PAM TALK

NEWS FROM THE VIRTUAL TRY-OUT SPACE

ISSUE 29

SUMMER 2005

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PAM-VA One launch

PAM-STAMP 2G 2005

PAM-FORM 2G 2005

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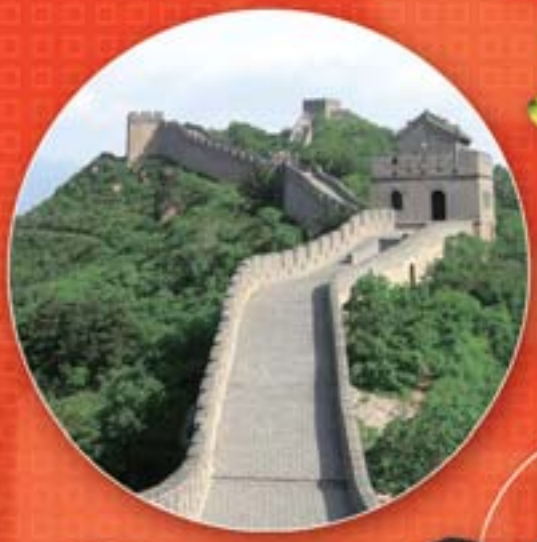
PARD uses SYSWELD for Spot Welding



Special Report on China

R & D

Can you crash Moore's law ?!

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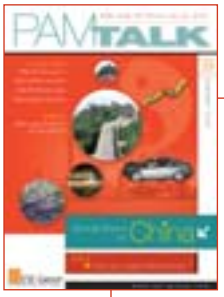

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editorial

I am very pleased to have this opportunity to introduce Issue 29 of PAM TALK having recently joined ESI Group in the capacity of Operational Vice President, Sales & Marketing. In this issue we feature a special report on China and the new releases of PAM-STAMP, PAM-FORM and PAM-CRASH and the exciting introduction of PAM-VA One, the 'One' integrated solution for full-frequency vibro-acoustic simulation.

In the following years, China will become one of the largest economies in the world.
Its continued economic growth fuelled by foreign investment is making China one of the most strategic markets in the world. ESI Group has distributed its products in China for many years through ESTI Engineering Simulation Technology Inc. In 2004 ESI Group acquired ESTI Engineering Simulation Technology Inc., to form Zhong Guo ESI Co., Ltd. To meet its customers growing needs, Zhong Guo ESI Co., Ltd. has recently opened office in Shanghai, the home of the Chinese automotive industry. You can learn more of ESI Groups expansion in China by reading the special report in this issue of PAM TALK.

editorial

ESI Group's commitment to innovation and the provision of unique simulation based design solutions for our customers is once more fulfilled with the introduction of PAM-VA One. Heralded by industry professionals as the most significant break-through in vibro-acoustics over the last twenty years, PAM-VA One is the world's first fully integrated environment for simulating the response of vibro-acoustic systems across the entire frequency spectrum. You can learn more about this unique software by reading the article which follows.

ESI Group continues to meet its commitments to its customers through high R & D investment in advanced simulation based design solutions to help our customers meet the growing demands of competition and technology innovation. Come and join us at EuroPAM 2005 being held in Potsdam Germany in October to learn more of the solutions offered by ESI Group and discuss your problems with industry professionals and ESI technologists. You can obtain further information on EuroPAM and register for attendance by accessing the dedicated web site http://www.esi-group.com/EuroPAM2005/

Brian Butcher
Operational Vice President
Sales & Marketing
ESI Group

Special report on China

Zhong Guo ESI

ESTI Engineering

Simulation Technology Inc. was set up in May 2000 to market ESI Group's simulation software in China. Since its creation, ESTI has shown its ability to build a diverse customer base which includes many of China's leading industrial companies.

The acquisition ESTI Engineering Simulation Technology Inc., in 2004 by ESI Group, is part of ESI's strategy to build a large distribution network in Asian markets with high potential. Acquiring control of its former Chinese agent allows ESI Group to extend existing partnerships with such key customers as Shanghai Volkswagen, First Auto Works, Dong Feng Motors and Harbin Hafei Motors and with leading universities in this area.

Following the take over, Engineering Simulation Technology Inc. was renamed Zhong Guo ESI Co., Ltd. Zhong Guo ESI Co., Ltd is responsible for the distribution of ESI Group software in China together with the provision of bespoke services to meet customer needs in design, engineering, manufacturing. With its head office at Guangzhou, the southern gateway to China, Zhong Guo ESI has expanded to meet its customers growing needs by opening a business office in Beijing in 2002 and another in Shanghai in 2005. Zhong Guo ESI maintains a close relationship with the most renowned Universities and Institutes of China, including Tsinghua University, Beijing University of Aeronautics & Astronautics, Harbin Institute of Technology, Tianjin University, Shanghai Jiaotong University, Tongji University, Fudan University and China South Technological University .

Dr. Xiaojun YANG
General Manager
Zhong Guo ESI Co., LTD

Zhong Guo ESI has attracted clients of high repute including, the Amtek Group, Foxconn Group, General Motor, Shanghai Volkswagen as well as major Chinese companies such as China South Aero Engine, Dongan Engine, Dongfeng Motor, First Auto Works, Harbin Hafei Motor, Panzhihua steel, Shanghai Baosteel, Shanghai Supercomputing Center etc.

The automotive industry is the largest market for ESI products in China with a considerable demand for simulation in Stamping, Crash and Safety, while ESI Group solutions for Casting, and Vibro-Acoustics predominate in the aircraft and aerospace industries. The demand for Composite materials is increasing with expanding use of PAM-RTM, PAM-FORM and SYSPLY. Sysweld, ESI Group's heat treatment software, is gaining popularity in heavy and ship building industries.

ESI Products have become a key element to help "precision industries" improve the quality of their goods and reduce lead time, thus increasing the exportation of their production to the international market.

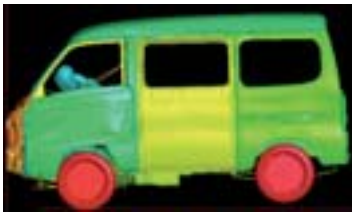
With an estimated 1.3 billion population, China is rapidly moving to become the largest domestic automotive market in the world. By 2020, China is forecasted to have 78 vehicles per 1000 people. Also, it is thought that in five years, 50 per cent of Chinese automotive sales, sold in the country, will be by local brands (FAW, Chery, Changan,etc…)

In the long term, China has every chance of becoming one of the most open and competitive markets in the world. With more to produce in less time and in better quality, CAE analysis is very useful to the Automotive OEMs. It is very likely that, in the upcoming years, we will see an increase in the need for simulation technology for automotive manufacturing and prototyping in China.

Exemples of Crash Simulation in China

Mini-Bus' Crashworthiness – First Auto Works

CMVDR 294, i.e. China Motor Vehicle Design Rule, was enacted on Oct 28. 1999, which is applicable to attest M1 vehicle for first-row outer-side occupant protection in frontal crash. The implementation of the rule is surely beneficial to enhance the technology level of Chinese vehicle passive safety. However manufacturers face some challenges in the production of mini-buses, which have been put on the market and do not satisfy the requirements of CMVDR 294. The common feature of these mini-buses is that few components can absorb kinetic energy in front of the A-pillar, and front wheels are located between A-pillar and B-pillar. When a crash occurs, the driver can be severely injured.



The weakness of mini-bus' passive safety mainly results from two points: the first is that its body crashworthiness is poor. When a crash occurs, the space for the driver is greatly reduced, and the driver's thigh and head suffer from direct physical injury. The second is that the driver's restraint system is not sufficiently well designed: either airbags are not adopted, or the restraint system is not well adapted to the driver's kinematics during the crash.

PAM-CRASH and PAM-SAFE were used for improving the design of the mini-bus of First Auto Works (FAW). The objective of the simulation was to study how to effectively improve the mini-bus' crashworthiness without changing the position of the wheels and without increasing too much the mini-bus' total length. After some parameters to improve the mini-bus' crashworthiness were put forward, two concepts to improve the mini-bus' crashworthiness were studied. On the basis of these studies, the mini-bus' body structure was modified, and its crashworthiness was significantly improved.

Train crash for high speed railway – China Academic Railway Institute

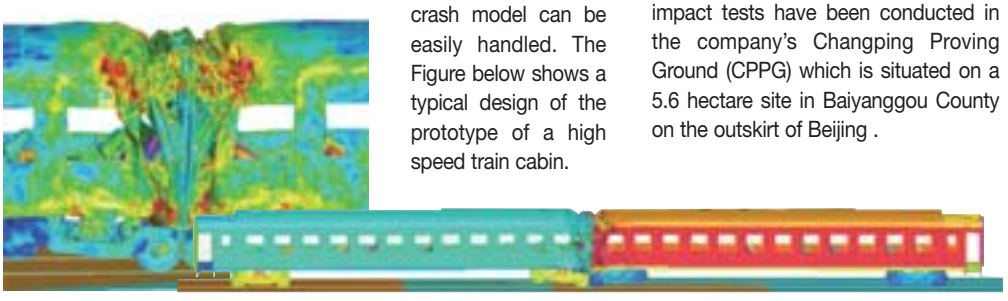
Railway has a very important role in China especially for long-distance travel. Today, the requirements for passive safety structural design applied to trains are more and more important due to the increase in the speed of the train each year. These requirements are the results of accidents which cannot be avoided by active safety measures.

An example is a train impacting a road vehicle at a highway crossing. In this particular case, the main occupant at risk in the train is the driver.

The assessment of train crashworthiness goes through radically different methodologies than passenger car crash design. The main reasons for this specificity are:

- the large size of the structures that makes detailed FE models larger than passenger car models,
- the cost of the structures allow only very limited physical full scale testing,
- the long duration of a train crash is several hundred milliseconds.

PAM-CRASH™ has been used in train crash applications at the China Academic Railway Institute. With the DMP version of PAM-CRASH 2G along with the attractive CRASH-EDITOR interface, the big crash model can be easily handled. The Figure below shows a typical design of the prototype of a high speed train cabin.



Barrier design for highway – Beijing Shenhuada Transportation Engineering

Beijing ShenHuaDa Transportation Engineering Co. Ltd (SHD) is a company specializing in road safety, traffic and transportation related tests (e.g: the roadside barriers, bridge barriers), research and development for various clients including the recent test of high containment parapet in accordance with SDMHKR for the Hong Kong-Shenzhen Western Corridor. The test facilities in SHD have been accredited by the China National Board for Laboratory (No. CNAL/AC01) and the capabilities of the laboratory include testing and calibration of vehicles, instrumentation of highway traffic safety protections and steel structure. SHD has close to 30 engineers who can handle full scale impact tests and computer simulation.

SHD has been using PAM-CRASH for the simulation of vehicles impacting a barrier for over four years. SHD owns authorized car models, bus models, double-deck models, truck models, dummy models and computer models that have passed the EN1317 requirement. The tests are all simulated using explicit FE models. The main projects include steel rail barriers, reinforced concrete barriers, tension wire barriers, stone barriers and crush cushions.

Since 2000, over 16 R&D projects have been carried out, more than 18 patents have been deposited and over 150 impact tests have been conducted in the company's Changping Proving Ground (CPPG) which is situated on a 5.6 hectare site in Baiyanggou County on the outskirt of Beijing .

PAM-STAMP for Progressive Stamping Simulation

Combined with the user's experience and skills, solving a complex progressive stamping project in one day has become possible

A progressive die performs a series of fundamental sheet-metal operations (at) two or more press (strike) stations in order to progressively develop a work piece as the metal strip moves from one die to the next. Each working station performs one or more distinct die operations. The strip must move from the first station, or stage, through each subsequent station to produce a complete part. When the total production volume for a given stamped part is high, a progressive die should be considered. The amount saved in total handling costs by progressive fabrication compared with a series of single operations is high enough to justify the extra cost of a progressive die.

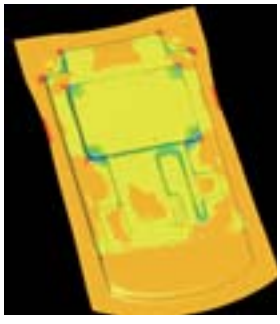
The quality of stamping coming from progressive dies is often higher than when done through individual dies. There is less chance for off-gage conditions due to part location problems, and the human factor has less influence on part's quality. The reduced labor costs together with the better quality of progressive die stampings, have been the key factors in justifying the choice of expensive coil stock over offal for stamping in recovery dies.

Because of the significant cost and quality benefits of progressive stamping, this technology is widely used on high volume domestic appliances, electronic and telecommunication interments, automobile accessories and computer peripherals. In Asia, the need for progressive stamping in metal stamping is more than 50% of the total market

It is well known that the design activity only represents a small portion (10% to 20%) of the total production cost of the part. However, decisions made at the design stage have a strong effect on the manufacturing and life cycle cost of a product. Due to the complexities involved in progressive stamping, the die design and development are usually made through a laborious trial-and-error process resulting in high cost and long lead-time. To meet the market needs in terms of production time, costs and also quality, CAE simulation is widely used in sheet metal stamping.

PAM-STAMP (and more recently PAM-STAMP 2G) has more than ten years experience in progressive stamping simulation. With many improvements in the software, it has become a major asset for companies in this field. Amtek Group is one of the pioneers of using simulation for such an application. The company was established in 1982 and manufactures precision metal stamping parts for computer and consumer electronics industries. Amtek Group has more than 30 subsidiaries and associated companies in Singapore, Malaysia, Indonesia, Thailand, China, North America, Mexico and France with the head office located in Singapore. Today, CAE simulation has become a standard procedure and key element in die design. Such technology has become an invaluable service to the customer at an early stage of the product design.

Mobile phone cover part (actual phone)



Simulation result of the mobile phone cover with thickness distribution

Results from Amtek Group / Mobile phone cover part and the simulation result

The crack of the left corner of the part (Actual photo)

The crack of the right corner of the part (Actual photo)

Simulation result of the crack, with element remove technology

Progressive dies typically run at relatively high rates, this in itself can cause some issues which are normally not encountered in standard transfer pressing. Notably the press rates mean that the part is formed at higher than usual 'strain rates'. It may be necessary to include this information in the simulation model, as for certain blank materials, it can have a profound influence on formability and springback. PAM-STAMP 2G offers a number of ways to incorporate the strain rate behavior of the blank material.

The very tight tolerance requirements which need to be met in many progressively stamped parts, place a great deal of importance on springback. Successful progressive die design will often need to consider the springback in between the stamping stages, in order to have the desired stamping effect in the following stage. Simulation with PAM-STAMP 2G offers fast and accurate springback simulation, helping the designer to improve the design of the entire strip layout.

A typical example is the forming of a mobile phone cover. Because the lead time was so short, it was impossible to do any trial-and-error in the die shop. CAE analysis must be carried out at an early stage, ideally during product design . However, due to new material and complex functional requirements, the forming process must be carefully studied in order to avoid cracks, wrinkling, and to control springback. Thanks to the new technology of PAM-STAMP 2G, multi-stage stamping is easy to setup and springback calculations are fast and accurate, making iterations and optimization during the design process much simpler than before.

In typical cases of mid-sized tooling, the time from design to prototype can be reduced by half through the use of PAM-STAMP 2G.

For Progressive Die Stamping, the use of CAE analysis can also be an effective way of enhancing the knowledge of die design (eg: training of a newcomer).

The modeling and simulation of progressive stamping dies should be carefully handled, as some times the model size can be very large:

1) For precision stamping, the radius of a part is often very small, almost a sharp edge sometimes. To conforme to FEA guidelines, the element size needs to be extremely small.

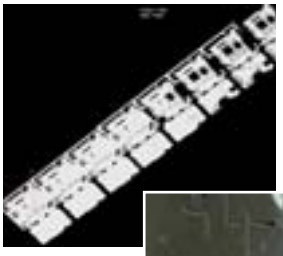
2) The high accuracy requirement also leads to reduced element size. Some times the flatness of the final part should be controlled within 0.10 mm, occasionally even less than 0.05mm.

3) Very small features, or negative clearance (light cold forging) can appear on the part. Solid elements or mixed element models are then used, due to the number of layers through the thickness, this results in even larger model sizes.

The PAM-STAMP 2G DMP solver technology helps to reduce the simulation time and to keep a high accuracy of the results. In the case of a progressive die for a complex computer casing as in Fig 2, with more than eight stages, the simulation can be done in one day with an eight CPUs Linux machine, from design stage to final result.

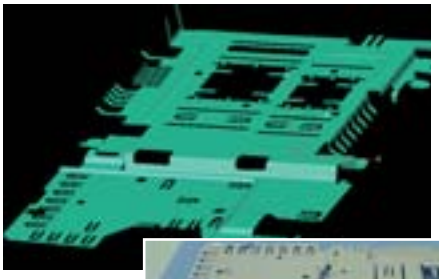
In conclusion, thanks to developments in software & hardware technology, the progressive die industry is now able to make successful use of stamping simulation as part of their core die development process, taking benefits in terms of improved part quality, reduced lead time, and reduced die development costs.

Results from ASUS Group / progressive stamping and simulation



Strip layout of a computer casing (simulation)

The actual strip layout of a computer casing



Simulation result of the final part

Actual part after the stamping

Simulation result of the springback

Actual result of the stamping, deformed due to Springback

> "The PAM-STAMP 2G DMP solver technology helps to reduce the simulation time and to keep a high accuracy of the results"

Parallel processing with ProCAST on HP ProLiant platforms

Increasing the casting industry productivity

Cutting costs and reducing time to market are two of the most pressing issues in the foundry industry today. Casting process simulation helps achieve these goals and is now widely used throughout the industry for process design, improved yield and better casting quality. While simplified solutions can be efficiently used to quickly evaluate mould filling and solidification, the accurate prediction of complex flows and metallurgical phenomena as provided by ProCAST still requires significant computational times.

Based on powerful Finite Element solvers and advanced specific options developed with leading research institutes and industries, ProCAST provides a complete and accurate solution which covers a wide range of casting processes and alloys. With parallel processing on HP cluster platforms, foundries can significantly improve productivity, bringing products to market faster.

ESI Group / HP alliance

HP and ESI Group are committed to developing and supplying the casting industry with a wide range of Linux-based products and services targeted specifically at the cluster environment. This shared commitment, coupled with HP's experience and leadership in the HPC market and Linux, is reflected in HP's Unified Cluster Portfolio and the new parallel HP-MPI ProCAST solution.

This trend towards increasingly powerful and affordable hardware combined with sophisticated and easier-to-use software, offers the casting industry:

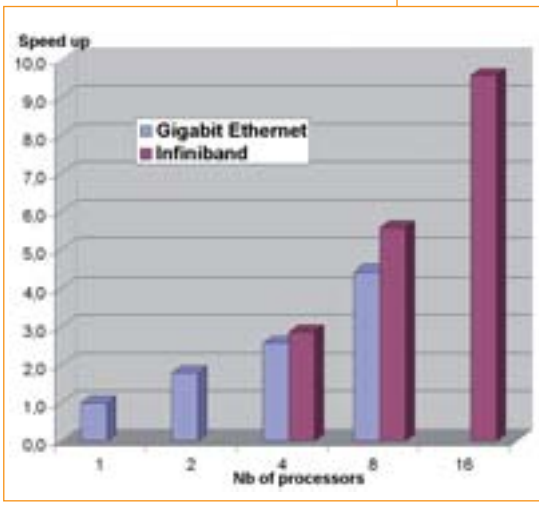
- High computing performance,
- Hardware and software flexibility,
- High return on investment,
- Reliability through HP and ESI Group certification.

Running ProCAST on HP Linux clusters

Compute clusters are fast replacing the legacy shared memory parallel systems that have been the traditional technology used in many high performance applications. Clusters can lower total cost of ownership and time to market by performing simulations even faster than giant supercomputers. The Unified Cluster Portfolio, with HP Cluster Platforms, allows you to quickly deploy clusters with ProLiant servers and popular interconnects, and support for Red Hat and SUSE Linux distributions and cluster management options such as XC System Software or Scali Connect. The ProCAST DMP (Distributed Memory Parallel) solution uses the latest available technology including dynamic domain decomposition and message passing communications to provide the best performance on Linux clusters. To satisfy the requirements for an efficient, portable and flexible application, ProCAST uses the HP MPI technology to support parallel message passing on HP Linux cluster platforms.

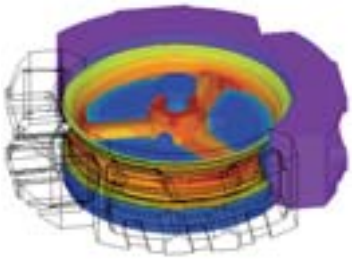
The ProCAST DMP solution based on HP-MPI provides optimal scalability on HP ProLiant Linux clusters running AMD Opteron or Intel® Xeon™ with EM64T. This solution offers the additional advantage of being independent from the interconnect. Together with the flexibility of HP's modular Unified Cluster Portfolio, you can design and deploy the high performance Linux solution that meet your needs:

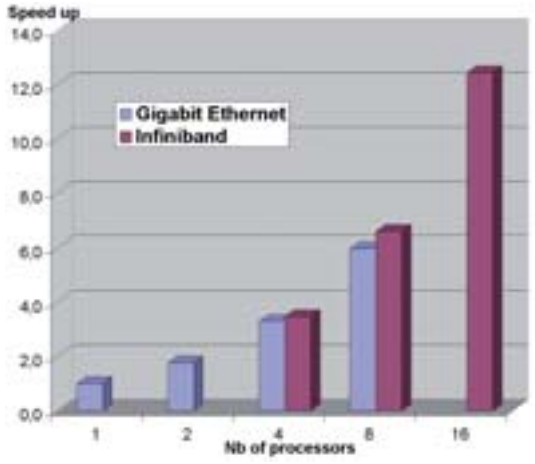
- Select your ProLiant architecture: AMD Opteron, or Intel® Xeon™ with EM64T,
- Select node and server upgrades,
- Select your interconnect: Quadrics, Myricom, InfiniBand, Gigabit Ethernet,
- Configure up to 512 nodes.



Gravity sand casting: speed up factors with Gigabit Ethernet and Infiniband interconnect on HP ProLiant DL 145 cluster

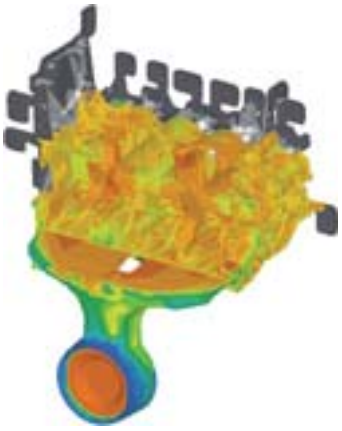
Model courtesy of ACTech GmbH

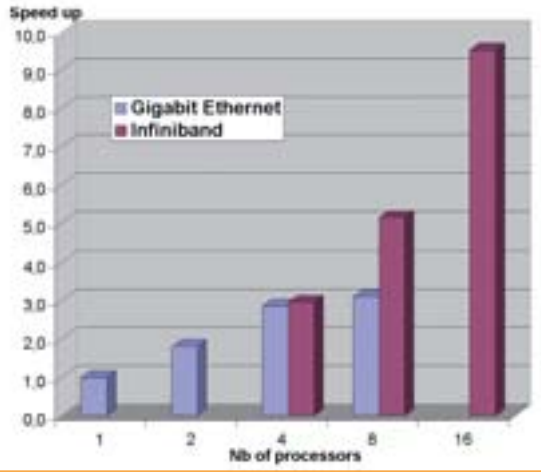




Die cycling in low pressure die casting: speed up factors with Gigabit Ethernet and Infiniband interconnect on HP ProLiant DL 145 cluster

Model courtesy of Rimstock





High pressure die casting: speed up factors with Gigabit Ethernet and Infiniband interconnect on HP ProLiant DL 145 cluster

Model courtesy of PSA Peugeot Citroën

Gravity sand casting

Key success factors in the gravity casting industry focus on optimising the runner system and on eliminating possible shrinkage areas. With parallel computing, it is possible to select a cluster configuration that allows multiple design iterations to be made within a single working day. For this compressor housing, design decisions related to the location of risers or the use of insulating or exothermic sleeves can be validated in 120 minutes on a 4 processor Gigabit configuration and reduced to 30 minutes on 16 processors with Infiniband interconnect.

Low pressure die casting

To reproduce industrial conditions in low pressure die casting, die cycles are performed to reach steady state die temperatures. While a standard 4 processor Gigabit configuration allows to simulate 5 complete die cycles in less than 45 minutes, a more powerful configuration with up to 16 processors and Infiniband interconnect, will give the same result in 13 minutes! Based on thermal die profiles, filling and solidification results, process parameters can be tuned to achieve optimal process quality.

High pressure die casting

The challenge in high pressure die casting is to obtain optimal shot piston velocity profiles and validate gating designs and overflow positioning for complex and thin walled components. For a cylinder head casting where the precise representation of all geometrical details typically requires large models, the full benefits of parallel computing can be achieved. From an overnight run on 4 processors, processing times can be reduced to 7 hours or even 4 hours on 8 and 16 processors respectively.

HP ProLiant Linux cluster

AVAILABILITY

The Procast 2005 parallel version is also available on other hardware vendor supported Linux clusters (Redhat 7.3 and Entreprise server) as well as UNIX multi-processor platforms from IBM and SGI.

Casting Solutions Seminars in Japan

ESI Group and NIHON ESI, together with HP, organized a serie of seminars in Japan to present and illustrate the benefits of ESI Group's Casting Solutions. Over Thirty attendees from universities and casting industries participated to the 2 events held on June, 30th in Nagoya and July 1st in Tokyo.

The complementary strengths and benefits of the PAM-QUIKCAST, ProCAST and CALCOSOFT solutions were illustrated on that occasion. The seminar program also featured an overview of recently released new product developments including:

the reduction of simulation turn around times achieved with the new PAM-QUIKCAST 2005,

- the performance of the new ProCAST DMP parallel version,
- the benefits of the advanced modules of ProCAST for micro-porosity, grain structure and micro-structure predictions.

The forthcoming new ProCAST developments to be released later this year also attracted a lot of interest from the audience.

The program ended with thematic presentations on industrial applications of micro-porosity predictions applied to high pressure die casting, thermo-mechanical coupling for the prediction of part distortions and residual stresses and finally, on the simulation of the core blowing process.

Solidification course 2005

For the 14th consecutive year, Calcom ESI organized its now renowned Solidification Course in Les Diablerets, Switzerland, from May 22-27, 2005. This years edition gathered 24 participants from 14 countries. Since its first edition in 1992, the course has gathered 451 participants coming from 172 companies distributed in 31 countries representing all 5 continents.

During the one week course, lectures were presented by renowned academic personalities such as Prof C. Beckermann (University of Iowa), Dr W.J Boettinger (NIST), Prof H. Combeau (Ecole des Mines de Nancy), Prof J. Dantzig (University of Illinois), Prof A. Ludwig (University of Leoben) and Prof. M. Rappaz (EPFL). Dedicated to metallurgists and foundry engineers, the course is orientated towards the application of solidification theories to industrial casting processes. Special emphasis was given to the control of micro-structural features and to defect reduction like porosity, cracks and segregation.

The 2006 Solidification Course will be held in Les Diablerets on June 4-9, 2006.

Registrations for the next edition are already open and available on: www.calcom.ch/Services&Support/Courses.html.

Optimize your Process Quality with ESI Group Casting Solutions!

How to improve your foundry product?

Embrace process simulation!

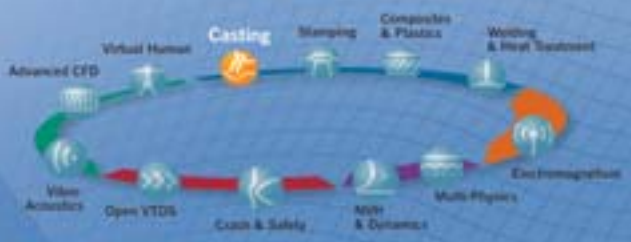
As a casting engineer your job is to deliver the best quality foundry products with a controlled time-to-market.

To get your job done, ESI Group has developed a comprehensive set of metallurgy simulation solutions which covers the entire industrial field for a wide range of casting processes:

- **Complete casting process validation**
  ProCAST
- **Rapid shape casting evaluation**
  PAM-QUIKCAST
- **Continuous casting**
  CALCOSOFT
- **Heat Treatment**
  SYSWELD

Compared to a traditional trial-and-error approach, ESI Group's physics-based solutions enable you to rapidly evaluate the effects of mold design and allow early decision on the manufacturing process. Simulation reduces your production costs and helps you master your product quality.

CREATE
WITHOUT LIMITS



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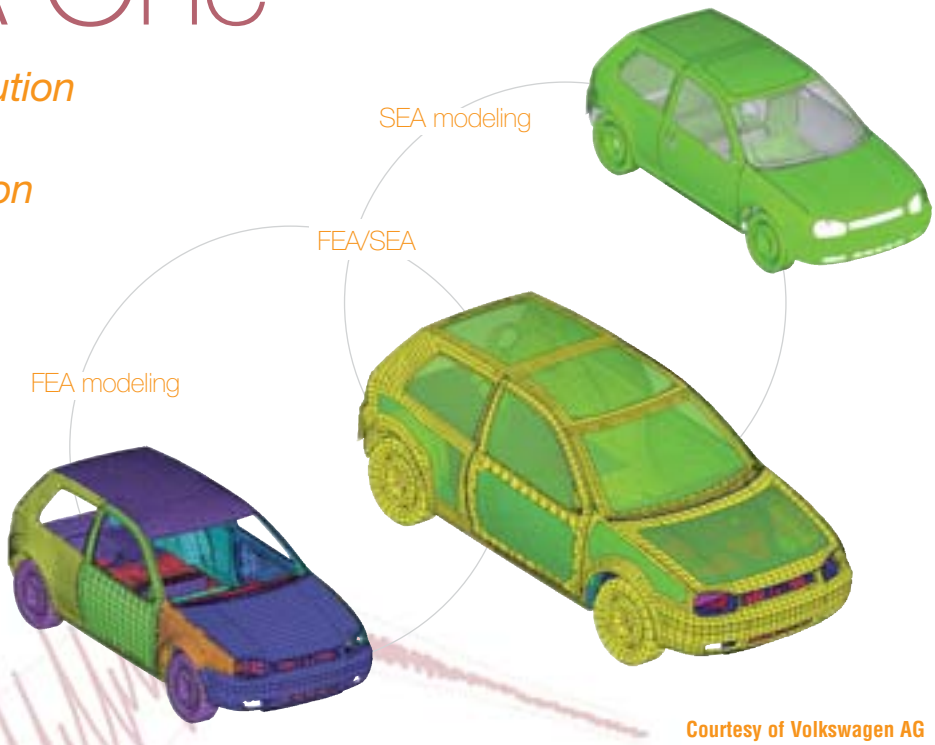
PAM-VA One

The One Integrated Solution for Full-Frequency Vibro-Acoustic Simulation

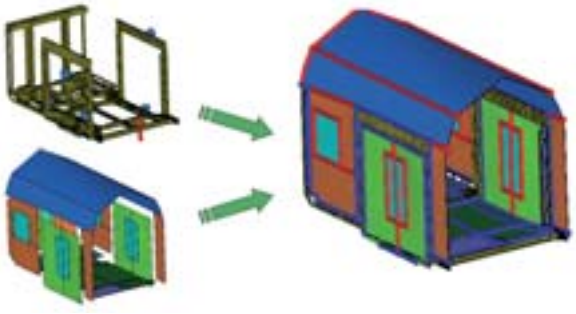


Courtesy of Volkswagen AG

Which simulation strategy should you use to best characterize the physics of your problem? Is the problem Low Frequency, High Frequency or does it fall into the Mid Frequency range?

Choice of the appropriate simulation method is always a challenge; deterministic tools such as Finite Element Analysis (FEA) and Boundary Element Method (BEM) offer effective solutions for low frequency phenomena, Statistical Energy Analysis (SEA) is the classic choice at higher frequencies. Mid frequency simulation leaves users with little choice of effective solution.

Model of an aircraft fuselage in which the skin and stringers are modeled as SEA ribbed panels and the frames and floor beams are modeled deterministically with FE.



Coupling the FE structural frame description to the SEA resonant panel descriptions results in a coupled FE/SEA model to address the vibro-acoustic behavior of this rail car across a broad frequency spectrum
Courtesy of Bombardier Transportation

Now, ***PAM-VA One*** brings you a completely integrated tool that allows you to solve fully coupled problems across the entire frequency range in ONE single environment… with ONE single model… and with only ONE software tool. The innovative formulation behind ***PAM-VA One*** provides a rigorous way to couple FEA and SEA descriptions of parts of a system together and enables a user to perform a fully coupled FEA/SEA analysis.

Not only does ***PAM-VA One*** provide a highly efficient operating environment combining all methods, but it can process problems orders of magnitude faster than existing methods. This innovative technology allows the designer to use the best of all technologies and reduce modeling requirements to quickly determine an efficient, fast, and accurate solution.

PAM-VA One allows the user to improve in-house CAE methods and reduce time-to-market by integrating these new revolutionary formulations directly into user's current design processes. Seamless integration and customization can be achieved via ***PAM-VA One's*** QuickScript™ and MATLAB® programming interface tools.

PAM-VA One now offers users a scalable environment that can improve the efficiency and productivity of existing vibro-acoustic design requirements across the full-frequency spectrum, contributing to the ever increasing demand for faster and more accurate simulation.
The scalability of ***PAM-VA One*** coupled with powerful customization tools provides an environment that will meet the simulation needs of today, as well as the future, guaranteeing a longer term return on investment.

3 questions to...

Denis Blanchet,
VA Product Manager
(denis.blanchet@esi-group.com)

PAMTALK: What is *PAM-VA One*?

Denis Blanchet: ***PAM-VA One*** is an innovative vibro-acoustic tool that allows the modelling and analysis of structure-borne vibro-acoustic problems with the use of a revolutionary formulation that couples Finite Element Analysis (FEA) and Statistical Energy Analysis (SEA).

In fact, ***PAM-VA One*** is the only software on the market that allows the modelling and analysis of a complex system with coupled deterministic and statistical model description within one single environment.

PAMTALK: Why is the recent official launch of *PAM-VA One* such an important milestone in VA?

Denis Blanchet: For over a decade, Vibro-Acoustic Sciences' (now part of ESI-Group) scientific team has worked in collaboration with renowned universities and major industry players to develop a formulation that would describe the vibro-acoustic behaviour of a system over the full-frequency range. This can't be solved with FEA or SEA alone. With this new FEA/SEA coupling formulation, it is now possible to tackle complex vibro-acoustic problems and get an in-depth understanding of the physics governing the system's response.

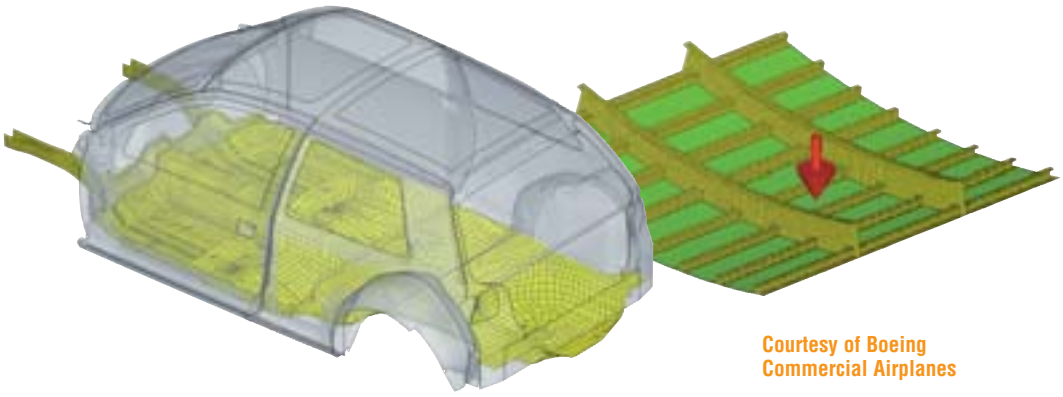
"The theory underpinning the FE/SEA coupling part of ***PAM-VA One*** is the most important breakthrough in vibro-acoustics in the past 20 years." says Prof Ken Heron FREng, QinetiQ Senior Fellow. "This is a vital step towards predicting structure-borne noise at mid and high frequencies."

PAMTALK: What is the Structure-borne Noise Consortium (SBNC)?

Denis Blanchet: The latest development and validation of the theory and implementation into ***PAM-VA One*** was made possible with the collaboration of Professor Robin S. Langley from University of Cambridge as well as several major players in the automotive, aeronautic and railroad industry members of the Structure-Borne Noise Consortium (SBNC).

"We are promoting the digital development to realize the short term development and high quality for customer. In this situation, the establishing of the mid frequency prediction method is one significant factor." Says Hirotaka Shiozaki, Manager Digital development office, Mitsubishi Motors Corporation. "We expect to built the effective tool for mid frequency prediction through the consortium and we are feeling the happiness to discuss with consortium member in the activity."

Consortium members include: Airbus Deutschland GmbH, Boeing Commercial Airplanes, Bombardier Transportation, EADS CRC Research Centre GmbH, Honda Motor Co, Mitsubishi Motor Co, QinetiQ Ltd, Rieter Automotive Systems, Volkswagen AG...



Courtesy of Boeing Commercial Airplanes

PAM-STAMP 2G v2005

A complete virtual stamping solution

With many developments and key new features, PAM-STAMP 2G has now become a complete industrial virtual stamping solution. Unique in the market, it provides large productivity gains for draw die design, formability evaluation, as well as for process validation, tuning, and quality control. It allows the user to simulate the entire stamping process in one consistent environment.

PAM-STAMP 2G includes:

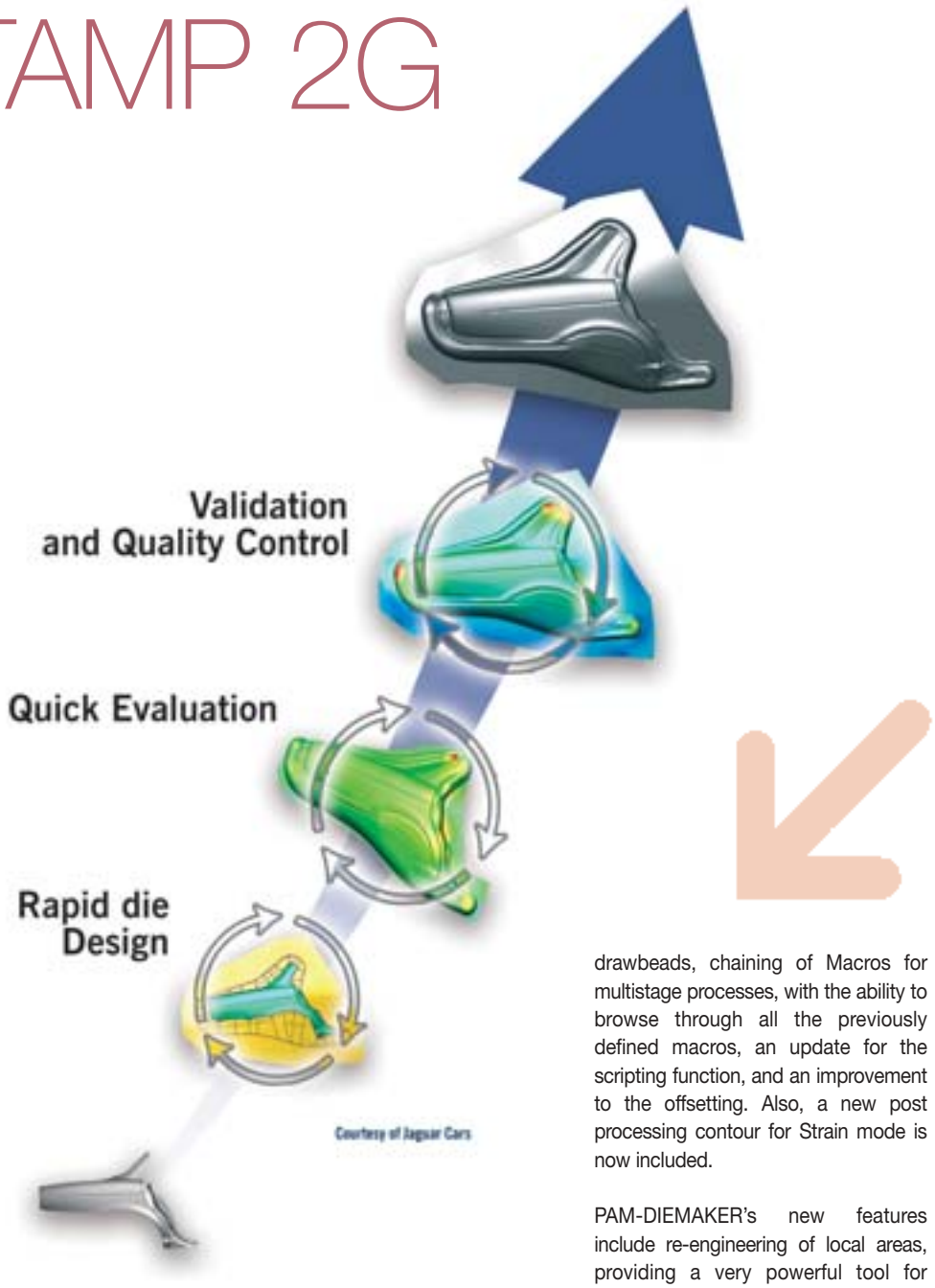
- PAM-DIEMAKER for rapid draw-die design and optimization of binder surface and die-addendum. It also ensures optimal data transfer with user's standard CAD geometry.

- PAM-QUIKSTAMP-Plus, with its brand new solver formulation, for rapid evaluation of the initial draw die design, offers significantly improved accuracy, whilst maintaining the fast turnaround times needed at early feasibility stages.

- PAM-AUTOSTAMP for forming process validation, quality and tolerance control, including springback and flanging. This module includes a powerful process macro template option and allows automatic chaining of Multistage forming simulations.

Key new functions

PAM-STAMP 2G v2005 offers a few large developments, and a large number of smaller enhancements. The main new features, explained in detail below are the new PAM-QUIKSTAMP Plus Solver, and an Automatic Springback Compensation module for PAM-AUTOSTAMP.



Several new Graphical User Interface features are provided aimed at improving the general 'look and feel' of the software and simplifying the workflow for the user, in addition to answering the requests from existing users.

Object types are now set by the tool builder & blank mesher, simplifying the data input to the macro templates.

Other enhancements include: the possibility to simultaneously copy and paste all of the attributes of an object makes the set up much simpler for the addition of new tools, and additional drawbeads, chaining of Macros for multistage processes, with the ability to browse through all the previously defined macros, an update for the scripting function, and an improvement to the offsetting. Also, a new post processing contour for Strain mode is now included.

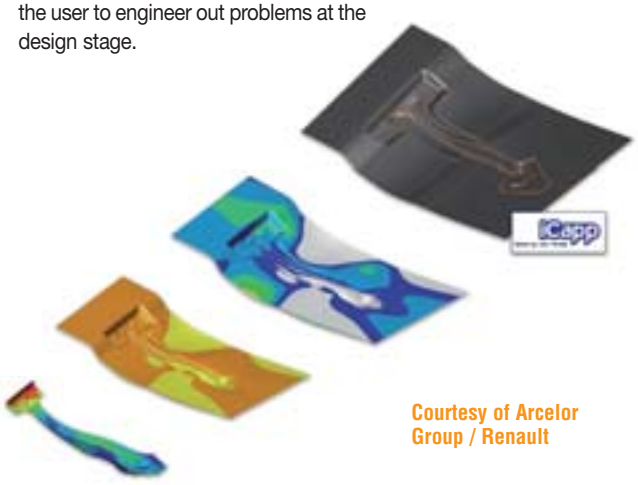
PAM-DIEMAKER's new features include re-engineering of local areas, providing a very powerful tool for localized die modifications. It gives the user the possibility to use all of the standard re-engineering functionalities & parametric modifications of PAM-DIEMAKER, but doesn't force you to spend time fitting areas which do not need modification.

Some enhancements in v2004.1 and v2005 provide more flexibility in the control of the surfaces which are created to fill large holes & apertures. In addition, this module includes an improvement of the part exchange and of the transfer to set up preventing the user from redefining objects while setting up a calculation.

PAM-QUIKSTAMP Plus is introduced in v2005. This is a major new development and it is an evolution of PAM-QUIKSTAMP Full Process delivering more added value to the user. It offers significantly improved results in terms of formability, whilst still maintaining the fast turnaround times which are needed. Compatibility with PAM-AUTOSTAMP has also been improved, making the switch from one solver to the other very simple in either direction.

PAM-AUTOSTAMP has been enriched with a number of new features, extending the stamping value chain to give a deeper look into panel quality prediction, and providing tools to allow the user to engineer out problems at the design stage.

Fast and Accurate Automatic Springback Compensation with PAM-STAMP 2G



Courtesy of Arcelor Group / Renault

With the release of v2005, ESI Group launches its first development in Automatic Die Compensation for Springback correction. With the increasing use of Aluminium, HSS & VHSS, the issue of springback compensation is coming to the fore in all tool and die shops across the world. This new module automatically adjusts the shape of the die in order to correct the effects of springback, thus avoiding expensive tooling re-cuts, and program delays. The module is fully integrated in PS2G v2005, and has been developed in partnership with Renault and Arcelor. It provides all the necessary tools to set up & examine the results of the automatic iterative compensation. To compliment the die compensation module, ESI Group has formed a partnership with iCapp Gmbh, to offer their PanelShop program, providing a quick and easy method to get from the compensated Die mesh, back to a full CAD definition.

Since v2004.1, PAM-AUTOSTAMP has provided a rendering tool for surface defect visualization, developed and validated with industrial partners. V2005 now adds a 'detachment contour' to help the user to predict areas of potential surface defects, which can then be examined in more detail with the visualization module.

A new 'fast animate' option means that even very large models can be animated in a fast way with a function that uses considerably less memory.

Other new features are: the possibility to include section forces in the 'post analyse' attribute which enables the user to have a post process curve of the evolution of the section forces against time and progression, a greater choice of rigid body definition allows the user to define a 'rotationally free blankholder', and the possibility to include the effects of gravity during an implicit springback calculation.

New materials models

Available for PAM-AUTOSTAMP since v2004.1 are two advanced material models.

The MATFEM CRACH material model, includes the instability and fracture criteria and is an orthotropic elastic plastic material. Supporting several different yield models, it enables the user to capture forming effects such as damage, and as such, it is very useful for coupling with PAM-CRASH.

The CORUS-VEGTER material model is the result of a partnership between Corus and ESI Group. It offers advantages in terms of accuracy by allowing to define the Yield ellipse of any material in a more precise way, resulting in improved forming and springback predictions. This option includes a selection of Corus materials pre-defined in the database as well as a description of the mechanical testing procedure, and access to the Corus website for updated material data files.

An industrial DMP solver

The DMP (Distributed Memory Parallel) solver of PAM-AUTOSTAMP offers excellent scalability, repeatability and interoperability. Use of the DMP solver is rapidly becoming the norm, with more and more customers switching to cost effective cluster based hardware. It has been updated to incorporate the Kinetic Damping option allowing the user to run explicit gravity and explicit springback calculations on Multi processor machines. It also allows to run very large gravity calculations in short time periods and simplifies the process of running multistage simulations on DMP machines.

An new feature is the solver control which enables the user to launch a calculation by command line or script, with settings that allow to change the solver in between stages of a calculation. It is therefore possible to run a holding and forming calculation with DMP and then switch to SMP solver to run the implicit springback calculation.

Deltamesh

Several new enhancements are included in the Deltamesh Automatic meshing module. These focus primarily on improvements to the CAD healing functions for gap and overlap treatment, together with the option to suppress 'hidden' entities during the reading of the CAD file.

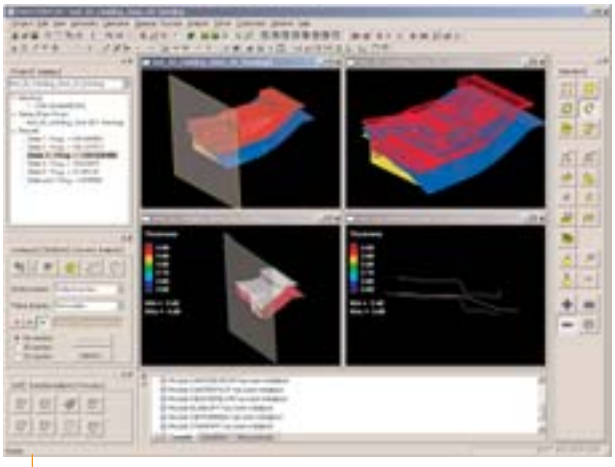
PAM-STAMP 2G v2005 was released mid-august 2005 and is now available from your ESI Group subsidiary or distributor.

For more information on PAM-STAMP 2G:
www.esi-group.com/SimulationSoftware/Stamping_simulation/

About Corus

Corus, Europe's third largest steel manufacturer, is achieving recognition in the automotive industry as an "intelligent supplier of material". Corus provides innovative solutions to construction, automotive, packaging, mechanical engineering and other markets worldwide.

PAM-FORM 2G 2005



Example of Car Carpet forming
PAM-FORM 2G is delivered as three different trade-oriented packages, PAM-FORM 2G for Plastics, PAM-FORM 2G for Trim and PAM-FORM 2G for Composites.

PAM-FORM 2G is an application-specific industrial software used to perform realistic and predictive virtual forming simulations of non-metallic materials. The software handles the forming of laminated composites, plastic sheets, fabrics, and car carpets.

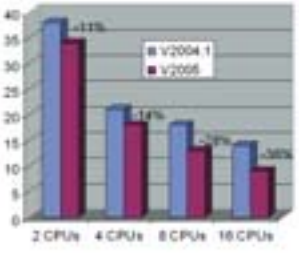
PAM-FORM 2G aims at providing to the composite and plastic industries the same services offered by PAM-STAMP 2G to the sheet metal stamping industries, where PAM-STAMP 2G is used as a virtual try-out press to validate and optimize manufacturing processes of metallic sheets on computer.

The software has proven to save time and reduce costs when used to assist in process tryouts. The software produces validated results (shows wrinkling, splitting if any, final thickness of sheet…), which up until now could be obtained only by actual tryout. Reducing the number of tryouts, or even eliminating try-out tools altogether, becomes achievable once PAM-FORM 2G is part of the tool design process. Thanks to having the same GUI basis as PAM-STAMP 2G, efficient iterations between the forming simulation and the die-design are possible.

For the first time a DMP version of PAM-FORM 2G is available; this will bring the use of PAM-FORM 2G for composite applications from the academic laboratory to the press shop.

For more information on PAM-FORM 2G:
www.esi-group.com/SimulationSoftware/Plastics_Forming_simulation/

PAM-CRASH 2G 2005



CPU Times in hours

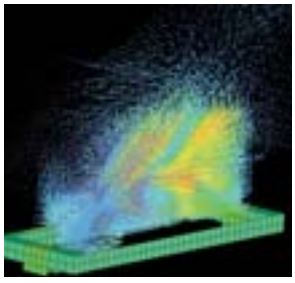
	V2004.1	V2005	V2005 vs. V2004
2 CPUs	36	34	-11%
4 CPUs	21	18	-14%
8 CPUs	18	13	-28%
16 CPUs	14	9	-36%

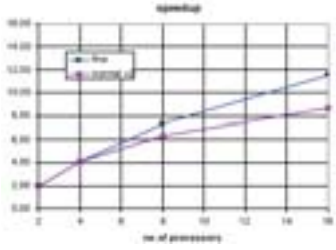
Example of CPU time reduction for a crash-safety synthesis model

This new version brings a series of improvements for crash and occupant safety application, resulting in:

- **enhanced performance** due to the increased scalability for models especially with large numbers of rigid bodies. The average speed-up is about 10-15% compared to V2004. However, in certain cases the new version can be up to twice faster. In V2005 mesh-free methods have been parallelized: Smooth Particle Hydrodynamic is now available in shared memory parallel mode, and the Finite Point set Method in distributed memory parallel mode enabling realistic airbag simulation.

- **more accurate** crash simulation capabilities with new elements and new or improved material models.





Speed-up factors for two airbag FPM models

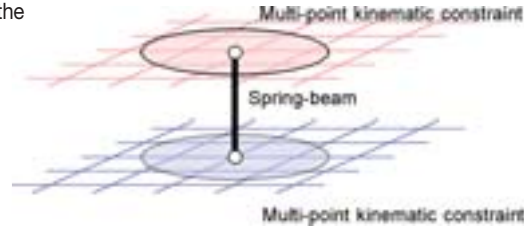
In particular, a new spot weld model brings an accurate treatment of bending and torsion, through the use of a spring-beam element and multi-point kinematic constraints. Porosity of cast parts can be taken into account by the new ProCAST - PAM-CRASH mapping interface. Elastic-plastic thick shells and bushing model are now available and are extending the field of application for PAM-CRASH 2G.

- a series of **usability** improvements: rigid bodies, cross-section with plane and radius, universal restart files, enhanced data checks, extended user-encryption, and an advanced MADYMO coupling, ...

Regarding the pre-and post-processing, the CRASH- and SAFE-EDITOR modules have been adapted to V2005. They can read and write V2005 data, however the new capabilities cannot be edited. PAM-VIEW 2005 supports all new solver output features. VCP version 1.5 supports PAM-CRASH 2004 input and crash applications. The next release, version 2.0 (planned for this fall) will support version 2005 of the solver and safety applications.

All dummy and barrier models are compatible with PAM-CRASH 2G 2005 and available independently from the present software release.

The pricing rules for multiple-processor systems have changed. It refers to the combination of the total number of processors and - new - the number of jobs running at the same time. In the present release, dual-core systems are seen as systems with twice more processors.



New mesh-independent spotweld model

For more information on PAM-CRASH 2G:
www.esi-group.com/SimulationSoftware/NumericalSimulation/

PAM-CRASH running on CRAY XD1

The Cray XD1™ supercomputer combines breakthrough interconnect, management and reconfigurable computing technologies to meet users' demands for exceptional performance, reliability and usability. Purpose-built for high performance computing (HPC) applications, the Cray XD1 system enables users to simulate, analyze and solve complex problems more quickly and accurately.

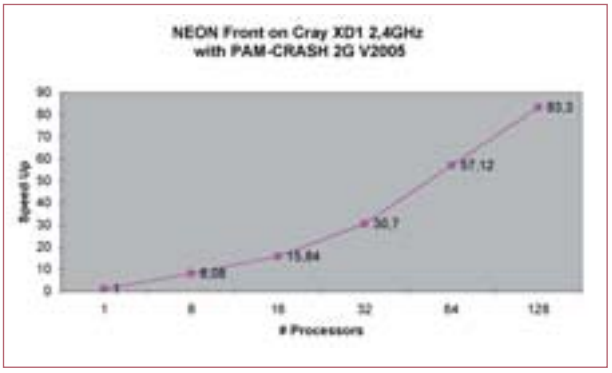
The system is based on the Direct Connected Processor (DCP) architecture which enables the integration of hundreds of processors into a single unified system and resulting in exceptional performance, reliability and usability.

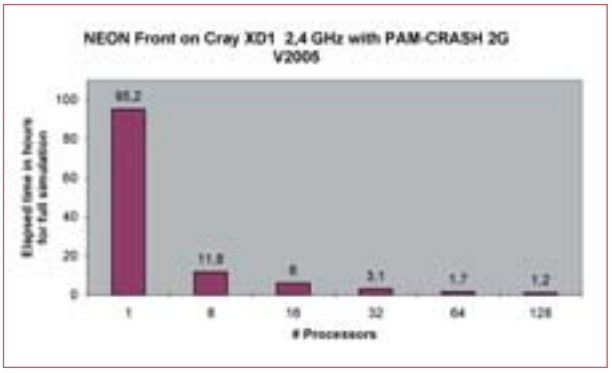
A single-chassis Cray XD1 system contains twelve AMD Opteron 64-bit single or dual core processors running on an HPC-optimized Linux. Up to twelve chassis can be installed in a single cabinet, with multi-cabinet configurations integrating hundreds of processors into a single system. Using the RapidArray interconnect, the Cray XD1 system delivers the industry's fastest embedded switching fabric, delivering 8 GB/sec bandwidth between nodes and 48 GB/sec bandwidth between chassis.

Every aspect of the system is controlled and managed by a real-time operating system, distributed software, an independent supervisory network and a management processor. This ensures superior usability and reliability through a single system command. The Cray XD1 system also provides fault detection, and prediction capabilities along with automated self-healing intelligence.

The Cray XD1 has proven to outperform competing systems on a variety of CAE applications. A benchmark performed on the NEON Front dataset clearly demonstrates the system's scalability with elapsed time-to-solution showing a 99% reduction from one to 128 processors (Figure 1) equating to a speedup of over 83 times (Figure 2).

The Cray XD1 system offers engineers and scientists the ability to tackle difficult problems that require considerably more computing power and with an excellent price/performance ratio. With superior scaling and high sustained application efficiency the system allows CAE users to run simulations that they would not have attempted just a few years ago.





Cray XD1™ supercomputer

Foster your Competitive Advantage with ESI Group's Virtual Engineering Solutions!

In today's competitive world, what does your customer expect from you?

The same as you expect from us! Get the best solution at the right price. Your job is to deliver product and engineering expertise while controlling your costs and taking advantage of computer resources.

To get your job done, ESI Group has developed a unique collaborative engineering environment based on a comprehensive suite of multi-trade simulation solutions for a wide range of industrial applications.

ESI Group helps you fully master your success factor by managing and leveraging your know-how with the most productive and appropriate physics-based solutions. Built on rigorous methodologies, these solutions offer robust design processes for a reliable simulation based design!

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  AutoSEA, RAYON, NOVA, FOAM-X
- **Aerodynamics & Aero-acoustics**
  PAM-FLOW
- **Manufacturing processes**
  STAMPING: PAM-STAMP 2G
  COMPOSITES: PAM-FORM, PAM-RTM
  CASTING: PAM-QUIKCAST, CALCOSOFT, PROCAST
  WELDING, HEAT TREATMENT, ASSEMBLY: SYSWELD
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  PAM-CEM, SYSMAGNA, CRIPTE
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  COMFORT

Photo credits: SEAT/SENER, AUDI AG

Predicting distortion and residual stresses in vehicle body assemblies

ESI Group has joined the Simulation project of the Premium Automotive Research and Development (PARD) Programme as a partner. Working with the team at the International Automotive Research Centre (IARC), based at the University of Warwick, enhancements to SYSWELD are being developed for predicting the distortion caused by joining processes.

Resistance Spot Welding (RSW) of steel components is a well established technology used extensively throughout the automotive industry for joining metal panel components to make a body structure. However, vehicle manufacturers are striving to minimise fuel consumption and environmental impact of their products. One way of contributing to this objective is to reduce vehicle weight by replacing steel body panels with new higher strength steels or lighter aluminium alloys.

In addition to the joining process the sequence in which welds or rivets are applied, the clamping arrangement and the properties of the substrate material have a significant effect on the level of distortion observed. Work carried out at IARC demonstrates these effects (Fig.1), emphasising the requirement to understand the high levels of distortion and residual stresses induced in assemblies manufactured using these relatively new automotive materials. The purpose of the project is to provide Product Development and Manufacturing Engineers with a simulation tool which will assist in establishing clamping requirements and joining sequences to balance the distortion and residual stresses.
SYSWELD has been chosen for this work because a spot welding simulation module is already in development and it is capable of studying the effects of welding sequence and fixturing conditions using the local / global method.

Here the detailed 2D model of a single spot weld can be swept through 360° to generate a 3D model (Fig.2) which is then transferred into the appropriate locations of an assembly (the global model) containing two or more parts (Fig.3). Within the assembly environment the sequence in which welds are applied, clamp locations and direction of restraints can all be varied. To minimise the size of the global models and the computational requirements the bulk of the individual components can be modelled as shell elements which are coupled to solid elements in the vicinity of the weld locations.

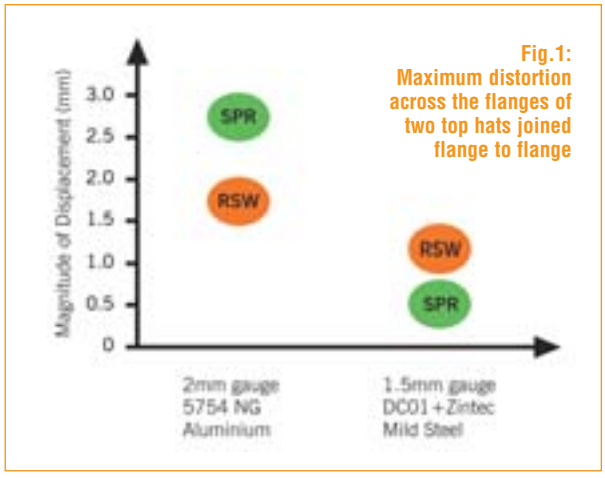

Fig.1: Maximum distortion across the flanges of two top hats joined flange to flange

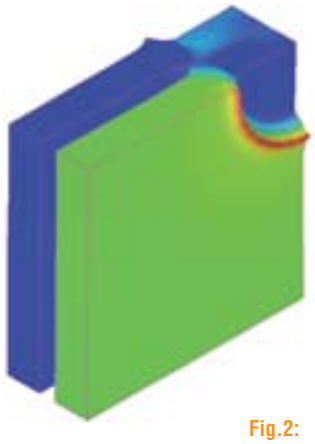

Fig.2: 3D model of spot weld in 1.5mm/1.5mm DC01 + Zintec steel

Working together, ESI Group and the IARC team are generating suitable material models for RSW of aluminium and high strength steels and the capability to handle fit-up gaps in manufacturing assemblies. Combining the results from PAMSTAMP 2G into SYSWELD to further refine predictions of residual stress and distortion will be investigated together with the possibility of representing a Self Piercing Rivet (SPR) within SYSWELD. The end product of this applied research activity will allow automotive manufacturers to predict the optimum clamp position and joining sequence prior to designing the manufacturing process, rather than having to wait until the facility and process exists to allow physical trials.

Iain Masters
Premium Automotive R & D Programme

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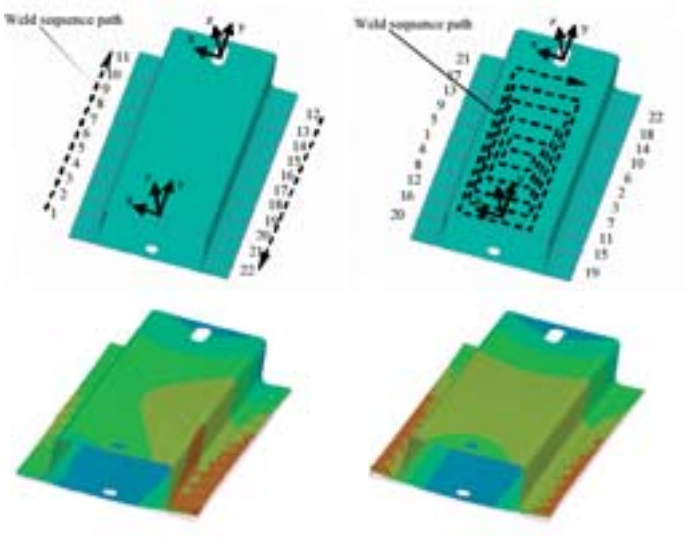


Fig.3: SYSWELD simulation of top-hat and closure plate assembly showing welding sequence and resulting distortion normal to the surface

Can you Crash Moore's Law ?!

Moore's 'Law'

In 1965 Gordon Moore, co-founder of Intel, made a statement which is interpreted today in the sense that any computer performance related quantity, Q_t, (number of transistors on a chip, compute power, number of finite elements in a model, etc.), doubles every M = 18 (optimistic guess) to 24 months (pessimistic guess) - or every Y = 1.5 to 2 years - at about the same cost or delay, starting from an initial value, Q_0, at time t = 0. This prophecy can be expressed by the mathematical formula

$$Q_t = Q_0\, 2^{m/M} = Q_0\, 2^{y/Y},$$

where y = m/12, Y=M/12 and where time t is expressed either in months, m, or in years, y. How does this 'law' apply to industrial crash simulation? To fix ideas, the "biggest ever" jobs at different dates are examined. Similar observations can probably be made for smaller size average industrial jobs at each date.

Year 1986

The first successful industrial full passenger car crash simulation ever with PAM-CRASH was performed in 1986 on a CRAY1 Super-computer, which simulated a frontal crash of a Volkswagen Polo, that had Q_0 = 5 555 thin shells.

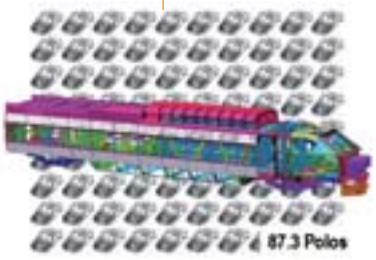
VW Polo frontal car crash simulation (1986: 5 555 shells = "1 Polo")

A typical Polo run went over about 40 000 time steps of 1.5 micro-seconds for a crash event duration of 60 milliseconds in about 4 hours CPU.

Year 1996

In 1996, y =10 years later, the largest ever PAM-CRASH model was given by the French TGV with Q_{10} = 485 000 shells, which corresponds to about 87.3 times the number of shells in the Polo model (= "87.31 Polos"). This model from GEC Alsthom ran on a 15 processor SGI Power Challenge R8000 in 300 000 time steps over about 5 days.

GEC Alsthom TGV engine crash simulation (1996: 485 000 shells = 87.31 Polos



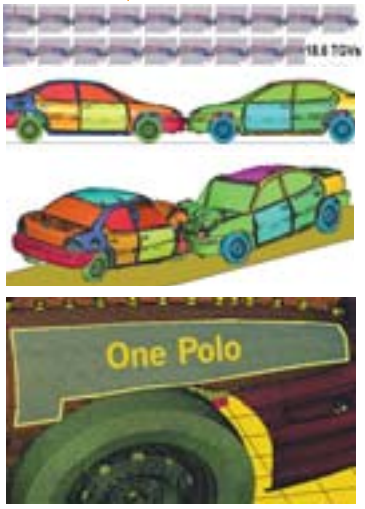
From these facts Moore's formula can be calibrated to obtain the number of years, Y = 1.550855 (M = 18.61 months), where the number of shells in the largest model will double. After y = 10 years this formula predicts indeed:

$$485\,000 = 5\,555\; 2^{10/1.550855} \text{ shells} = 87.31 \text{ Polos}.$$

Year 2004

On the EUROPAM 2004 Conference, y = 18 years after the Polo runs, HP Europe presented a successful simulation - *"The biggest PAM-CRASH job in history"* - of the NEON-04 US-NCAP car-to-car offset frontal crash event:

NEON-04 US-NCAP car-to-car crash (2004: 9 Mio shells = 18.6 TGVs = 1620 Polos)



In order to probe present limits of hard- and software, that job used a total of Q18 = 9 Million thin shell finite elements (= 18.6 TGVs = 1620 Polos) over 300 000 time steps with "normal termination" after 16 hours and 12 minutes wall clock time. The job was run on 128 Itanium 1.5 GHz HP-UX CPUs at the HP Böblingen RX2600 InfiniBand Cluster. This demonstration model was refined automatically 16 times from an NCAC public domain baseline model by Thorsten Queckbörner of ESI GmbH without extra care for efficiency. For fixing ideas, the highlighted patch on the fender of one of the NEON models contains exactly 5600 shells, or about 1 Polo.

Using Q_{18} = 9 000 000, Q_0 = 5555 and y = 18 years, one can recalibrate Moore's 'law' with Y = 1.688251 years (M = 20.26 months) where the number of shells will double. Indeed:

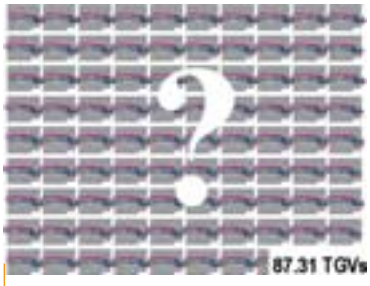
$$9\,000\,000 = 5\,555\; 2^{18/1.688251} \text{ shells} = 1\,620 \text{ Polos} = 18.56 \text{ TGVs}$$

However, the 1996 calibration (Y = 1.550855) would have predicted almost twice this value by 2004, namely 17 321 639 = 5 555 $2^{18/1.550855}$ shells = 3 118 Polos = 35.71 TGVs. Inversely, the 2004 calibration (Y = 1.688251) would lead to only 337 110 elements (instead of 485 000) by 1996.

Year 2006?

In a presentation, given in 1999 at PUCA (PAM User's Conference in Asia), the author had bet that one will reach the following number of elements by the year 2006, based on the calibration of Moore's 'law' made with the 1996 data:

$$42\,344\,854 = 5555\; 2^{20/1.550855} \text{ shells} = 87.31^2 = 7\,623 \text{ Polos} = 87.31 \text{ TGVs}$$



Author's 1999 bet for 2006: 42 344 854 shells = 7 623 Polos = 87.31 TGVs

Based on the 2004 calibration, this figure must be revised to a mere

$$20\,457\,846 = 5555\; 2^{20/1.688251} \text{ shells} = 3\,683 \text{ Polos} = 42.18 \text{ TGVs},$$

or to only about half of the author's 1999 bet for the number of elements in the largest FE crash model by the year 2006.

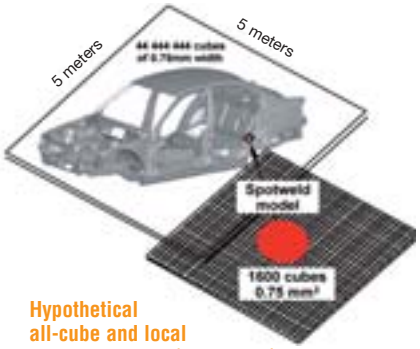
If the author's 1999 bet may prove to fall short by a factor of 2, the order of magnitude is correct and it falls well within the bounds defined by Moore's 'law'!

Large models

What will be the use of having so large models in crash simulation? In 1999 the author wrote (giving an order of magnitude):

An average (small) passenger car (body in white) is made of approximately 25 m² of soft car body steel, with an average thickness of, say, 0.75 mm. If this volume of steel were modeled with perfect 0.75x0.75x0.75 mm cubic solid elements, one would obtain (5000/0.75)² = 44 444 444 solids.

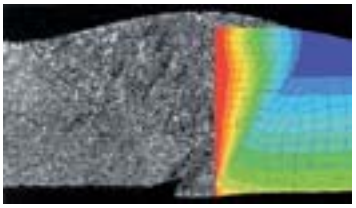
This figure is curiously close to the above mentioned large numbers of elements. The hypothetical model is shown below.



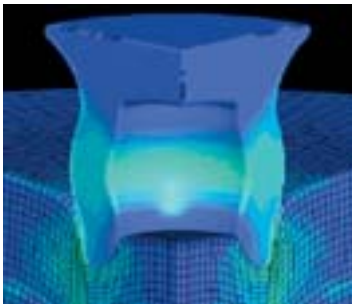
Hypothetical all-cube and local spotweld model (schematic)

Connections

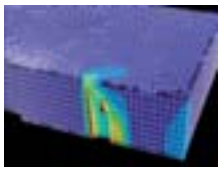
While it may appear unsound to make a uniformly fine model of the whole car body in white, local models for predicting fracture, say around spotwelds, rivets or near other critical areas or components, could very well be made as fine, and even much finer!



Spotweld



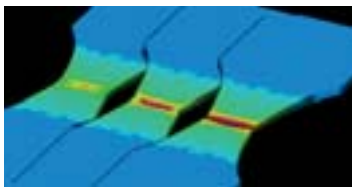
Self piercing rivet

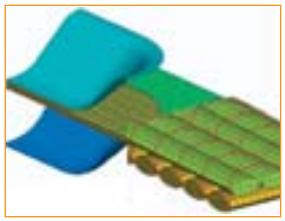


Tunnelling fracture in steel

Fracture

Recent pressure for fracture prediction during a crash simulation in ductile / brittle aluminum, composite or high strength steel components ask for locally very fine models that might use several layers of solid elements spread over the component wall thickness.





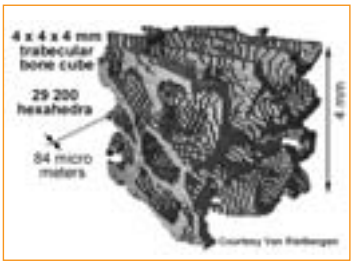
Composite fabric structure

Composite component fracture

Human models

In human occupant safety simulation it is very easy to imagine useful models of the human body that will add very large numbers of elements to the large model of the car structure.

Fine brain model



Trabecular bone models

Different densities

A car body in white can be made of, say, a cubic volume of 300 x 300 x 300 mm³ = 27 liters of material (x 7.8 = 210 kg steel). This volume can be subdivided, say, into equal size limit cubes with width w = (27 000 000 / Q)^1/3 millimeters. These widths, w, and the projected numbers of elements, Q, over the years are indicated in the following graph.

Future nano-scale crash models?

All bets are open! But one thing is sure: Provide an analyst with all the available compute power, then he or she will use it up in an astonishingly short lapse of time.

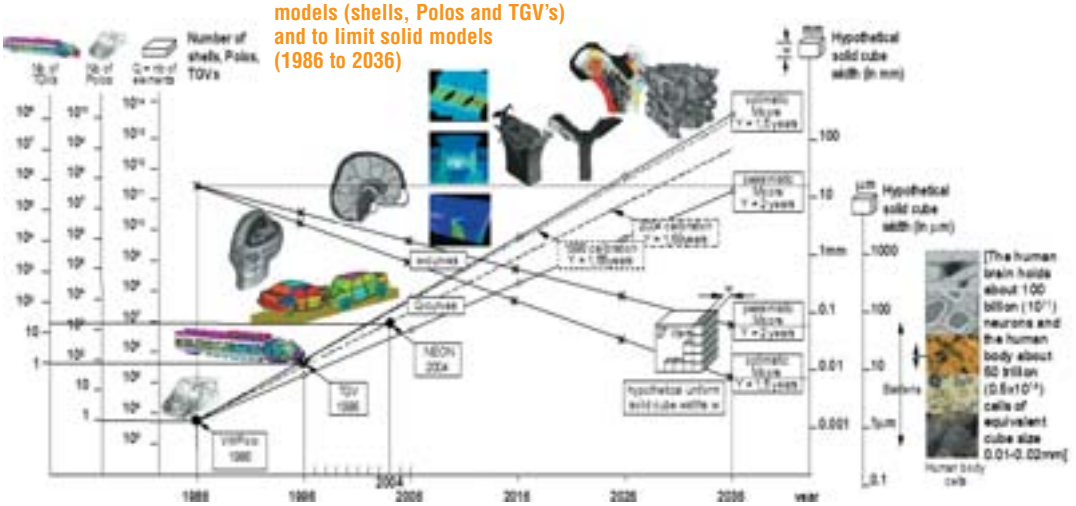
E. Haug

January 2005

[PS: The ultimate laptop

Will there be a limit to progress in compute power? In a recent article in the Scientific American "Black Hole Computers" (November 2004) two authors (S. Lloyd and Y.J. Ng) discuss the theoretical limits to the computational power contained in one liter of ordinary matter. It could operate 10^{20} parallel instructions per second (10^{11} GHz) and store 10^{31} bits of information – to be compared to today's 1GHz and 10^{12} bits per processor. If Moore's 'law' were sustained, this computer would be available during the 23rd century.]

Moore's 'Law' applied to crash models (shells, Polos and TGV's) and to limit solid models (1986 to 2036)



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Date	Event		Place
Sept. 25-28	ASM Heat Treatment Show		Pittsburgh, PA (USA)
Sept. 26-28	North American Hydroforming Conference		Novi, MI (USA)
Sept. 27-30	FENAF 2005	Southern American foundry fair	Brazil (Sao Paulo)
Oct. 5-7	EUROPAM 2005	15th European Conference and Exhibition on Digital Simulation for Virtual Engineering	Potsdam (Germany)
Oct. 10-11	COE 2005	Bringing together the users of CATIA, ENOVIA, DELMIA, and SMARTEAM	Dearborn, MI (USA)
Oct. 20-21	2005 Computer Modeling Conference		Northbrook, IL (USA)
Oct. 20-22	Alumotive 2005	Internationale fair of the innovative solutions, in the field of aluminum and materials technology for the industry of transports	Italy (Modena)
Oct. 20-22	FOUNDRY 05	19th foundry exhibition supported by the UK Foundry Equipment & Supplies Association, FESA.	London (UK)
Oct. 24-26	International Conference on Hydroforming		Fellbach (Germany/ 3rd)
Nov. 6-9	53rd Investment Casting Tech. Conf		Dearborn, MI (USA)
Nov. 7-8	HANPAM 2005	11th Conference and Exhibition on Digital Simulation for Virtual Engineering	Seoul (Korea)
Nov. 10-11	PUCA 2005	16th Conference and Exhibition on Digital Simulation for Virtual Engineering	Tokyo (Japan)
Nov. 12-18	SuperComputing 2005	International Conference for High Performance Computing	Seattle, WA (USA)
Nov. 14-15	CHINAPAM 2005	4th Conference and Exhibition on Digital Simulation for Virtual Engineering	Shangai (China)

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The PAM-CEM Solutions suite is a software package aimed at performing realistic and predictive ElectroMagnetic Compatibility (EMC) simulations for the transportation industry (automotive and railways), in aeronautics, telecommunications and electronics.
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A series of new press releases have been posted on our News & Events section. This will give you additional information on the latest partnerships, product developments and financial results.

The worldwide conferences and exhibitions on digital simulation for virtual engineering are largely advertised on ESI Group's website. EuroPAM 2005 is the first of a series of four annual events where users come from around the world to share experiences, learn about new software tools and meet major harware system vendors.
HanPAM, PUCA and ChinaPAM will be held in November respectively in Seoul, Tokyo and Beijing.

Of course, the latest issues of ESI Group's electronic newsletters, PAMTALK and "News on-line", are posted at the bottom of the page for download or on-line subscription.

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