network access monitoring, packet filtering firewalls, routing restrictions, secure VLAN extranets, and secure cell architecture environments.

The HP data center environments are thoroughly "scrubbed" after each use, and each customer organization receives fresh compute power. In addition, the set of CPUs you're assigned is accessible by no other party — not even HP.

Wide scalability and nimble responsiveness for today's Adaptive Enterprise

HP Flexible Computing Services can be leveraged as essential building blocks of an Adaptive Enterprise in which business and IT are synchronized to capitalize on change.

These innovative services deliver key capabilities to help you scale computing power in response to fast-moving business opportunities, cost-effectively align infrastructure capacity with shifting business demands, and profit from the financial flexibility and agility enabled by pay-per-use utility pricing.

Platforms, applications, and expertise — all geared to your changing needs

Delivering high-performance computing capabilities based on a broad range of hardware platforms, HP Flexible Computing Services are available with all major operating systems and select industry-specific applications. Initial portfolio offerings include:

- **Infrastructure Provisioning Service (IPS):** A highly available, highly secure IT utility service delivered from HP data centers. HP owns the assets, including all hardware, and offers you a choice of operating system environments. Your organization provides and manages the application(s).

- **Infrastructure Provisioning Service plus scheduling (IPS+):** Augments the Infrastructure Provisioning Service with HP installation and management of software such as batch scheduling, compiler, and grid tools to enhance the efficiency of the jobs you're running on the utility.

- **Application Provisioning Service (APS):** Includes Infrastructure Provisioning Service or Infrastructure Provisioning Service plus scheduling. In addition, HP installs key vertical industry application software you supply.

- **Application Provisioning Service for Computer-Aided Engineering:** This complete application utility service includes soft-

ware solutions for structural, crash, and fluid analysis. HP alliances with leading CAE software vendors enable you to access the entire computing stack — hardware, operating system, and applications — on a flexible payment basis.

Looking for a low-cost, low-risk test drive? Join the "Club."

The innovative HP Flexible Computing Club gives you an easy, affordable way to gauge how this public utility solution suits your IT and business needs. As a Club member, you'll enjoy a host of valuable benefits — an introductory pilot project, environment and needs assessment consulting, orientation training to help you get off to a smooth start, expert ongoing guidance from HP Services professionals, and more.

Contact an HP sales representative for details on how to become a Club member and take advantage of this exclusive "try-before-you-buy" opportunity

Engineering Interest
FEA Information Feature: KBEC L.C.

Gun Metal Drive – Don't Let The Name Fool You!

Located in Central Texas is a street called Gun Metal Drive. Don't let the name fool you. It isn't where Khanh Bui relocated with his family to become a gunsmith.

Khanh Bui, formerly with LSTC technical support, relocated with his family to Central Texas and is continuing his expertise in LS-DYNA, under his own company KBEC L.C. located on Gun Metal Drive.

Khanh had spent almost 2 years at General Motors working with DYNA3D, 5 years at Lockheed with DYNA3D and LS-DYNA and almost 13 years with LSTC.

KBEC is able to provide sales, technical support and consulting services, along with turn key Linux clusters to run LS-DYNA in Texas and southern state regions.

KBEC L.C.
12400 Gun Metal Dr.
Austin, TX 78739
(512) 363-2739
(512) 291-0873 FAX
kdbui@sbcglobal.net

We are glad to announce KBEC L.C. has joined FEA Information Inc. as a consulting participant.

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
Engineering Technology Associates (China) Inc.	Martin Ma Tel: + 86-21-64385725 Contact: support@eta.com.cn
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

FEA Information China Participants

Software, Hardware, Training, Consulting, Services

SGI China	Carl Zhang Tel: +86 -10 - 65228868 Ext. 3362 Contact: carl@sgi.com
Tsinghua University	Qing Zhou, PhD. - Professor Department of Automotive Engineering Beijing, 100084, China
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

LSTC Training Classes - 2006

LSTC Training Classes:

Jane Hallquist
Training Coordinator
LSTC California & Michigan
Email: ***jane@lstc.com***
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	
Advanced Option in LS-DYNA	$750		· Feb 20 – 21
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

LSTC Training Classes - 2006

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 Materi-als	$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

Distribution & Consulting Channels - January

US Participants
Sales – Support –Training – Benchmark – Consulting.

Engineering Technology Associates, Inc. (ETA) is a software development an engineering company specializing in automotive CAE applications worldwide. ETA' mission is to be the leading global supplier of CAE software, services, training and technology solutions.
DYNAMAX, INC, Located in an automotive environment near Motown Detroit, Dynamax, Inc. has always kept updated in its engineering expertise and understood customer's expectation. With more than ten years professional experience in using the LS-DYNA software to solve customer's problems especially in the automobile industries.
Predictive Engineering: A mechanical engineering consulting company specializing in finite element analysis (FEA). Under this banner, a broad range of capabilities are brought to bear in developing predictive engineering models via expertise in thermal/fluids (CFdesign), drop-testing and impact analysis (LS-DYNA), and static/dynamic/nonlinear/thermal structural analysis (FEMAP / NX.Nastran).
SE&CS: Engineering services to Government and commercial clients. Services include the application, and development, of computational mechanics techniques with specializations in nonlinear transient phenomena and constitutive modeling. Len Schwer, PhD, has over 25 years of experience in the application, and development, of finite element analysis software. With a specialization in the application of the LSTC code LS-DYNA.
Structure Incorporated: 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

EVENTS – 2006

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

2006	
Feb 22-23	**CEI Visualization Conference – Orlando, FL. US**
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**
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**
Oct 12-13	**LS-DYNA Users Meetin**g - Hosted by DYNAmore **Ulm, Germany**
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.

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	IRIX6.5
SGI IA64	Altix/Prism

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

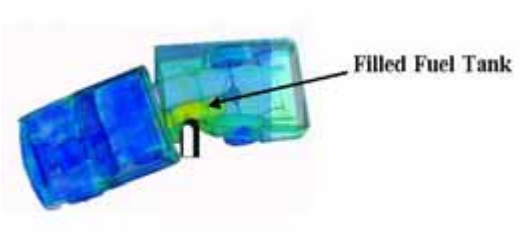
Includes a complete CAD interface capable of importing, modeling and analyzing, any die design. Available for PC, LINUX and UNIX, DYNAFORM couples affordable software with today's high-end, low-cost hardware for a complete and affordable metal forming solution.

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

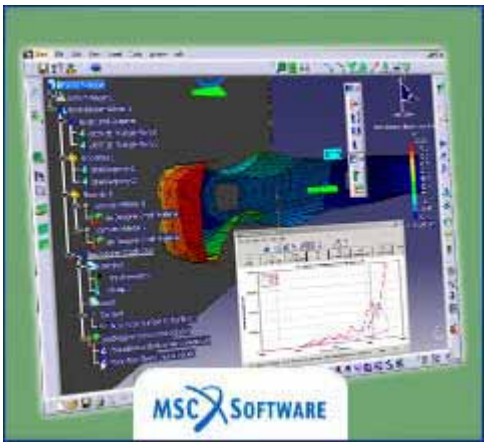
MSC.Software - MSC.Nastran / SOL 700

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

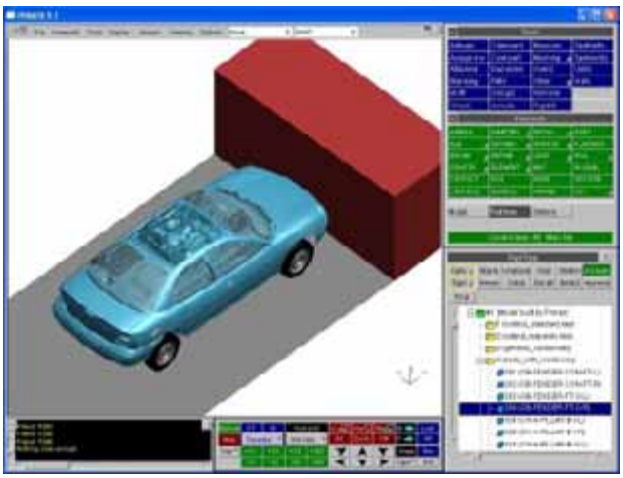
Gateway for LS-DYNA provides you with the ability to access basic LS-DYNA simulation capabilities in a fully integrated and generative way. Accessed via a specific Crash workbench on the GPS workspace, the application enhances CATIA V5 to allow finite element analysis models to be output to LS-DYNA and 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
www.esi-group.com/SimulationSoftware/EASi_CRASH-DYNA

Interfaced to the latest version of LS-DYNA Easi-CRASH DYNA supports LS-DYNA Version 970. EASi-CRASH DYNA has powerful editing features, such as automesh and remesh.

LS-DYNA/MADYMO coupling capabilities for pre- and post processing. With direct read in of LS-DYNA® data it has highly optimized loading and animation of LS-DYNA results for design

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

Australia Manly, NSW www.leapaust.com.au	**Leading Engineering Analysis Providers** Greg Horner info@leapaust.com.au 02 8966 7888
Canada Kingston, Ontario www.mfac.com	**Metal Forming Analysis Corporation** Chris Galbraith galb@mfac.com (613) 547-5395
India Bangalore www.altair-india.com	**Altair Engineering India** Nelson Dias info-in@altair.com 91 (0)80 2658-8540
Italy Torino www.altairtorino.it	**Altair Engineering Italy** sales@altairtorino.it
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

Educational & Contributing Participants

Alphabetical Order By Country

China	Dr. Quing Zhou	Tsinghua University
India	Dr. Anindya Deb	Indian Institute of Science
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.

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.**

December Highlights from FEA Information Inc.

Website: www.feainformation.com

The SX-8 Series, that implements an eight-way SMP system in a very compact node module and uses an enhanced version of the single chip vector processor that was introduced with the SX-6, is NEC's latest and most powerful supercomputer

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ESI GROUP
THE VIRTUAL TRY-OUT SPACE® COMPANY

EASi-CRASH DYNA - a fully integrated package for crash simulation which covers the CAE-process from start to finish. It achieves this by integrating all aspects of model building, dataset preparation, 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 solvers like LS-DYNA

IBM®

The IBM® @serverBlue Gene® Solution is the result of an IBM supercomputing project begun over five years ago, dedicated to building a new family of supercomputers optimized for bandwidth, scalability and the ability to handle large amounts of data while consuming a fraction of the power and floor space required by today's fastest systems.

9th International LS-DYNA Users Conference

Monthly Update - Publications

-

Publications – Dr. Wayne L. Mindle - papers@lstc.com

In the February Issue we will list the FEA Information Participant Sponsors that will be Exhibitors at the Conference.

The deadline for submitting abstracts for the upcoming LS-DYNA Conference was January 2nd. I would like to thank all of those that submitted abstracts. Official acceptance of abstracts will be sent out by January 27, 2006. Sessions will be announced shortly thereafter.

Once again, the "LS-DYNA User Community" encompasses a wide range of applications. The range of topics in submitted papers includes the following areas of interest.

Automotive Design and Manufacturing
Crashworthiness
Occupant Safety
Barrier Design
Metal Forming
Composites
Fracture Mechanics
ALE Applications
Hardware Performance
Biomedical Applications
Explosive Impact
General Impact Analysis
Vibration Analysis
Drop Testing
Theory – Element Development and Material Modeling
Optimization
SPH and Mesh-Free Applications
Bird-Strike
Civil Engineering Applications
Material Testing
Pre-Processing

A CD of the papers will be available from LSTC including mailing worldwide at no charge. You will be able to sign up for the CD in April on the website www.ls-dynaconferences.com

Registration is now available on line at www.ls-dynaconferences.com