2nd Anniversary Issue

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Technical Writer	**Uli Franz**
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Announcement: We are proud to start our 2nd anniversary issue by welcoming our new Technical Writer, Uli Franz of DYNA*more*, Germany. Additionally, Arthur B. Shapiro is now Editor for Technical Content.

Trent Eggleston, Editor

Editorial
Meshing Methods: Advantages and Disadvantages

A brief survey of my favorite meshing techniques
Trent Eggleston, Editor - FEA Information, Inc.

Due to the many available commercial meshing software products on the market, almost no names in this editorial are mentioned - except for Delaunay, who died about a hundred years ago.

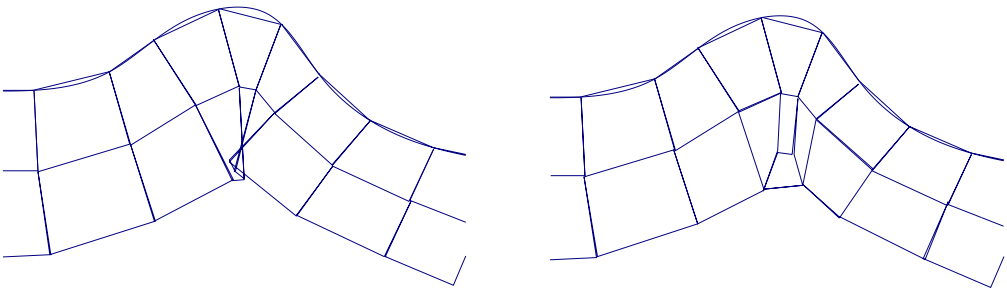
A mesh generator is a computer program that decomposes a computer model of a physical object into small pieces suitable for use by a physics simulation code such as LS-DYNA. Or a mesh generator is a person who must use one of these brutish programs. The decomposition produced by a mesh generator is called a mesh and pieces are called elements.

Not all decompositions of an object are created equal when it comes to finite element simulation. A mesh that is best suited for a finite element structural analysis should consist of some combination of quadrilateral shell elements, hexahedron solid elements, and beam elements. The quadrilateral elements should be as square as possible: the interior angles should be as close to 90 degrees as possible, and the aspect ratios (ratio of longest side to the shortest) as close to 1 as possible. Similarly the hexahedron elements should be as cubic as possible. The element sizes should be no smaller than absolutely necessary, and element sizes of neighboring elements should vary no more than about 10% or 20%. In my opinion the holy grail of meshing is that the mesh should be generated automatically.

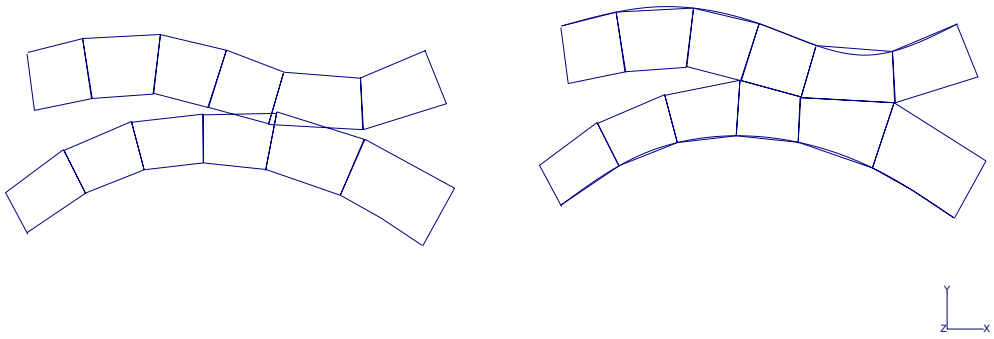
Paved Quadrilateral Mesh

Fully automatic 2D quadrilateral mesh generation is possible using the paving method. The idea behind the paving method is suggested by its name: one marches along the boundary of a 2D region (including around holes) and lays strips of quadrilateral elements in much the same way that one might lay sidewalk. The outer boundaries are discretized and elements are created by starting at the points on the boundary and moving toward the inside of the region in a direction that is roughly perpendicular to the boundary. A fourth side is added to close off the element.

Any implementation of the paving method must include methods for fixing elements whose own edges collide



and for zipping up the mesh when the previously paved layers begin to merge.

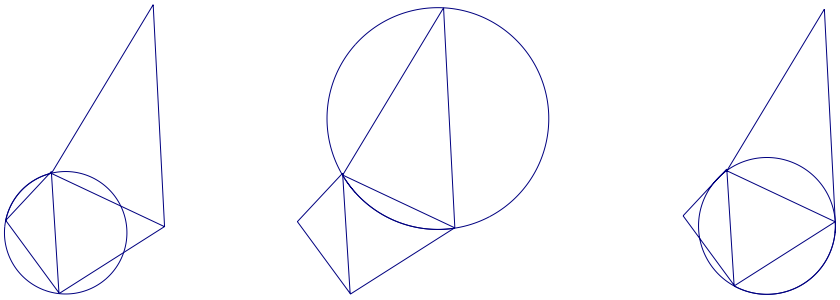


Paving cannot produce an all-quadrilateral mesh for even a simple region with no interior holes unless you start with an even number of nodes around the boundary. To see this, simply note that the number of outer boundary edges of a quadrilateral mesh is 4 times the number of quadrilaterals minus 2 times the number of shared edges. So the algorithm to zip merging paved layers must be done in such a way that the new boundaries contain an even number of edges. Otherwise the paving algorithm must produce triangle(s).

The paving method can be extended to produce a mesh of 3D surfaces, and this makes it one of the most effective automatic shell meshing methods. Any fully featured mesh generator should include such a paving algorithm.

Delaunay Triangular Mesh

A triangulation is called a Delaunay triangulation if the circumscribing circle of each triangular element contains no other points of the mesh in the interior of the circle. An example of such a mesh is shown below, along with the circumscribing circles.



The Delaunay method is used to produce a Delaunay mesh for an arbitrary set of points in the plane. In fact, such triangulations are unique under reasonable restrictions on the points.

To use the Delaunay method, begin with a set of points in the plane. Connect all of the points to all of the other points in the set--the outermost segments define the boundary of the so-called convex hull of these points. It is a theorem that one can find a Delaunay triangulation of the convex hull of these

points. In fact, the resulting triangulation is unique if no four of the original points lie on a common circle.

The uniqueness of a Delaunay mesh is quite convenient because it will apply to small submeshes as well, and it is this property that allows one to reduce the global Delaunay property to a local one.

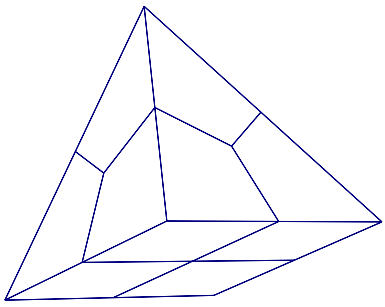
The basic Delaunay method has at least two defects. The first defect is that it tends to produce needle thin elements that are not suitable for finite element analysis. Fortunately, various quality control algorithms exist to fix the mesh after the fact, and are guaranteed to converge. The second defect is that algorithm does not preserve boundaries. That is to say if you start with a region which has a boundary different from the convex hull of the boundary points, then the resulting mesh may enclose the entire convex hull instead of just the desired region. The solution to this problem is a part of the conforming Delaunay algorithm.

The surface Delaunay methods do not extend well to 3D surfaces for obvious reasons.

Hexahedron Mesh

Three-dimensional paving algorithms have not been successful except in very special cases. Starting with a quadrilateral surface mesh on the outer boundary of a solid region and attempting to pave in 3D has proven to be too difficult to handle. The number of possible ways in which the paved layers can collide in 3D is perplexing.

It is interesting to note that the proponents of 3D paving worked for many years before even asking the question of whether or not such an algorithm can work. That is, given a quadrilateral mesh of a boundary of a simply-connected 3D region with an even number of elements, is it possible to produce a hexahedron mesh whose boundary is the given quadrilateral mesh? The following problem was offered as a simple challenge to those who believed it was possible:



This seemingly innocuous problem was solved around 1996, but only in a graph theoretic sense. The proposed solution contains 19 elements and it is not clear whether or not the edges can be adjusted so that the resulting elements are suitable for finite element analysis. The answer to the general question is yes, provided you accept elements that may not be acceptable for finite element analysis. It is amazing that tens of millions of taxpayer dollars were spent trying to develop 3D paving algorithms before this fundamental question of existence was resolved.

One conclusion of those promoting 3D paving is that it was better to try to construct decompositions of 3D solids using large blocks instead of the smaller elements. It seems they may have failed to recognize the equivalence of these problems.

So far the most effective, sure-fire approach to quality hexahedral meshing has been the INGRID approach: Fill the solid object with blocks, and force the outer boundaries to conform to the 3D surfaces that define the outer boundaries of the region.

Tetrahedron Mesh

A tetrahedron mesh is a Delaunay mesh if the circumscribing sphere of each tetrahedron element contains no node points in the interior of the sphere. Delaunay algorithms do exist for tetrahedron meshes. And conforming Delaunay algorithms exist which allow one to construct a 3D tetrahedron mesh whose outer boundary is a given triangular mesh. Unfortunately, there seem to be no good Delaunay-type methods to produce the required triangular mesh of the outer boundary.

Tetrahedron meshes have come into vogue for the reason that they can be reliably and automatically constructed. A finite element analysis using such a mesh may not produce answers that are as accurate as for a hexahedron mesh. But manually creating a realistic, quality hexahedron mesh of the air beneath a hood that actually conformed to all of the parts inside would most likely require years of effort.

Surface Meshing and CAD Geometry Fixup

Surface meshing is required for shell element meshes, and tetrahedron mesh generators require a triangular boundary surface to get started. It is no wonder so much effort is spent on automatic surface meshing methods.

Surfaces from modern CAD systems are normally described by mathematical functions such as

$$S(u,v) = (X(u,v),Y(u,v),Z(u,v)),$$
$$0 <= u <= 1, 0 <= v <= 1.$$

These surfaces may also be trimmed--that is, the domain (u,v) region is trimmed from a simple square to a general 2D region which may have holes cut in it. Nearly all conventional approaches to surface meshing involve meshing the 2D region in the (u,v) plane and adjusting the (u,v) mesh so that the surface mesh is of higher quality. Then the surface meshes of the individual pieces are joined together. Joining these surface meshes is a hard problem that exists largely because of the decision to use this "mapped meshing" method.

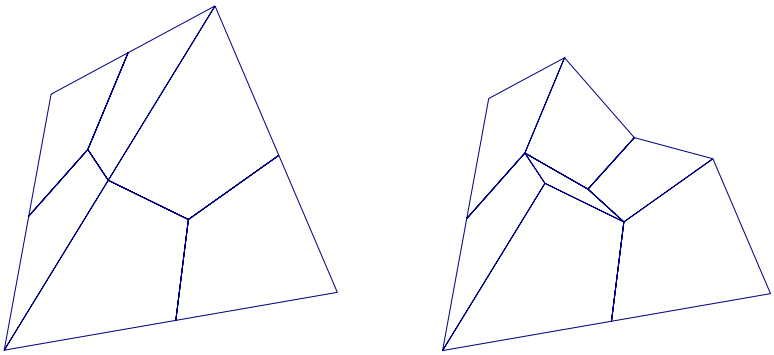
There are many problems associated with this traditional mapped meshing approach. First, it is difficult if not impossible to glue all of these hundreds of individual meshes together after the fact. Secondly, even if the meshes can be glued together, the individual surfaces may be so badly distorted or needle-like that the patched mesh requires extensive fix-up. And the fix-up methods may cause the nodes of the mesh to leave the prescribed geometry. Finally, gaps between surfaces and vastly different parametric representations of adjacent surfaces can confuse even the best algorithms of this type. Often the user is faced with recreating perfectly acceptable CAD geometry in order to simplify the gluing process, to eliminate needle-like surfaces, or to reduce gaps.

The projection method can be used to eliminate virtually all of these problems. First, a combination of paving and nearest-point projection can be used to create a mesh that will naturally extend across all of the surfaces to be meshed. Because nearest-point projection does not depend on the way the surfaces are built, but only on the final shape, small needle-like surfaces and parametric irregularities are irrelevant. Best of all, small gaps between surfaces don't cause problems. Nodes will lie on one side of the gap or the other--so if the gaps between surfaces are small compared to the size of the elements, then the gaps will not matter.

If the gaps between surfaces are comparable to the required element sizes, then the geometry really is garbage and should be fixed. However, this is rarely the case because most professional CAD operators are competent. All CAD geometry will have small gaps between surfaces unless the surfaces and their intersections can be represented exactly by CAD entities. The most general surfaces available in CAD are NURBS, which consist of piecewise ratios of polynomial functions. However, the intersection of piecewise rational functions cannot generally be represented as other piecewise rational functions. Even when the intersections can be so represented, the fitting algorithms used to create the intersection curves will have small errors. So CAD geometry gaps are a fact of life. Mapped meshing techniques are intolerant of these natural defects in CAD geometry and require the user to "fix" the geometry. Projection-based meshing methods are fault tolerant.

Converting Tet Elements to Hex Elements

A tetrahedron can be subdivided into four hexahedron elements as shown below. Tetrahedron meshes can be automatically generated from a triangle surface mesh. So this gives one way to automatically mesh a solid object with hexahedron elements. However, this does not give a way to fill an object with hexahedron elements whose boundary is a prescribed quadrilateral mesh. It does offer one automatic way to generate hexahedron meshes. The pictures below illustrates how four hexahedron elements can be used to create a single tetrahedron element—the top hexahedron element is removed in the picture on the right to reveal the details of this construction.



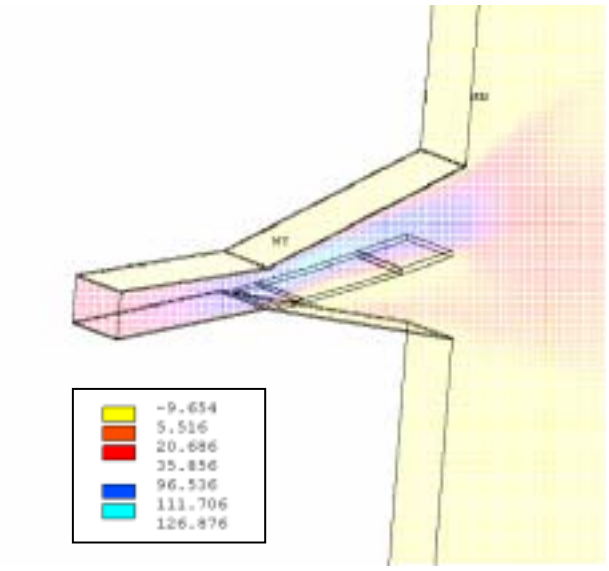
The angles of the hex elements produced in this way are rarely ideal, and there is no way to change this without removing angles by reconnecting the elements. The connectivity of these meshes is less than ideal, too, as can be seen in the dual mesh obtained by connecting the element centers. Here the dual mesh is quite circular in nature making it vastly different from the dual mesh of a simple INGRID block of hex elements. In situations where hex elements are critical, this method may prove to be quite valuable.

Center of Computer's Technology in Mechanics (CTM) Institute of Mechanics Lomonosov's Moscow State University

Fluid-Structure interactions example

GENERATOR OF PULSE JETS (GPJ)

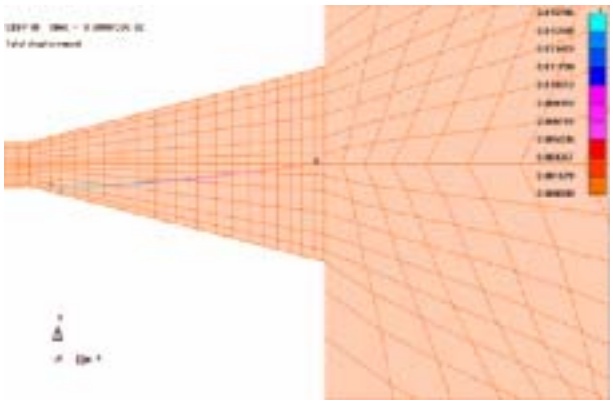
Guvernyuk S.V., Mossakovsky P.A., Zubkov A.F.

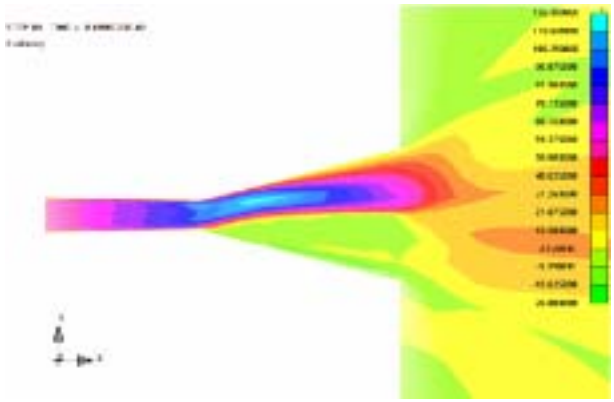


Generator of pulse jets (GPJ) is a pneumatic mechanical device that creates a pair of anti-phase pulse jets. GPJ is used to intensify the heat and mass transfer in chemical reactors and in spray-dispersion driers.

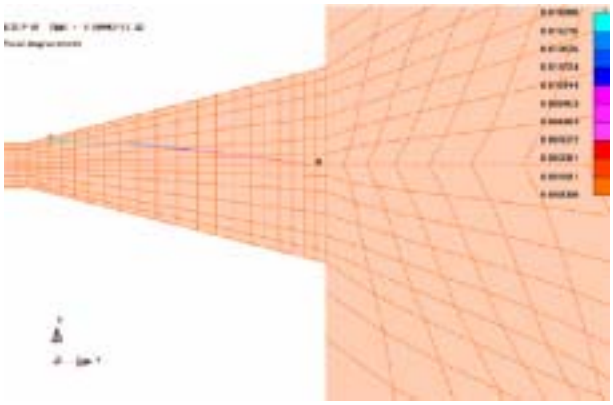
The principle of GPJ operation is based on the excitation of self-induced oscillations of the flow in a plane diffuser with a mobile longitudinal partition, possessing a degree of freedom in the transversal direction. The flow in such a diffuser (when the partition is placed symmetrically) is unstable. At startup, a spontaneous displacement of the partition causes a sharp rearrangement of the flow. The unbalanced fluid forces on the partition, caused by the straitened flow in the diffuser, cause the partition to move. The partition executes periodic transverse oscillations with an amplitude sufficient to cause the partition to collide with the walls of the diffuser. Experimental investigations show that there is a dependence of the oscillation frequency and amplitude on: (1) the dynamic head in the jet at the exit of the diffuser, (2) the geometry of the neck of the partition, and (3) the elastic properties of the partition and diffuser. The latter determine the value of the viscous-elastic kinetic energy losses of the partition during its collision with the walls of the diffuser.

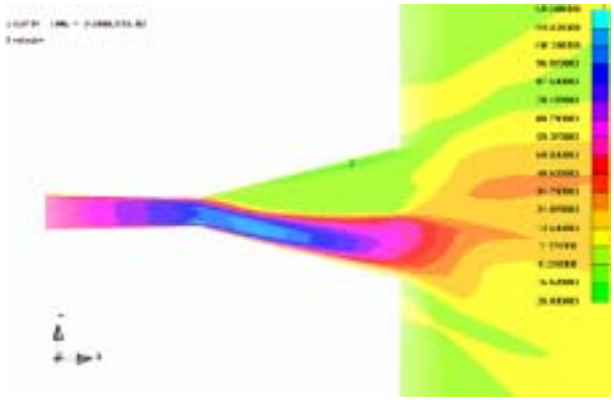
The numerical investigation of the GPJ-process in LS-DYNA was carried out with use of ALE-technology (Arbitrary Lagrangian-Eulerian formulation) jointly with the Van Leer MUSCL





algorithm (Monotone Upwind Schemes for Conservation Laws). The fluid was modeled using LS-DYNA constitutive model #9 with a linear polynomial equation of state. The mobile longitudinal partition was modeled using a linear elastic constitutive law.





HP helps New York Fire Department get fired-up for training © Copyright, HP
by Heather Schroeder

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HP, Intel®, Pinnacle Systems and B&H Photo and Video delivered a first-of-its-kind workstation solution for the Fire Department of New York (FDNY). The FDNY, as well as other fire departments around the country, today rely heavily on videos for training, archival and historical purposes. As with many fire departments, the FDNY realized over the last few years that their equipment was not keeping up with technology and was outdated. Digital Producer Magazine ran an article in May 2002 that focused on that very problem. Pinnacle Systems' General Manager, Jerry Thompson, read the story and decided to make a difference.

partnerships solve problems

Thompson realized he could not launch this on his own, so he enlisted three other industry leaders to help with the solution — HP, Intel and B&H Photo and Video. HP got involved through a close working relationship with Pinnacle Systems around PCs and workstations.

HP and the combined expertise and experience of the other three technology companies devised an all-digital solution to meet the needs of the FDNY as well as other organizations with similar digital editing needs. The joint solution also offers a graphic illustration of the power of partnerships to solve problems for companies and organizations of all sizes. Using two HP Workstation x4000s with dual

Intel Xeon™ 1.8HGz processors, the four companies built two first-of-its-kind digital video publishing workstations worth about $12,000 each. Using the HP Workstation x4000 systems and their high performance functionality, the applications really come to life. Both systems were donated to the FDNY in late August 2002.

The two workstations allow firefighters to capture on video fires and other emergencies in the field, and then quickly store, edit, view and analyze that video at headquarters. Such field videos can be incorporated into training films and used to stage specific emergency scenarios.

While the FDNY has used video for training techniques in the past, the process of creating those videos was time-consuming and antiquated.

major improvements — ease of use and quality

Fire officials are already using new digital cameras to capture footage, but that digital footage had to be transferred to a lower quality VHS tape format before it could be edited.

The latest software and hardware, donated by HP, Pinnacle Systems, Intel and B&H Photo and Video, will improve that process. FDNY believes the major improvements will come in the ease of use and quality by allowing all production to stay digital until it is ready for distribution.

"It works just like Windows down to the control panel and start…things most people are familiar with," said Jeff Bierly, the sales director of Pinnacle Systems. "It's very, very easy to customize and is very, very fast."

"HP is pleased to work with Pinnacle Systems on this amazing public safety project," said Jim Zafarana, HP vice-president of worldwide workstation marketing. "The events of September 11, 2001 focused attention on the importance of preparedness within the nation's fire departments. HP is elated that we could provide the FDNY with the reliable technology and expertise required to create and archive their data."

Keeping Personnel Safe " In the Line of Duty" © ANSYS Inc. Adapted from the website www.ansys.com

Challenge: To adapt Precision Remotes' TRAP T-2 remote platform—developed for use in civilian law enforcement organizations—into larger version for military operations

Solution: Implement DesignSpace® from ANSYS, Inc. simulation software to ensure redesign successfully accommodates weaponry up to .50 caliber

Benefits: - In compliance with strict military code HDBK-217 - Platform accommodates larger weaponry while maintaining ease of operation - Verified proposed design for confident prototype construction - Platform ready in time for live demonstration to military personnel

Introduction: Local, state and federal law enforcement agencies throughout the world have begun to investigate innovative and unconventional methods for diffusing potentially volatile situations and reducing the number of civilian and officer fatalities. Improvements to equipment, enhancements in training, and the increased use of personal protection devices—such as soft body armor—have gone a long way to help accomplish this goal. However, as the old adage goes, there is always room for improvement.

In 1997, Precision Remotes, Inc. (PRI) was founded in San Francisco, California, U.S.A. The design firm—specializing in what has come to be known as "telepresence" technology—responded to a need to keep police officers safe and out of the line of fire. Telepresence is defined as the next step beyond remote control, involving a multi-sensory connection between a remote device and its operator. This interface allows an instinctive control of the remote device with greater precision and an inherent understanding of its movements.

Although PRI's solution, the Telepresent Rapid Aiming Platform (TRAP), has not yet been adopted by police departments, it unexpectedly caught the attention of the United States Department of Defense. Representatives from three branches of the United States Armed Forces surmised that, in fact, the TRAP system could prove useful in full-scale military operations. PRI was subsequently approached to come up with a slightly larger version, which would be built to accommodate rifles up to .50 caliber for use in both standalone tripod- and vehicle-mounted situations—something not possible with the original T-2.

"We originally didn't target the military because, being non-military, we felt they must have similar (remote) platforms that we didn't know about," recalls Eric Hobson, one of PRI's chief mechanical engineers. "As it turns out, at this scale they do not." In fact, Hobson points out that many of the available systems similar to the original TRAP model were extremely heavy, not very accurate, and completely automatic—with little to no human operator control.

Challenge: World-renowned designer Graham Hawkes first conceived the idea for the TRAP system in 1991 and founded PRI to develop the design. “Graham realized that the police were put in a very difficult situation when set against well-armed opposition,” Hobson said. “They can’t tolerate any casualties, so matching force with force is very tricky. He thought there must be a better way to project force while not putting an officer in harm’s way.” This basic premise makes the TRAP system an ideal tool for use in dangerous scenarios like explosive ordinance disposal, hostage rescue, sniper/countersniper operations, and remote guard posting.

The TRAP system is designed to operate a range of light weaponry, sensors and/or surveillance lenses, making it practical for use in a variety of military, security and law enforcement applications. It is small, easy to conceal, and does not provide a potential human target for hostile gunfire. Moreover, the operator can alter the TRAP’s point-of-aim by as little as ⅓-inch at 100 yards, acquire a target, and—when used as a weapons mount—fire in less than two seconds with the dispersion and accuracy of a “benched” rifle.

This intricate remote system required a high degree of custom design and engineering, and many of the components used in its assembly had to be specially manufactured. Combined with the importance of the work for which it would be used, it was vital for PRI’s engineers to ensure that the TRAP system was designed and built to perform flawlessly, even under the most extreme conditions.

The largest issue PRI faced in constructing the new platform naturally centered on the sufficiently heftier size of the firearm to be mounted in it. For their initial design assumptions, PRI’s engineers anticipated a Barrett M82A-1—a large .50 caliber semi-automatic rifle—would be most commonly deployed in military field operations. Contrary to what one might expect, the main design concern originated not from the weight of the rifle itself, but rather from the force of the recoil or “kick” the rifle produces as it is fired.

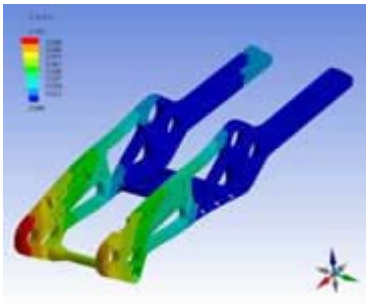
As a matter of simple physics, the higher the caliber of the projectile, the greater the force needed to propel it from the rifle barrel. As anyone who has ever fired a rifle will tell you, “the bigger the gun, the bigger the kick,” and consequently, the higher the degree of difficulty in maintaining a steady aim. As Eric Hobson himself observes, “The force required to hold this caliber weapon when it is discharged is substantial.”

In fact, as it is constructed, the M82 exerts approximately 86½ ft. lbs. of force when fired. Under ordinary circumstances, this would make the rifle nearly impossible for a human operator to effectively

control. However, the rifle's manufacturer, Barrett Firearms, includes a detachable "muzzle brake" with each rifle that helps reduce the overall kick by approximately 70%. Therefore, the net recoil force equates to nearly 26 ft. lbs.—or approximately the equivalent force of a standard 12-gauge shotgun. Still somewhat difficult to control, but not impossible.

Because of its 29-inch barrel, the M82 is generally fired from a "benched" position—often with V-shaped "spike legs" attached to the barrel to maintain its position on target. Therefore, the engineers at PRI had to determine how to best steady this larger rifle within the new platform's cradle to achieve bench-firing accuracy, while simultaneously maintaining the same lightweight, mobile construction of the platform's predecessor.

Solution: Using their custom-built dual-processing 550 MHz Pentium® III PhEnix PCs from Core Microsystems—running the Windows® 2000 operating system—the engineers set about the task of revising their original Autodesk Inventor and Mechanical Desktop T-2 models to meet the new specifications. Hobson and the other engineers at PRI turned to DesignSpace from ANSYS, Inc. to confirm their assumptions for the new T-250 platform. "We used DesignSpace to verify our geometry of the T-250 frame," said Hobson. "The analysis focused on the loading of the rifle carriage—the framework that the rifle interfaces with."



According to their calculations, PRI's engineers concluded that the same hard anodized 6061-T6 aluminum that was used in the construction of the original T-2 platform's rifle carriage required a thickness of ½-inch in the new one. Model tests on DesignSpace verified that this thickness would be appropriate to cradle the weight of the rifle—as well as help minimize the vibrations generated by its recoil—while simultaneously ensuring a manageable overall weight. Additionally, DesignSpace helped the engineers realize where excess material could be eliminated in the platform's construction in order to keep the weight of the platform down while at the same time, maintaining structural integrity.

Subsequent design iterations determined that a series of six 1½-inch diameter, ¾-inch thick rubber gun barrel dampeners also needed to be incorporated within the rifle carriage. "(The barrel dampeners') main function is to remove the high energy spike of the recoil. The recoil has a very high, very short shock that could damage cameras, etc.," notes Hobson. Because of the sensitive electronic surveillance

and control equipment that are integral components of the T-250, it is easy to see why these dampeners became an important design concern. DesignSpace was also instrumental in determining the exact position of these dampeners—one on either side at the front of the carriage, groups of two on either side slightly further back—for optimum recoil control.

Moreover, DesignSpace aided PRI's engineers in their analysis of the important pan spring support underneath the rifle carriage. This spring rotates the platform—in either direction—a total of 60 degrees from its original fixed position. "We're using a die spring that exerts about 400 lbs. (of force)," says Hobson. The T-250 is built upon a standard pintle mount—for easy attachment to both standalone tripods and vehicle-mounted applications. Therefore, it was vital to ensure that this spring's rotation force would not only be strong enough to move the rifle, but also not so strong that it would shake the platform loose from its mooring.

Benefits: Eric Hobson attributes part of the T-250's success to the use of DesignSpace from ANSYS, Inc. in its design and construction. "(DesignSpace verified) the proposed design so we could build the prototype with confidence. We had a live firing for our customers two days after getting the prototype assembled, so absolutely no surprises could be tolerated."

As with PRI's previous efforts, the T-250 performed to all expectations, achieving the same fully benched dispersion and accuracy as the original T-2 platform. Additionally, the T-250's final overall dimensions were even smaller than those of the T-2 (T-250=24 x 15 x 10 inches, T-2=33 x 16 x 13 inches). And, perhaps most astonishingly, the T-250 weighed in at only ten pounds heavier than its older brother.

More importantly, the platform has adhered to strict standards for both safety and reliability under military code HDBK-217. Its rated reliability for a one-year mission is more than 95%, while its probability of an inadvertent discharge is less than .00001%. Military personnel can also gain basic competency in the use of the T-250 with only an hour of instruction and can acquire expert level knowledge with only 10 hours of training.

The commercial (i.e. law enforcement agency) and full military versions of both the TRAP T-2 and T-250 are currently available from PRI. Meanwhile, the firm is also applying the TRAP technology to other devices. Among them: a fixed-based armed surveillance system for 5.56/7.62 caliber rifles (the T-2FS) as well as a series of remotely aimed optic and sensor stations (T-O). It is anticipated that these devices will prove invaluable in resolving urban terrorist scenarios as well as full-scale military operations while simultaneously saving the lives of countless military and law enforcement personnel.

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China	ANSYS Bejing	www.ansys.com (link on international)
France	Dynalis – Cril Technology Simulation	www.criltechnology.com
Germany	DYNAmore	www.dynamore.de
Germany	CAD-FEM	www.cadfem.de
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Italy	Altair Engineering srl	www.altairtorino.it
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Korea	THEME Engineering	www.lsdyna.co.kr
Korea	Korean Simulation Technologies	www.kostech.co.kr
Russia	State Unitary Enterprise - STRELA	www.ls-dynarussia.com
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USA	MSC.Software	www.mscsoftware.com
USA	DYNAMAX	www.dynamax-inc.com
USA	CEI	www.ceintl.com
USA	AMD	www.amd.com
USA	Dr. T. Belytschko	Northwestern University
USA	Dr. D. Benson	Univ. California – San Diego
USA	Dr. Bhavin V. Mehta	Ohio University
USA	Dr. Taylan Altan	The Ohio State U – ERC/NSM
USA	Prof. Ala Tabiei	University of Cincinnati
Russia	Dr. Alexey I. Borokov	St. Petersburg State Tech. University
Italy	Prof. Gennaro Monacelli	Prode – Elasis & Univ. of Napoli, Federico II

FEA Information September News archived on the site's News Page
www.feainformation.com

September 02

SGI	The Silicon Graphics Octane2 visual workstation delivers advanced desktop visualization
ETA	Background: ETA was established in 1983
ANSYS	ANSYS China – Distributor in China

September 09

OASYS	*Oasys* PRIMER is designed to make preparation and modification of LS-DYNA models as fast and as simple as possible
HP	hp pavilion zt1290 notebook pc
Cril/Technology	Distributor in France

September 02

Intel	Intel® server and workstation components
Flotrend	Distributor in Taiwan

Events & Conferences

2002	
Nov 16 - 21	**SC2002** Trade Show - High Performance Networking and Computing
Dec 18 - 21	**HiPC 2002** will be held in Bangalore, India known as the Silicon Valley of India.
2003	
Feb 18	**Fujutsu LS-DYNA seminar** will be held at Makuhari System Laboratory, Makuhari, Japan
May 19-21	**BETECH 2003** taking place at the Hyatt Regency Dearborn hotel in Detroit, USA - **15th International Conference on Boundary Element Technology**
May 22 - 23	**4th European LS-DYNA Conference** will be held in ULM, Germany presented by DYNAmore (Germany), Cril Technology Simulation (France), ARUP (United Kingdom), Engineering Research AB (Sweden) and STRELA (Russia)
June 17-20	**The Second M.I.T. Conference on Computational Fluid and Solid Mechanics,** taking place at Massachusetts Institute of Technology Cambridge, MA.,USA
2004	
May	**8th International LS-DYNA Users Conference** will again be held at the Hyatt Regency Dearborn, Fairlane Town Center, Dearborn, MI 48126 - hosted by LSTC and ETA

Press Release **Source: DaimlerChrysler**

The Chrysler Group Adopts Innovative Technology Approach To Impact Simulation Testing
Monday October 21, 9:05 am ET

* Use of a Linux Cluster of workstations results in new price- performance curve for part of the product development process.

* Collaboration with IBM, **Intel(R), LSTC** and Red Hat enables Chrysler Group to reach a new plateau in computer-aided engineering.

* Benefits include increased simulation speed and significant reduction in hardware investment, while maintaining the same precision per simulation.

DETROIT, Oct. 21 /PRNewswire-FirstCall/ -- The Chrysler Group unit of DaimlerChrysler announced today a revolutionary approach to the technology required to perform impact simulations during vehicle development. The announcement was made at the kickoff of Convergence 2002, the premier global transportation electronics conference.

The approach utilizes a Linux cluster of commercial-grade PCs, also known as workstations. It enables the Chrysler Group to perform impact analysis simulation at a speed that is 20 percent faster than Company's previously used hardware solution, maintaining the same precision required from the analysis of the simulations, and at a cost that is 40 percent lower than the other solutions available on the market today.

"The dramatic shift we are seeing in the price-performance curve on computers will allow us to perform impact analysis with greater precision and reduced turn-around time," stated Bernard Robertson, Senior Vice President of Engineering Technologies and Regulatory Affairs for the Chrysler Group. "We expect to see a direct contribution to the quality and safety measurements of our vehicles, as well as improved productivity, lower cost with faster speed-to-market."

Vehicle and occupant impact simulation accounts for 70 percent of the simulation computing capacity that the Chrysler Group engineering community utilizes on a daily basis. The need for new and innovative approaches that are implemented in a disciplined manner without compromising design creativity is significant.

The automotive industry is continually working to improve product efficiency in the areas of variable cost, cycle time and the function and performance of the vehicle. One means by which great strides have been made is in the area of computer-aided engineering (CAE) and simulation.

Supplier Collaboration Creates Innovative Approach

The new hardware strategy for simulation was born out of collaboration between the Chrysler Group's information technology team and IBM, **Intel, Livermore Software Technology Corp (LSTC)** and Red Hat:

* The Chrysler Group's technical and engineering team helped define the needs for impact analysis, including hardware performance and process

requirements. They also worked on system integration;

* IBM built the commercial-grade workstations, IBM Linux Cluster and Storage, to create a cluster. A108-node IBM IntelliStation cluster was deployed;

* **Intel(R) Xeon(TM) processors running at 2.2 GHz and Intel(R) PRO/1000 server adapters were used for high-level performance and flexible connectivity**;

* **LSTC provided a modified version of their LS-DYNA software to perform impact test simulations, in order to comply with Linux standards; and**

* Red Hat provided the Linux operating system, which is based upon open standards, in order for data to flow between differing computer hardware, utilizing a common software (LS-DYNA).

IBM Global Services experts worked with the Chrysler Group's technical and engineering team to implement the solution. Integrated together were IBM Intellistation M Pro 6850 workstations, TotalStorage FAStT500 using Gigabit Ethernet servers and other components to create a 108-node Linux cluster system.

"The creation of this new automotive approach was a total team effort between the Chrysler Group, IBM**, Intel**, Red Hat and **LSTC**. Our Linux and High-Performance Computing technical team worked closely with LSTC and Intel to build, configure and benchmark the application at IBM's Integration Lab in Minnesota, before shipping the cluster to the Chrysler Group in Michigan," stated Lucy Oakleaf, IBM Vice President, Sales and Business Development -- DaimlerChrysler. "These skills and this process helped eliminate potential issues during the implementation of the cluster at the Chrysler Group's Technology Center."

The cluster is based on Intel® Xeon(TM) processors running at 2.2 GHz. Intel Xeon processors are the heart of today's most advanced dual-processor (DP) workstations, delivering exceptional floating-point performance. The cluster also utilizes Intel PRO/1000 server adapters, which provides fast, flexible connectivity while enhancing performance with uncompromising speed, security and scalability.

"The same great volume economics that Intel brought to the PC, we now bring to workstations and servers, delivering complete solutions for high-performance technical computing. Intel-based clusters provide outstanding performance at a fraction of the cost of proprietary offerings," said Tom Gibbs, Director, Industry Solutions, **Intel**. "This price-performance, coupled with ongoing innovation by leading-edge software vendors and automotive IT experts, allow engineers to create better designs and quickly visualize complex data."

Livermore Software Technology Corp of Livermore California is a provider of finite element simulation software for the worldwide engineering and academic community. LS-DYNA is widely used by the automotive industry to analyze vehicle designs. LS-DYNA accurately predicts a car's behavior in a collision and the effects of the collision upon the car's occupants. With LS-DYNA,

automotive companies and their suppliers can test car designs without having to tool or experimentally test a prototype, thus saving time and expense.

An Evolution in Impact Simulation Testing

Since the early 1980s, the Chrysler Group's impact simulation strategy began with the adoption of one super computer that was used to run tests in a virtual world, replicating real-world scenarios. The cost of those computers at the time was tens of millions of dollars.

Technology evolved in a way that enabled the Chrysler Group to move from the one large computer to a network or cluster of computers for more efficient simulation computing, at a faster rate and lower cost. This phase, taking place between 1996 and 1999, introduced the Unix-based machines within the network.

Today's announcement marks another shift in the use of innovative and emerging technology. The Chrysler Group is able to utilize workstations in a network and marry the LS-DYNA software that has become an auto industry standard via the use of a Linux operating system.

The Move to Linux for Impact Analysis

Linux is an open-source operating system, the brain of the computer. It runs on a wide variety of hardware platforms, from small desktop systems to large mainframes or supercomputers.

Linux is cost-effective, reliable, and scalable that enables users the flexibility of running one operating system on a variety of hardware, often from different vendors.

The Chrysler Group will continue to look at new ways of applying the Linux Cluster technology to its other types of simulations, such as computational fluid dynamics, noise vibration and harness, metal forming, among others.

On The Internet

Visit DaimlerChrysler's Media Services Web Site at **http://media.daimlerchrysler.com** for additional DaimlerChrysler news.