NOVEMBER
2005

fea INFORMATION

WWW.FEAINFORMATION.COM

COVER STORY

CRAY

PING Shaves Strokes Off Its Golf Club Design Cycle With a Cray XD1 Supercomputer

PRODUCT SPOTLIGHT

FUJITSU

PRIMERGY Blade Servers Powered by AMD OPTERON

NEWS GROUP

LS-DYNA USERS FORUM

FEA Information Worldwide Participants

Contents

Editor:
Trent Eggleston
Managing Editor:
Marsha Victory
Technical Editor:
Art Shapiro
Graphic Designer:
Wayne L. Mindle

Technical Writers:
Dr. David Benson
Uli Franz
Dr. Ala Tabiei
Suri Bala
Technical Consultants:
Steve Pilz
Reza Sadeghi

FEA Information Announcements

TopCrunch

Two new features have been added to TopCrunch run by Prof. David Benson at UCSD, with support from his students, post-docs, research engineers, and web site support from the Jacobs School of Engineering.

Yahoo Yammerings by Len Schwer

Since April 2000 there has been a Yahoo Groups discussion list devoted to LS-DYNA.

LSTC 9th International LS-DYNA Users Conference 2006:

www.ls-dynaconferences.com
Call for Papers on Page and can be downloaded from our conference site:

FEA Information New Developments in LS-DYNA series Continued:

LS-DYNA NEWS – Part 5. Each month, for those readers that have missed LS-DYNA conferences, we will be providing information directly from the Power Point slides at the conferences.

Sincerely,
Trent Eggleston & Marsha Victory

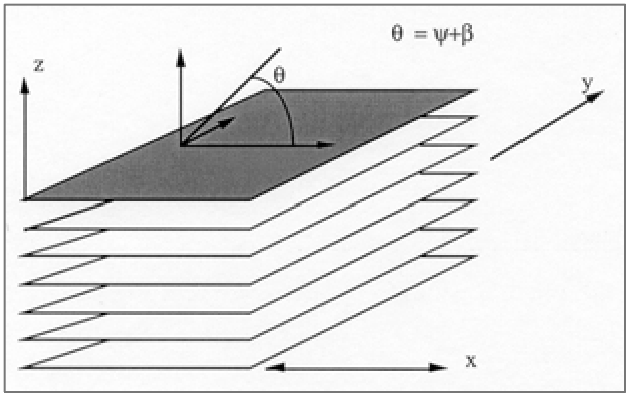
LS-DYNA News – Part 5
Version 971 Developments

*Element_shell_…_offset

- "Offset" option has been added for all shell elements.
- The offset is included when defining the connectivity of the shell element
- The mid-surface is projected along its normal vector
    - Offsets greater than the shell thickness are permitted
    - Overrides the offset specified in the *SECTION_SHELL input
- Nodal inertia is modified to account of the offset and provide a stable time step of explicit computations
- Explicit and implicit implementation
- Offsets will be considered in contact in near future

*Integration_shell

- Material types can change from integration point to integration point through the shell thickness.
    - Mix orthotropic, elastic-plastic, and viscoelastic materials
    - New input option to control failure when material types are mixed
        - EQ.0: Element is deleted when the layers which include failure, fail.
        - EQ.1: Element failure cannot occur since some layers do not have a failure option.



*Integration_shell

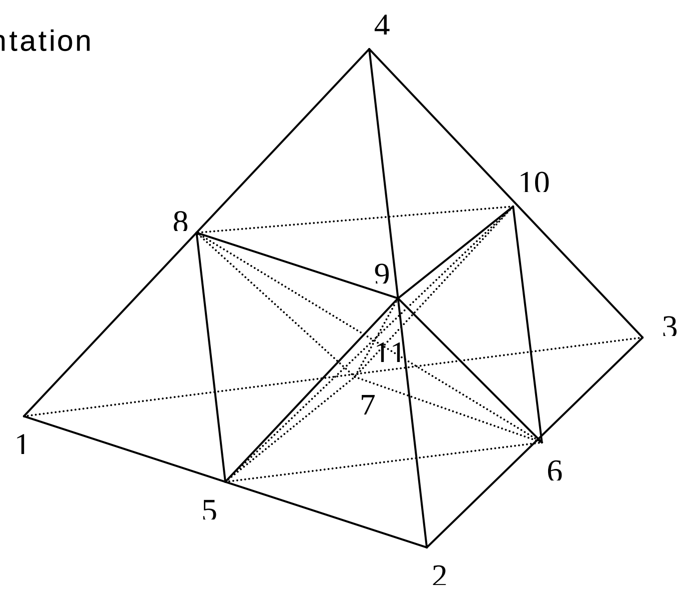
- Contact stiffness is now based on a weighted average of through thickness values
- Time step size is based on a weighted average of through thickness sound speeds.

Nonlinear shell element with thickness stretch

- Belytschko-Tsay, type 2, and the assumed strain, fully integrated, type 16, shell elements has been extended to account for a linear strain through the thickness
  - Now implemented in version 971, but its release to users depends on how well it works on a range of problems
- An 8-parameter theory accounts for thickness changes leading to a 32 DOF shell
  - Nodal connectivity uses 4 nodes and 4 scalar nodes where each scalar node has 2 DOF
- Scalar nodes can be user defined or generated automatically
- Full 3D constitutive routines employed – not necessarily zero stress through thickness. Constitutive models for solid elements are used.
- Obvious applications are in manufacturing simulations
- Surface loading is better captured – more accurate solutions as thinning is not predicted solely from membrane straining but also from the normal tractions
- Responds to double sided contact situations, for instance in the situation with a sheet squeezed between dies in metal forming applications
- May be useful for predicting delamination in composite materials since a meaningful normal stress is available for the failure calculations.
- Possible applications in crash analysis, but much additional development will be required
  - Spotweld constraints will need to consider the normal degrees of freedom
  - Mesh definition for intersecting shells will require multiple scalar nodes for each mesh node

Composite Tetrahedron

- Based on Belytschko-Guo unpublished paper (1997)
- Ten-node tetrahedron divided into 12 sub-tetrahedrons
- Linear displacement in sub-tetrahedron
- Assumed linear strain, or constant volumetric and linear deviatoric strain over entire tetrahedron
- Implicit and explicit implementation
- SMP-MPP
- Speed ~ fully integrated solid



Cohesive elements

- Used to predict interface failure.
    - Glued surfaces
- Two new constitutive models are available
    - *MAT_COHESIVE_ELASTIC
    - *MAT_COHESIVE_TH
        - Tvergaard and Hutchinson theory
- Solid element type 19 for connecting solid elements and type 20 for connecting shells at their mid-sufaces
    - Type 20 transmits moments, 19 does not
    - Four planar integration points
    - Hexahedron shape

*Element_direct_matrix_input

- Option for reading and using superelements
    - Explicit or Implicit
    - Allows multiple superelements connecting into the LS-DYNA model at <u>over-lapping attachment nodes.</u>
        - Note: in version 970 overlapping attachment nodes were not allowed.
- Demonstrated in a vehicle driving simulation with superelements for body and frame and detailed modeling of tires and suspension system

Engineering Research Nordic AB, Linköping, Sweden

Enhanced user-defined capabilities in LS-DYNA v971

Thomas Borrvall and Daniel Hilding

Introduction

In mechanical research, whether it is in academia or industry, the development is principally narrowed down to a special field of interest, for instance to developing constitutive models for a particular application. However, proper usage and testing of research results often requires complicated finite element models and an accompanying robust and efficient simulation tool. Needless to say, a researcher should only be concerned with the development in his/her own field and should not have to deal with development and maintenance of the finite element software.

User-defined features in LS-DYNA allow users to create their own Fortran or C subroutines and link them with the LS-DYNA objects to form a tailor-made LS-DYNA executable. In this way LS-DYNA can be customized for particular applications, which makes it a powerful tool in research and development.

How to use LS-DYNA with user-defined features

To customize LS-DYNA for your particular application you will need an object version of LS-DYNA and a Fortran compiler. The object version of LS-DYNA (or MPP-DYNA for parallel computations) comes with no extra charge and can be obtained from your local LS-DYNA distributor. Here you also can get information on which compiler you will need for your particular platform. The compiler must be bought separately.

In the LS-DYNA object distribution there is a Fortran text file containing all user-defined subroutines. You will need to edit the subroutines according to the particular task you want to accomplish. This code is compiled and linked with the rest of the LS-DYNA objects typically by executing a makefile script either from a command prompt or from a graphical user interface. The result is an LS-DYNA executable ready to be used.

Available user-defined features

A list of the user-definable features in LS-DYNA v971 is given below. In this report we will take a closer look on the first three items.

- User defined structural materials
- User defined elements
- User defined thermal materials
- User defined equation of state
- User defined airbag sensors
- User defined solution control, including far-reaching control of output of solution results
- User defined friction
- User defined interface control, which enables control of contacts on a low level
- User defined weld failure

- User defined loads
- User control over output of shell stresses and history variables to the d3plot database
- User defined material failure for commonly used material models for metals
- User defined mesh refinement for 3D-shell adaptivity

If you have difficulties understanding how to customize LS-DYNA to suit your needs, please contact your local LS-DYNA distributor.

Invoking your user-defined features

To invoke your particular feature, you will need to adjust the model input file accordingly. For each user-defined feature, there is a corresponding set of keywords that needs to be defined along with appropriate input parameters. To know what keywords to use and how to use them the reader may consult the LS-DYNA 971 keyword user's manual where most user-defined features are described in detail in the appendices.

Support and further reading

Theoretical foundations for the user-defined features may be found in the books listed among the references. Any practical issues are resolved through courses and support by your local LS-DYNA distributor.

User-defined structural materials

A well-known user-defined feature in LS-DYNA that has been available for many years is the possibility to implement structural materials. Up to ten structural materials can be implemented for beam, shell and solid elements in a single LS-DYNA executable.

The user interface consists of two subroutines for each material. In the first, called the material subroutine, the true stress should be determined from the deformation history, i.e., from the strain increments and any material related history variables. In the second, only needed for implicit analysis, the material tangent modulus is implemented so that LS-DYNA can set up the global stiffness matrix.

History variables, as well as material constants, are associated to a material via the model input file. It is also possible to define material anisotropy in the same way as for any other standard anisotropic material. If a material requires the deformation gradient or temperature information, this can be specified in the input file and LS-DYNA will make this available in the material subroutine. For anisotropic materials, the strain increments and deformation gradient will be transformed to the local system to be used directly without any manipulations. Other features include the use of load curves and definition of failure models. The abstraction level of the interface for these particular features is in LS-DYNA v971 enhanced, which simplifies the implementation to a great extent.

User-defined elements

A new user-defined feature in LS-DYNA v971 is the possibility to define structural elements. Up to a total of ten quadrilateral shell and hexahedral solid elements can be implemented in a single LS-DYNA executable for both explicit and implicit analysis.

For each user-defined element the interface consists of two subroutines, one routine for numerically integrated elements and one for any additional force and stiffness contributions (hourglass, drilling etc). Property parameters and history variables can be connected to the element by defining this in the model input file. Furthermore, extra degrees of freedom per node can be used if the element formulation so requires. These extra degrees of freedom could for instance represent shell thickness or hydrostatic pressure.

For numerically integrated elements the user only needs to implement the strain-displacement matrix and Jacobian, leaving LS-DYNA to take care of stress updates and force and stiffness assembly. This allows the user to take advantage of the rich supply of standard materials in LS-DYNA and also relieves him/her from the tedious work of assembling the global finite element matrices. It is of course possible to combine the user-defined element with a user-defined structural material in the usual fashion. The integration points can be placed at arbitrary locations within the element to avoid any forms of restrictions in this context. If the element requires stabilizing forces, these may be implemented in a separate routine to complete the definition of the element, or one could simply use the standard LS-DYNA stabilization (hourglass) routines.

For other elements, i.e., elements that do not use the rate of deformation tensor to define the kinematics, the global force vector and stiffness matrix must be implemented in a single routine. While this puts little or no limits in terms of what type of elements that can be defined, extra amount of work may be needed to define the element in question. For users especially concerned with the computational efficiency, even numerically integrated elements can be implemented in this way, although it may be somewhat awkward.

User defined thermal materials

Starting with LS-DYNA v971, it is possible to add user-defined thermal material models. Up to 5 thermal materials can be implemented for solid, shell, and thick shell elements in a single LS-DYNA executable. Material models can include orthotropic heat conduction as well as heat sources.

The addition of a thermal user material routine is fairly straightforward and very similar to adding a structural user material. The thermal user materials are controlled using *MAT_THERMAL_USER_DEFINED, which is described in the appendices of the LS-DYNA Keyword User's Manual.

Thermal history variables

Up to 100 history variables can be used in a thermal user material. Thermal history variables are output to the tprint file using *DATABASE_TPRINT.

Thermo-mechanical simulations and material models

LS-DYNA offers great possibilities for simulating time-dependent thermo-mechanical events. A thermo-mechanical simulation works by coupling the thermal solver with the structural solver in a so-called staggered step approach. In this approach each solver has its own time-step size and solution technique and they continuously communicate updated solution variables such as temperatures and strains to each other.

In a coupled structural-thermal simulation, LS-DYNA automatically creates a corresponding thermal solid or shell element for each structural solid or shell element. Thus the simulation model consists of pairs of structural and thermal elements that share the same nodes. The thermal and structural element in such a pair each has its own material model and element formulation.

If in a coupled thermo-mechanical solution both a thermal and mechanical user-defined material model are defined for a part, then the two user material models optionally have read access to each other's history variables. If the integration points of the thermal and mechanical elements not are coincident then interpolation or extrapolation is used when reading history variables. Linear interpolation or extrapolation using history data from the two closest integration points is used in all cases except when reading history variables from the thick thermal shell. For the latter thermal shell, the shape functions of the element are used for the interpolation or extrapolation. Thus it follows that history variables such as stresses, strains, phase composition, and temperatures can be exchanged between a thermal and structural user material model. The latter makes it possible to implement complex thermo-mechanical material models involving e.g. phase transformations.

Future development

Increasing the scope and functionality of the user-defined features in LS-DYNA is always ongoing which the additions described in this article are proof of.

References

- LS-DYNA Keyword User's Manual v971, Livermore Software Technology Corporation, Livermore CA, 2005.
- LS-DYNA Theoretical Manual, Livermore Software Technology Corporation, Livermore CA, 1998.
- Maugin, GA., The Thermomechanics of Plasticity and Fracture, Cambridge University, Press, 1992.
- Nonlinear Finite Elements for Continua and Structures, T. Belytschko, W.K. Liu and B. Moran, John Wiley & Sons Ltd, 2000.
- Non-linear Finite Element Analysis of Solids and Structures I & II, M.A. Crisfield, John Wiley & Sons Ltd, 1997.

Unit System for a Coupled Thermal-Mechanical Analysis

Dr. A. Shapiro www.heattransferanalysis.com

SI presents a consistent set of units to perform a coupled thermal mechanical analysis. This unit system is presented in Tables 1, 2 and 3.

Table 1: SI base units

length	meter	m
mass	kilogram	kg
time	second	s
temperature	kelvin	K

Table 2: SI derived units

force	newton	N = kg m / sec^2
pressure, stress	pascal	Pa = N / m^2
work, energy	joule	J = N m
power	watt	W = J / s

Table 3: SI derived quantities

Density ( )	Kg / m^3
thermal conductivity (k)	W / m K
heat capacity (Cp)	J / kg K
heat flux	W / m^2

A consistent set of units must be used in performing a coupled thermal-mechanical analysis. Mechanical units are chosen based on historical practice in the industry. Table 4 presents typical units used for metal stamping. Problems arise due to a mismatch between the mechanical unit for work and the thermal unit for energy. There are 2 approaches that can be taken to satisfy the requirement of a consistent set of units.

1. Convert the thermal units into the base units being used for the mechanical problem. This is done for unit sets 1 and 2 in Table 4. The mechanical units for Unit Set 1 are defined in a way that the thermal units are in joules and watts. This is not the case for Unit Set 2. Although Unit Set 2 is consistent, the thermal units are not familiar.

2. Use the SI unit for thermal energy, the joule, and define the mechanical equivalent of heat to convert the mechanical work unit into joules. This is done for Unit Set 3 in Table 4. The mechanical equivalent of heat is entered in the *CONTROL_THERMAL_SOLVER keyword.

Following is the procedure to convert units. My approach is to start with SI units and apply conversion factors to obtain the desired units. This gives a multiplication factor [i.e., (SI units)*(factor) = (desired units)] for the conversion.

For Unit Set 1:

$$force = ma = (kg)\left(\frac{m}{s^2}\right) = \left(\frac{kg\ m}{s^2}\right)\left(\frac{10^3 mm}{m}\right)\left(\frac{s^2}{10^6 ms^2}\right) = 10^{-3}\left(\frac{kg\ mm}{ms^2}\right)$$

$$\text{Or, } 10^3\ N = 1\ kN = 1\ \frac{kg\ mm}{ms^2}$$

$$pressure = \frac{F}{A} = \frac{N}{m^2} = \left(\frac{kg\ m}{s}\right)\left(\frac{1}{m^2}\right)\left(\frac{m}{10^3 mm}\right)\left(\frac{s^2}{10^6 ms^2}\right) = 10^{-9}\left(\frac{kg}{mm\ ms}\right)$$

$$\text{Or, } 10^9\ \frac{N}{m^2} = 1\ GPa = 1\ \frac{kg}{mm\ ms}$$

$$work = Fd = (N)(m) = \left(\frac{kg\ m}{s^2}\right)(m) = \left(\frac{kg\ m^2}{s^2}\right)\left(\frac{10^6 mm^2}{m^2}\right)\left(\frac{s^2}{10^6 ms^2}\right) = \frac{kg\ mm^2}{ms^2}$$

$$\text{Or, } 1\ N\ m = 1\ J = 1\ \frac{kg\ mm^2}{ms^2}$$

$$power = \frac{work}{time} = W = \frac{J}{s} = \left(\frac{J}{s}\right)\left(\frac{s}{10^3 ms}\right) = 10^{-3}\ \frac{J}{ms}$$

$$\text{Or, } 10^3\ W = 1\ kW = 1\ \frac{J}{ms}$$

$$thermal\ conductivity = \left(\frac{W}{m\ K}\right) = \left(\frac{J}{s\ m\ K}\right)\left(\frac{s}{10^3 ms}\right)\left(\frac{m}{10^3 mm}\right) = 10^{-6}\ \frac{J}{ms\ mm\ K}$$

$$\text{Or, } 10^6\ \frac{W}{m\ K} = 1\ \frac{kW}{mm\ K} = 1\ \frac{J}{ms\ mm\ K}$$

$$flux = \left(\frac{W}{m^2}\right) = \left(\frac{J}{s\ m^2}\right)\left(\frac{s}{10^3 ms}\right)\left(\frac{m^2}{10^6 mm^2}\right) = 10^{-9}\ \frac{J}{ms\ mm^2}$$

$$\text{Or, } 10^9\ \frac{W}{m^2} = 1\ \frac{kW}{mm^2} = 1\ \frac{J}{ms\ mm^2}$$

Table 4: Shown are typical unit sets used for metal stamping. Properties are for 1020 cold rolled steel.

Mass	Length	Time	Force	Pressure	Work	Mechanical Equivalent of heat	Density	Elastic modulus	Thermal Conductivity	Heat capacity	flux
SI											
kg	m	s	N	Pa	N m	N m = J	kg/m^3	Pa	W/m K	J/kg K	W/m^2
						1.	7.87e+03	2.05e+11	5.19e+01	4.86e+02	1.
Unit Set 1											
kg	mm	ms	kN	Gpa	kN mm	kN mm = J	kg/mm^3	GPa	kW/mm K	J/kg K	kW/mm^2
						1.	7.87e-06	2.05e+02	5.19e-05	4.86e+02	1.e-09
Unit Set 2											
ton	mm	s	N	MPa	N mm	not applicable	ton/mm^3	MPa	$ton\ mm/s^3\ K$	mm^2/s^2K	ton/s^3
						1.	7.87e-09	2.05e+05	5.19e+01	4.86e+08	1.e-03
Unit Set 3											
ton	mm	s	N	MPa	N mm	$N\ mm=10^{-3}J$	ton/mm^3	MPa	W/mm K	J/ton K	W/mm^2
						1.e-03	7.87e-09	2.05e+05	5.19e-02	4.86e+05	1.e-06

Cray XD1 – PING Inc. – LS-DYNA – LS-OPT

SEATTLE, WA, Nov 07, 2005
(MARKET WIRE via COMTEX News Network)

Running Livermore Software Technology's LS-DYNA computer-aided engineering (CAE) software on the Cray XD1 system, PING has reduced the time needed to conduct preliminary structural tests of new club designs from weeks to mere hours.

PING Shaves Strokes Off Its Golf Club Design Cycle With a Cray XD1 Supercomputer

Company Uses Complex Simulations to Speed Design and Testing of Prototypes

Global supercomputer leader Cray Inc. (NASDAQ: CRAY) today announced that leading golf equipment designer and manufacturer PING Inc. has made a Cray XD1(TM) supercomputer a critical part of its research and development program.

The Cray XD1 system employs a high-performance computing (HPC) architecture that allows designers to run larger, more detailed simulations with greater accuracy than was possible with a conventional engineering workstation.

By simulating golf club characteristics on the Cray supercomputer using finite element analysis (FEA) techniques, PING engineers can eliminate weak or ineffective designs before they move on to more expensive and time-consuming physical prototyping, which involves molding an actual club and testing it using a robotic golfer to precisely hit the balls. It generally takes the company about three to four weeks to produce a physical prototype.

PING tests new club designs on the supercomputer by creating a three-dimensional matrix that closely approximates how the equipment would perform in real life. The system can simulate the impact of a club head against a ball, the bending of the shaft during a stroke, the stability of a putter while in motion and other complex problems. With these capabilities, the PING design team can, for example, identify areas of low stress and virtually reposition weight to other areas of the club, increasing performance while maintaining the original balance and feel.

“PING is committed to ensuring that the innovations we design into our golf clubs result in solid improvements that make the game more enjoyable for our customers," said Eric Morales, staff engineer and FEA design analyst at PING. "With the Cray XD1 system, we can now run simulations in minutes that previously took several hours or even days on a generic workstation.

The LS-OPT design optimization and probabilistic analysis package that we use to compute the best design features within specified parameters demands a complex simulation environment that can run jobs across multiple processors simultaneously. That level of computing would have been impossible on our previous system."

"The business advantages that PING will gain through virtual equipment prototyping showcases the power and versatility of the Cray XD1 system's purpose-built, high-performance design," said Himanshu Misra, CAE business manager at Cray. "PING demonstrates that the benefits of HPC are no longer confined to scientific and large-scale engineering organizations. Enterprises of many kinds are increasingly taking advantage of supercomputing to bring better products to market, increase productivity and sharpen their competitive edge in the marketplace."

About the Cray XD1 Supercomputer

The Cray XD1 supercomputer combines direct-connect system architecture, HPC-optimized Linux, management and reconfigurable computing technologies to deliver industry-leading performance on real-world applications. Purpose-built for demanding HPC applications such as computational chemistry, environmental forecasting and CAE, the Cray XD1 system lets users simulate, analyze and solve complex problems more quickly and accurately. The x86-based Cray XD1 system supports a broad range of 32- and 64-bit HPC applications on AMD Opteron single- or dual-core processors. The system also provides application acceleration capabilities using field-programmable gate array (FPGA) technology directly connected to the Cray XD1 compute environment.

About PING Inc.: Founded in 1959 in the garage of the late Karsten Solheim, PING designs, manufactures and markets a complete line of golf equipment that includes metal woods, irons, putters and golf bags. The family-owned company is credited with numerous innovations that have revolutionized the industry. Among PING's advances have been perimeter weighting, individualized custom fitting and the use of investment casting in the manufacture of clubs. PING game-improvement products can be found in more than 70 countries. Go to www.pinggolf.com for more information.

Safe Harbor Statement: This press release contains forward-looking statements. There are certain factors that could cause Cray's execution plans to differ materially from those anticipated by the statements above. These include the technical challenges of developing high-performance computing systems, the successful porting of application programs to Cray computer systems, reliance on third-party suppliers, Cray's ability to keep up with rapid technological change and Cray's ability to compete against larger, more established companies and innovative competitors. For a discussion of these and other risks, see "Factors That Could Affect Future Results" in Cray's most recent Quarterly Report on Form 10-Q filed with the SEC.

Fujitsu PRIMERGY Blade Servers Powered by AMD Opteron Processors Offer More Choices, Flexibility in Scaling Data Centers

PRIMERGY BX630 and PRIMERGY RX220 Deliver Unique Scalability Options, Lower Environmental Costs for Highly Dense Data Centers

The PRIMERGY BX630 server will be available in mid November 2005 with pricing starting at $2350. The PRIMERGY RX220 server will be available in December 2005 with pricing starting at $1700.

PRIMERGY® BX630 blade server and the PRIMERGY RX220 rack server powered by dual-core AMD Opteron™ processors provide data-center administrators maximum flexibility in how they scale up and scale out their infrastructures to increase efficiency and reduce total cost of ownership (TCO).

These AMD Opteron-based PRIMERGY servers offer a smart architecture that enables existing and future hardware building blocks to be combined for optimal efficiency and density, resulting in maximum return on investment. The low power budget - the ratio of power consumption and related heat dissipation to computing power - of the AMD Opteron processors permits a high computer density, a key purchase criteria in the data center.

The powerful PRIMERGY BX630 blade server offers low power consumption and increased performance for memory-intensive applications. AMD Opteron-based PRIMERGY BX630 blade servers can be installed in the current PRIMERGY BX600 chassis and mixed with existing Intel® Xeon® based PRIMERGY blade servers, the BX620 S2 or BX660 variants, enabling customers to choose the best technology for specific businesses and applications.

Customers will appreciate the natural scalability of the new Fujitsu PRIMERGY BX630 server. A feature of the AMD Opteron architecture - the HyperTransport interconnect - makes it possible to link a pair of the PRIMERGY BX630 server blades into a single, 4-processor powerhouse server blade with the performance of a native 4-way server. This configuration of the PRIMERGY BX630 server using the dual-core AMD Opteron processors supports up to 8 processor cores, giving customers the flexibility to move new classes of applications to the PRIMERGY BX600 blade platform. This platform is ideal for simultaneously scaling out and scaling up data centers with increased efficiency and utilization.

The PRIMERGY RX220 rack-optimized 1U server, designed for high-performance computing (HPC) environments, leverages the excellent floating point (FP) performance of the

AMD Opteron processor. These memory-intensive arithmetic applications can also take advantage of the AMD Opteron's advanced memory architecture. The PRIMERGY RX220 rack server is fully integrated with the PRIMERGY Management Suite.

"The inclusion of AMD Opteron in the PRIMERGY family offers our customers the widest range of choices for how they build out their data centers to meet both current and future needs," said Richard McCormack, senior vice president of product and solutions marketing at Fujitsu Computer Systems. "With AMD Opteron-based servers, our customers will be able to achieve greater density and price performance, two top-level data center goals."

Service and Support

Professional services from Fujitsu Computer Systems ensure successful implementation and support of the most complex operating environments.

About Fujitsu Computer Systems Corporation

Headquartered in Sunnyvale, Calif., Fujitsu Computer Systems is a wholly owned subsidiary of Fujitsu Limited (TSE:6702) committed to the design, development and delivery of advanced computer systems and managed services for the business enterprise. The company offers a complete line of high-performance mobile and desktop computers, scalable and reliable servers as well as managed and professional services. Fujitsu Computer Systems emphasizes leading-edge technology, exceptional product quality, and productivity, as well as outstanding customer service. More information on Fujitsu Computer Systems is available at http://us.fujitsu.com/computers.

About Fujitsu: Fujitsu is a leading provider of customer-focused IT and communications solutions for the global marketplace. Pace-setting device technologies, highly reliable computing and communications products and a worldwide corps of systems and services experts uniquely position Fujitsu to deliver comprehensive solutions that open up infinite possibilities for its customers' success. Headquartered in Tokyo, Fujitsu Limited (TSE:6702) reported consolidated revenues of 4.7 trillion yen (US$44.5 billion) for the fiscal year ended March 31, 2005. For more information, please see: www.fujitsu.com.

Yahoo Groups Yammerings

Len Schwer - Schwer Engineering & Consulting Services
Len@Schwer.net

Since April 2000 there has been a Yahoo Groups discussion list devoted to LS-DYNA. The group started with a focus of helping ANSYS users with LS-DYNA 'solver.' It has long since lost the ANSYS subgroup emphasis and is now devoted to improved understanding and use of LS-DYNA. There are over 1500 subscribers from all over the world, and the 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** .

There are several LS-DYNA 'experts' offering advice on all topics e.g. ALE (Rudolf Bötticher) and SPH particle methods ("SPH_USER" a Nome deplume). By far the greatest contributor to the collective knowledge is Jim Kennedy, who singularly is responsible for the success of this group. Past posting are searchable via the Yahoo Groups web site and provides a wealth of information.

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** .

As a sample of the kind of questions and responses that can be found in the archives, and in the daily email exchanges, below I reproduce a question and response provided by me with an nice augmentation by Suri Bala of LSTC.

Subject: Peak load does not converge during mesh refinement?

My simulation can be simply illustrated as follows: there is a rectangular steel plate with groove, let's say a single groove that divides the plate into two parts. One side is clamped along its edges and the other said is free. The free side is impacted by a rigid body with initial an velocity. Due to the impact, the plate will tear along the groove.

For element deletion I set failure strain to 0.6 (too large?). This is the only failure criterion I applied. What I am monitoring is the peak impact load which occurs before the initial erosion of elements along the groove. This peak load is getting lower and lower as I use a more dense mesh. I do not find that the load tends to converge?

Response by Len Schwer:

Let me try to explain with a trivial example how mesh refinement and failure strain can interact in a mesh refinement study.

Suppose there is a cantilever beam, end loaded, such that the strain in the beam is given by epsilon = sin(0.5*pi*x/L) for the end load P=P* (failure load with strain = 1 at x=L).

The beam is modeled by constant strain elements for the following cases:

1 Element - strain = sin(pi/4) = 0.71 (at mid-point of the element).

2 Elements - strain = sin(pi/8) = 0.38 & sin(3*pi/8) = 0.92

4 Elements - strain = sin(pi/16) = 0.20 & sin(3*pi/16) = 0.56
strain = sin(5*pi/16) = 0.83 & sin(7*pi/17) = 0.98

If your model is to provide for failure in each of the above cases, the failure strain would have to INCREASE with model refinement, i.e.

1 Element - failure strain 0.72
2 Elements - failure strain 0.92
4 Elements - failure strain 0.98

Conversely, if you selected an ad hoc failure strain of say 0.6, then in each case the as the mesh is refined, the load to obtain failure would be DECREASING less than P*.

I hope this provides some insight into why failure based on strain is not unique.

Follow-up Response by Suri Bala

Failure/Damage in finite element analyses is in general ‘element size/model scale’ dependent. Recent improvements in LS-DYNA related to this is the use of non-local failure parameters where the intent is that the element size dependency is vastly reduced by taking a weighted average of the failure parameter in the neighborhood of interest.

Considering the example from Len with strains (a, ab, abcd) in the case of 1,2, and 4 elements, the corresponding weighted average strains would be {a, (a1*a+a2*b), (b1*a+b2*y*b+b3*c*z+b4*d)} where a[1-2], b[1-4] are weights This yields strains of approximately {0.7, 0.65, 0.6425} at the center of the beam, which are in close agreement. The use of *MAT_NONLOCAL eliminates the need to tweak the failure parameters as the mesh is refined.

TOP CRUNCH NEWS – Benchmarks Online

Dr. David Benson – www.topcrunch.org - 09/17 – 11/22

The objective of TopCrunch is to track the aggregate performance trends of high performance computer systems and engineering software. Instead of using a synthetic benchmark, actual engineering software applications are used with real data and are run on high performance computer systems.

TopCrunch is not owned or operated by FEA Information Inc. but is supported by DARPA HPCS through a subcontract from the USC Information Sciences Institute. TopCrunch is run by Prof. David Benson at UCSD, with support from his students, post-docs, research engineers, and web site support from the Jacobs School of Engineering.

Two new features have been added to TopCrunch.

- Users can now select the number of processors in their search for results, allowing them to compare, for example, all the 16 processors, 3 vehicle results.
- The results can be sorted by column by clicking on the column heading. For example, they can be sorted and alphabetized by a list of vendor or date posted.

Vendor / Organization	Computer / Interconnect	Processor	#Nodes x #Processors per Node x #Cores Per Processor = Total #CPU	Time (Sec)	Benchmark Problem	Date
Rackable Systems/AMD	Emerald/PathScale InfiniPath / Silverstorm InfiniBand switch	AMD Dual-Core Opteron Model 275 (2.2GHz)	64 x 2 x 2 = **256**	239	neon_refined	11/04/2005
Rackable Systems/AMD	Emerald/PathScale InfiniPath / Silverstorm InfiniBand switch	AMD Dual-Core Opteron Model 275 (2.2GHz)	64 x 1 x 2 = **128**	258	neon_refined	11/04/2005
Rackable Systems/AMD	Emerald/PathScale InfiniPath / Silverstorm InfiniBand switch	AMD Dual-Core Opteron Model 275 (2.2GHz)	32 x 2 x 2 = **128**	268	neon_refined	11/04/2005
Rackable Systems/AMD	Emerald/PathScale InfiniPath / Silverstorm InfiniBand switch	AMD Dual-Core Opteron Model 275 (2.2GHz)	48 x 1 x 2 = **96**	294	neon_refined	11/04/2005

Rackable Systems/AMD	Emerald/PathScale InfiniPath / Silverstorm InfiniBand switch	AMD Dual-Core Opteron Model 275 (2.2GHz)	32 x 1 x 2 = **64**	373	neon_refined	11/04/2005
Rackable Systems/AMD	Emerald/PathScale InfiniPath / Silverstorm InfiniBand switch	AMD Dual-Core Opteron Model 275 (2.2GHz)	16 x 2 x 2 = **64**	394	neon_refined	11/04/2005
Rackable Systems/AMD	Emerald/PathScale InfiniPath / Silverstorm InfiniBand switch	AMD Dual-Core Opteron Model 275 (2.2GHz)	64 x 2 x 2 = **256**	1988	3 Vehicle Collision	11/04/2005
Rackable Systems/AMD	Emerald/PathScale InfiniPath / Silverstorm InfiniBand switch	AMD Dual-Core Opteron Model 275 (2.2GHz)	32 x 2 x 2 = **128**	2655	3 Vehicle Collision	11/04/2005
Rackable Systems/AMD	Emerald/PathScale InfiniPath / Silverstorm InfiniBand switch	AMD Dual-Core Opteron Model 275 (2.2GHz)	48 x 1 x 2 = **96**	3092	3 Vehicle Collision	11/04/2005
Rackable Systems/AMD	Emerald/PathScale InfiniPath / Silverstorm InfiniBand switch	AMD Dual-Core Opteron Model 275 (2.2GHz)	24 x 2 x 2 = **96**	3216	3 Vehicle Collision	11/04/2005
Rackable Systems/AMD	Emerald/PathScale InfiniPath / Silverstorm InfiniBand switch	AMD Dual-Core Opteron Model 275 (2.2GHz)	32 x 1 x 2 = **64**	4167	3 Vehicle Collision	11/04/2005
Rackable Systems/AMD	Emerald/PathScale InfiniPath / Silverstorm InfiniBand switch	AMD Dual-Core Opteron Model 275 (2.2GHz)	16 x 2 x 2 = **64**	4296	3 Vehicle Collision	11/04/2005
IBM/Oak Ridge National Laboratory	IBMP690/*Information Not Provided*	Power 4 1.3 GHz	2 x 32 x 1 = **64**	945	neon_refined	11/11/2005
IBM/Oak Ridge National Laboratory	IBM P690/*Information Not Provided*	Power 4 1.3 GHz	1 x 32 x 1 = **32**	1469	neon_refined	11/11/2005
IBM/Oak Ridge National Laboratory	IBM P690/*Information Not Provided*	Power 4 1.3 GHz	1 x 16 x 1 = **16**	2072	neon_refined	11/11/2005
IBM/IBM	IBM P690/*Information Not Provided*	Power 4 1.3 GHz	4 x 32 x 1 = **128**	706	neon_refined	11/14/2005

HP/HP	Opteron CP4000/Voltaire	Dual Core Opteron 2.2 GHz DL145	16 x 2 x 1 = **32**	6989	3 Vehicle Collision	11/15/2005
HP/HP	Opteron CP4000/Voltaire	Dual Core Opteron 2.2 GHz DL145	8 x 2 x 2 = **32**	8042	3 Vehicle Collision	11/15/2005
HP/HP	Opteron CP4000/Voltaire	Dual Core Opteron 2.2 GHz DL145	8 x 2 x 1 = **16**	12635	3 Vehicle Collision	11/15/2005
HP/HP	Opteron CP4000/Voltaire	Dual Core Opteron 2.2 GHz DL145	4 x 2 x 2 = **16**	14214	3 Vehicle Collision	11/15/2005
HP/HP	Opteron CP4000/Voltaire	Dual Core Opteron 2.2 GHz DL145	4 x 2 x 1 = **8**	23349	3 Vehicle Collision	11/15/2005
HP/HP	Opteron CP4000/Voltaire	Dual Core Opteron 2.2 GHz DL145	2 x 2 x 2 = **8**	26704	3 Vehicle Collision	11/15/2005
HP/HP	Opteron CP4000/Voltaire	Dual Core Opteron 2.2 GHz DL145	2 x 2 x 1 = **4**	44934	3 Vehicle Collision	11/15/2005
HP/HP	Opteron CP4000/Voltaire	Dual Core Opteron 2.2 GHz DL145	1 x 2 x 2 = **4**	51388	3 Vehicle Collision	11/15/2005
HP/HP	Opteron CP4000/Voltaire	Dual Core Opteron 2.2 GHz DL145	1 x 2 x 1 = **2**	89555	3 Vehicle Collision	11/15/2005
HP/HP	Opteron CP4000/Voltaire	Dual Core Opteron 2.2 GHz	1 x 1 x 2 = **2**	99578	3 Vehicle Collision	11/15/2005

LSTC Training Classes

LSTC Training Classes:

Jane Hallquist,
Training Coordinator
LSTC California
(jane@lstc.com)
Tel: 925-449-2500

Michigan Location:
1740 W. Big Beaver Rd
Suite 100 , Troy , MI 48084
voice: 248-649-4728
fax: 248-649-6328
www.lstc.com

2006 classes are now being schedule in California and Michigan.

Introductory LS-DYNA Training Class

- January 16-19 – Michigan
- February 07-10 – California

Advanced LS-DYNA Training in Impact Analysis

- February 23 – 24 – Michigan

ALE/Eulerian & Fluid Structure Interaction in LS-DYNA

- February 15 – 17 – California

Mesh-Free Methods in LS-DYNA (SPH-EFG)

- February 1-3 - California

Jane Hallquist **- jane@lstc.com**

LSTC Distribution & Consulting Channel – November

FEA Participants for LS-DYNA Sales – Support –Training – Benchmark – Consulting

Listing of a few of the many products they distribute

Japan – CRC

www.engineering-eye.com/

- LS-DYNA
- LS-PREPOST
- LS-OPT
- FEMB
- MSC. Marc
- MSC.Nastran
- DYNAFORM
- VPG

Sweden – ERAB

www.erab.com

- LS-DYNA
- LS-PREPOST
- LS-OPT
- Oasys Primer
- TrueGrid
- FEMB
- DYNAFORM
- GLview
- VPG

USA – Predictive Engineering

www.predictiveengineering.com

- **Specializing in finite element analysis (FEA).**
- **Models via expertise in thermal/fluids (CFdesign), drop-testing (LS-DYNA), kinematics modeling, and static/dynamic/nonlinear/thermal structural analysis (FEMAP / NX.Nastran).**

USA – ETA

www.eta.com

- VPG
- DYNAFORM
- FEMB
- LS-DYNA

EVENTS - 2006

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

April 24-26
MSC.Software 2006 Americas Virtual Product Development Conference, Detroit, MI, US

May 02-04
2006 International ANSYS Conference, Pittsburgh, PA., US

July 02-06
ICSV13 Vienna - Vienna, Austria

June 04-06
LS-DYNA
9th International LS-DYNA Users Conference – Deerborn, MI, US (LSTC)

July 05-07
Heat Transfer 2006, The New Forest, UK

July 16 –22
7th World Congress on Computational Mechanics,
California, US.

LS-DYNA Resource Page

Interface - Hardware - OS and General Information

Participant Hardware and OS that run LS-DYNA (alpha order)
All Hardware and OS listed have been fully QA'd by Livermore Software Technology Corporation

AMD Opteron	Linux
CRAY XD1	Linux
FUJITSU Prime Power	SUN OS 5.8
FUJITSU VPP	Unix_System_V
HP PA8000	HPUX
HPIA64	HPUX or Linux
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 (alpha order)

Fully QA'd by Livermore Software Technology Corporation

Vendor	O/S	HPC Intereconnect	MPI Software
AMD Opteron	Linux	InfiniBand (Silver-Storm), 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

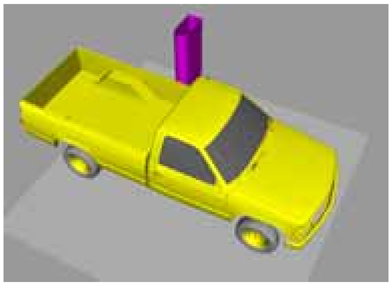
Includes a complete CAD interface capable of importing, modeling and analyzing, any die design. Available for PC, LINUX and UNIX, DYNAFORM couples affordable software with today's high-end, low-cost hardware for a complete and affordable metal forming solution.

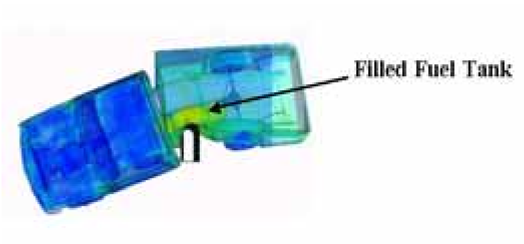
ETA – VPG
www.eta.com

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

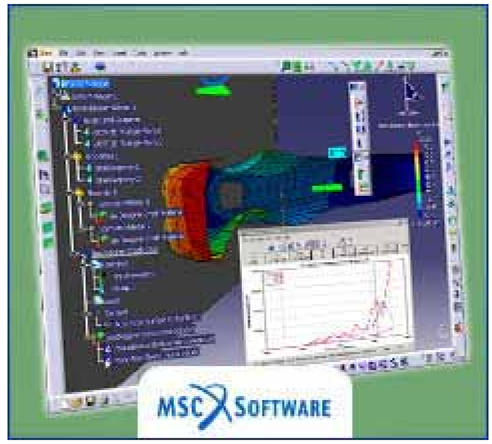
The MSC.Nastran™ Explicit Nonlinear product module (SOL 700) provides MSC.Nastran users the ability access the explicit nonlinear structural simulation capabilities of the MSC.Dytran LS-DYNA solver using the MSC.Nastran Bulk Data input format. This product module offers unprecedented capabilities to 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.

The MSC.Nastran Sol 700 will be released in November 2005. Beta release is available now !

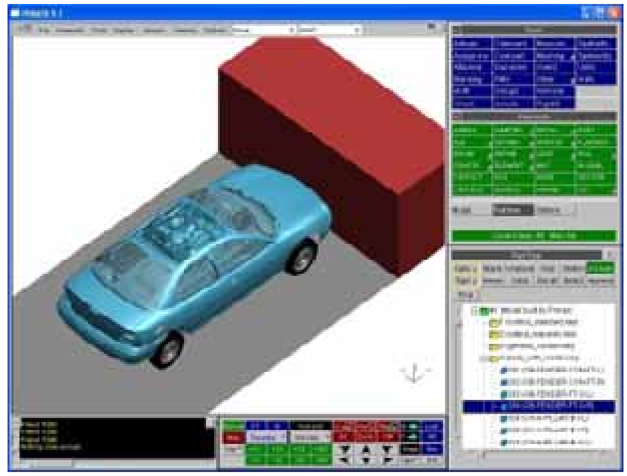
MSC.Software – Gateway for LS-DYNA

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

AMD

www.amd.com

FUJITSU

www.fujitsu.com

hp invent

www.hp.com

IBM

www-1.ibm.com/servers/deepcomputing

intel

www.intel.com

NEC

www.nec.com

sgi

www.sgi.com

CRAY

www.cray.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**
Turkey	FIGES **www.figes.com.tr**
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 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

Educational & Contributing Participants

Alphabetical Order By Country

China	Dr. Quing Zhou	Tsinghua University
India	Dr. Anindya Deb	Indian Institute of Science
Italy	Professor Gennaro Monacelli	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

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.

Archived News Information On Site for November

Decades of globally recognized mainframe expertise provides the foundation of every PRIMEPOWER® SPARC® Solaris™ server. Unique to the industry, Fujitsu server development began in the data center, forging a technology that can withstand the heavy business demands for mission critical availability and massive scalability.

Presentation downloads are available on website.

The Primer 9.1 presentation is highly recommended

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

---

- Direct read in of IGES, NASTRAN®, , MADYMO and LS-DYNA® data
- Fully automatic meshing and automatic weld creation
- Rapid graphical assembly of system models
- Coupling between FE and rigid body models using EASi-CRASH's multi-window/multi-models/multi-application environment with visual verification

---

Deep Computing: delivering innovative and powerful breakthrough solutions to address the demands of intense computation, visualization, or manipulation and management of massive amounts of data

Release: MSC.ADAMS 2005 r2 - MSC.ADAMS is a multi-body dynamics simulation solution that allows engineers to gain an in-depth understanding into the performance of their mechanical systems. Several significant enhancements aimed at increasing user productivity have been implemented in MSC.ADAMS 2005 r2 including:

- Improved flexible system modeling plus further integration of MSC.ADAMS and MSC.Nastran for higher-fidelity durability simulations.
- New experimental capability for exporting validated MSC.ADAMS models to MSC.Nastran for detailed NVH analysis

---

Audi AG chooses LS-OPT and LS-DYNA

Stuttgart, Germany, 30 August 2005 – DYNA*more* GmbH, the German LS-DYNA distributor, announces that with Audi AG another new important customer from the automotive industry has become an LS-OPT and LS-DYNA user.