

PAM TALK

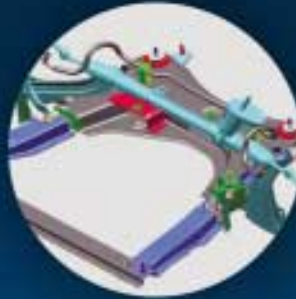
NEWS FROM THE VIRTUAL TRY-OUT SPACE

product news

PAM-RTM 2004 enables simulation of very large composites structures using the VARI process

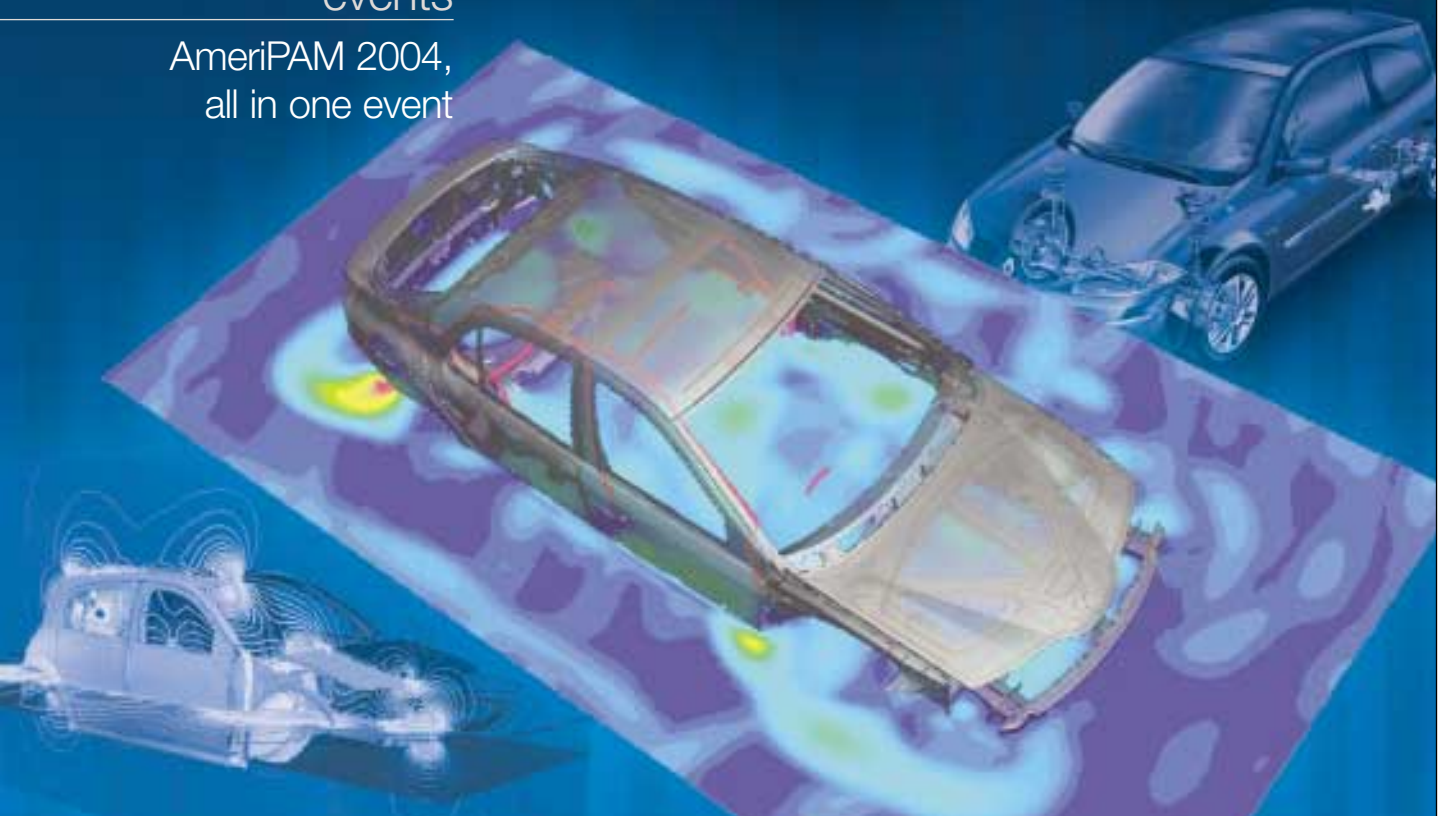
events

AmeriPAM 2004, all in one event



ISSUE
26

SUMMER
2004



strategy

Renault

Placing digital simulation at the heart of the automotive design process

Adopting 3G PLM solutions

User Conferences

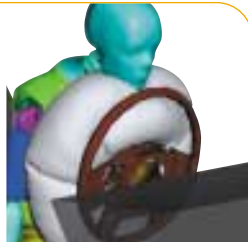
October 11, 2004

Cité des Sciences et de l'Industrie, La Villette



1st Crash & Occupant Safety User Conference

Since the mid 80's, crash test and the simulation of restraint systems, have driven FE based simulation advances in the automotive market.



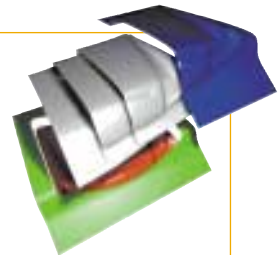
OOP simulation using PAM-SAFE

Don't miss this unique opportunity to share your concern with users and the PAM-CRASH 2G and PAM-SAFE 2G development teams.

- 10:00 Overview of the PAM-CRASH 2G and PAM-SAFE 2G solution
- 12:30 Lunch
- 14:00 Technical thematic workshops on scalability, material rupture, optimization
- 16:00 Coffee break
- 16:30 Crash Safe User Group open discussions.

2nd European Stamping User Conference

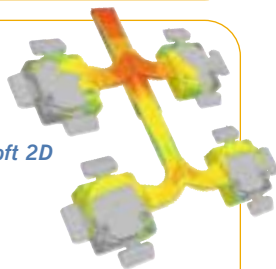
Join the 2nd European Stamping User Conference to be updated on the best-in-class developments of PAM-STAMP 2G 2004. **Use this opportunity to express your requests for future developments, meet other users and the people behind PAM-STAMP 2G.**



- | | |
|---------------------|----------------------------|
| 10:00 Introduction | 12:30 Lunch |
| 10:15 PAM-DIEMAKER | 14:00 User presentations |
| 11:00 PAM-QUIKSTAMP | 16:00 Coffee break |
| 11:30 PAM-AUTOSTAMP | 16:30 Discussion - Closing |

1st European Casting User Conference

Discover the new releases of Calcosoft 2D and 3D 2004, PAM-CAST 2004.1 and don't miss out on the overview of ProCAST 2005. Meet other users and learn from their experience.

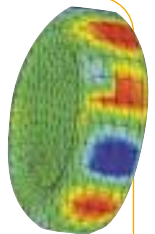


- 10:00 Casting solutions product news & product strategy
Overview of R&D research projects
Parallel processing for casting applications
- 12:30 Lunch
- 14:00 Technical thematic workshops on casting model set-up and meshing, mold filling scenario for different processes, material databases and material property predictions, porosity predictions, coupled stress calculations
- 16:00 Coffee break
- 16:30 Product validation procedures and applications
Specific software tutorials
Open user group discussions

2nd European Vibro-Acoustics User Conference

Conference will focus on:

- Analysis of real-life trimmed structures for both low and high frequency
- Use of Statistical Energy Analysis SEA and deterministic simulation solutions that deploy both Finite Element and Boundary Element
- Reduce modeling time and expertise to meet the time constraints imposed by concurrent engineering
- Model building productivity improvement thanks to the deployment of existing model morphing tools and use of custom scripts
- Recent developments related to structure-borne noise simulation



Whether you are currently using physical test for vibro-acoustic prediction and considering simulation, or you are actively involved in simulation, **this event will provide you with plenty of material to pursue the most effective vibro-acoustic strategy for your company.**

17th SYSTUS User Conference

The 17th edition of the SYSTUS, SYSPLY, SYSWELD, SYSMAGNA User Conference, for French speaking users, will take place at Forest Hill*** Paris La Villette, situated in the immediate neighborhood of the Cité. For more information, please go to:

http://www.esi-group.com/Consulting_services/customer.html

Register Now!

www.esi-group.com/EuroPAM2004



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SUMMER 2004



Why turn to PLM?

The acronym PLM, for Product Lifecycle Management, gathers large opportunities and challenges. Basically PLM stands for integrating product and process information in a global loop, aiming at optimizing the product processes. Expected benefits for industrial groups are huge; all of them are looking to reduce costs and lead-times, to speed-up time-to-market, to work smarter, faster and in a collaborative way, creating value, improving quality, etc.

Beyond just connecting processes and product data, PLM involves re-thinking the organization, rationalizing processes, setting up connections between multiple functions, departments and suppliers. To achieve true interoperability and data sharing, a PLM strategy requires solid foundations. Pillars underpinning PLM are at the same time, Computer Aided Design with digital mock-ups, Computer Aided Engineering or simulation, Product Data Management, Digital Manufacturing and Customer Relationship Management.

e d i t o r i a l

Taking into account the physics of materials, ESI Group's 3G PLM solution provides for a global and dynamic decision-making tool. Known as the Virtual Try-Out Space (VTOS), this open and collaborative virtual environment will allow predictive evaluation and continuous improvement of virtual prototypes and processes with all the actors of the extended enterprise, particularly by coupling product and simulation data and enabling process automation.

The acquisition of EASI's technology and the integration of its advanced development platform EASI-Vista / EASI-Process will provide our customers with a new and unique combination of advanced simulation software embedding an innovative process methodology to support industry's critical transition towards simulation based design. ESI Group is putting in place the cornerstones of an adaptive and open 3G PLM solution that integrates simulation data management and CAE re-engineering services, allowing automation of customer's processes and workflow.

Partnering with Dassault Systèmes, ESI Group is committed to deliver the next-generation Virtual Prototyping and Manufacturing Solutions within the CAAv5 environment. The CAAv5 strategic development agreement will help create the ideal platform for product, process and resource optimization, reducing development time, minimizing the requirement of hardware prototyping. New ESI Group CAAv5 based products will augment the dynamic communication of simulation based design methods within the PLM environment.

Let's move forward and take the PLM turn

Vincent Chaillou
*President and Chief Operating Officer,
Products Operations, ESI Group*



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What's new at www.esi-group.com?

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Chaining PAM-CRASH & PAM-STAMP, ACI achieves cost and mass reduction

Taking into account forming effects, PAM-CRASH/PAM-STAMP coupling proves efficient for design optimization of Renault's Megane II suspension arm and opens new perspectives for other automotive components.

“Controlling and reducing vehicle weight has become a strong incentive in the automotive industry to limit gas emissions,” says Laurent Taupin, CAE manager sheet parts, Auto Chassis International (ACI). “The use of

ACI and ESI Group have successfully validated the potential benefits of a coupled product/process engineering approach based on crash and stamp coupling with correlation of simulation and experimental results.

A vital component subjected to high loads during stamping

Renault Mégane II suspension arm has to match stringent stiffness requirements to ensure an accurate tracking of the wheels and good vehicle handling. In addition, this heavy duty, safety critical component is designed to sustain abuse loading conditions, such as emergency braking, pot holes, pavement shock or fatigue cycles. Its patented design involves a complex set of flanges and stiffeners and is made from a single sheet of four millimeters thick high strength steel.

Three main forming stages have been

simulated using PAM-STAMP's embedded mapping feature. The material history, specifically residual thickness and equivalent plastic strains after forming, is transferred from PAM-STAMP to PAM-CRASH. The areas located around point A (see fig. 1) and all along the flange are subject to high thickness variations and large plastic strains leading to significant localized material property changes. As a matter of fact, with a 10% equivalent plastic strain, the initial yield stress increases by 60%. As mechanical characteristics are not homogeneous, the resulting behavior is a compromise between the strength loss due to thinning and the strength gain due to work hardening.

More realistic yield stress results with coupling

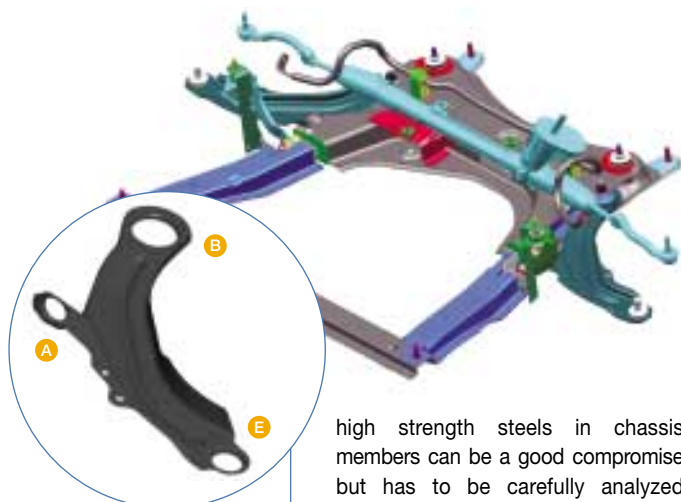
The objective is to determine the greatest admissible load, whilst avoiding any plasticity in case of an abuse load such as an emergency brake. Both thickness and equivalent plastic strains are transferred from PAM-STAMP to a multi-purpose FEA code. The suspension arm is designed to sustain this force without plasticity. Simulation proved that without coupling, the maximum load is only 4% above the prescribed requirement, while it is 31% above what is required when taking into account the forming effects.

“The coupling method allows us to increase the admissible load and this is the most evident benefit” states Laurent Taupin. “Two large areas of the arm exceed the criterion of acceptance when neglecting the forming effects with the increased load, whereas the whole arm remains within an acceptable level when using a coupled calculation. Ignoring the forming effects could cause the rejection of a relevant technical solution, or the selection of an “overkill” material grade, with potential problems downstream.”

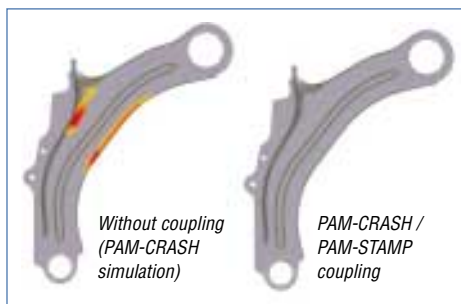
high strength steels in chassis members can be a good compromise but has to be carefully analyzed because of the increasing complexity of the forming process.” In this context,



Mégane II front and rear suspension offering a high level of safety for all occupants



1 - The suspension arm is fastened to the engine cradle at points A and B by means of elastic bushings and to the knuckle at point E through a ball joint



2 - With coupling, the arm sustains an emergency brake load case

Buckling analysis reveals substantial cost savings

The buckling analysis of the arm assesses the maximum collapse load of the part when applying a displacement along the X or Y direction at point E. This value is part of the technical requirements and needs to be carefully monitored as it is strongly dependent on the thickness and the quality of the material. As this calculation involves high levels of plasticity, the ability to retrieve both thickness, and residual plastic strains from PAM-STAMP in the analysis code is of major importance.

In comparison with the standard method, the coupled calculation predicts a 15.7% increase of the collapse force along the X direction, and 6.3% along the Y direction. "These variations are way under physical tests results where the collapse loads can exceed up to 30% the uncoupled simulated ones. In the same way, coupling allows significant cost reductions and can be applied to other body-in-white components" concludes L. Taupin.

Shock calculations greatly benefit from coupling

To meet the technical requirements, the arm has to withstand shock loads with various thresholds and impact severities without exceeding the maximum admissible deformation value measured at critical points. Two kinds of shock simulation are performed with PAM-CRASH, taking into account, or not, the forming history in both thickness and residual plastic strains from PAM-STAMP.

Straight wheel longitudinal pavement shock

In this configuration, the applied load at point E is predominantly oriented along

the X direction. The stiffness of the arm between points B and E is therefore of major importance. Tremendous differences appear between the standard and coupled calculations. A complete collapse of the arm can be observed after shock without coupling, whereas the coupled simulation

presents no visible deformation afterwards. A better correlation between calculations and physical tests can therefore be achieved using a coupled approach. This shows that the stiffness of the arm is not only conditioned by the flange geometry but also by material history. In addition, the plastic strain appears to be the factor of higher influence on the results since the thickness of the flange area is only slightly affected by forming.

Steered wheel lateral pavement shock

This time, the applied load at point E is equally distributed along the X and Y directions. Here, the work hardening induced stiffness is even more important for this shock. Similarly to the physical test, the coupled simulation sustains the shock without damage, whereas the deformation obtained without coupling is catastrophic, with a rotation of the arm around point A where the work hardening is as influential as in the flange between points B and E. The thickness reduction due to forming in the area of point A is compensated by the work hardening effect.

"For both configurations," says Laurent Taupin, "a coupled PAM-CRASH/PAM-STAMP approach greatly improves correlation between calculations and physical test results, revealing the strong influence of residual plastic strains compared to the thickness effect. The method brings considerable benefits mainly for simulations involving plasticity, such as buckling or shock. We

“ A coupled PAM-CRASH/ PAM-STAMP approach brings considerable benefits, helping to design parts to their ‘just needed’ performances. ”



3 - Results of the straight wheel longitudinal pavement shock calculations



4 - Results of the steered wheel lateral pavement shock calculations

are now considering applying it to other chassis components or automotive parts requiring complex stamping operations and presenting high residual work hardening effects. Work is ongoing to improve the accuracy of fatigue results and to limit the size of computations. Next step will be the integration of coupled simulations in the early stages of the projects for increased time and costs gains."

Longitudinal pavement shock test rig



About ACI

As a Tier 1 supplier, Auto Chassis International designs, manufactures and sells suspension and chassis systems for vehicle manufacturers worldwide. Over 100 million vehicles have been equipped with Auto Chassis International systems and components.

Auto Chassis International is established in Europe, Slovenia, Romania, Turkey, North America, Mercosur and Asia. The company employs 4,000 people and has a turnover of 1 billion Euros.

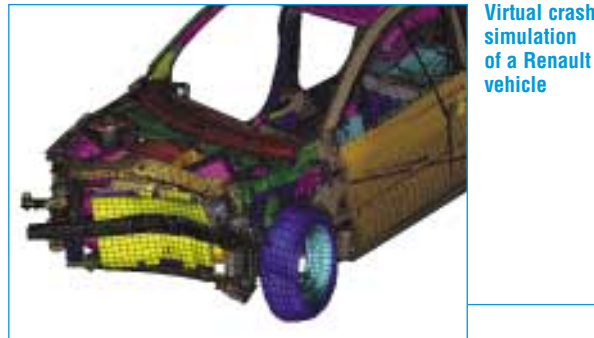
Placing digital simulation at the heart of the automotive design process

Bernard Thomas, CAE expert engineer, Renault, draws an overview on the on-going partnership with ESI Group for numerical calculation simulation

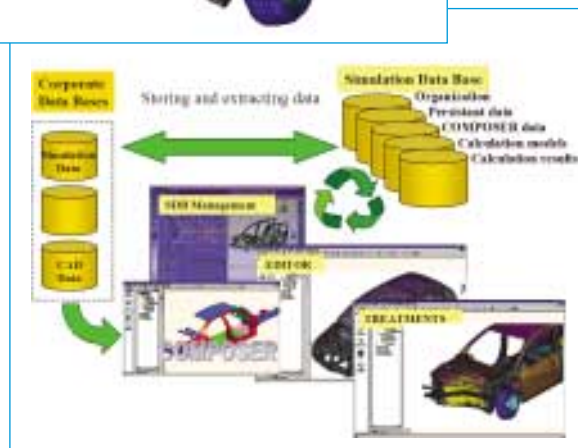


Bernard Thomas has contributed for more than 25 years to the development of the digital simulation process at Renault and to its implementation both inside the group and in cooperation with its partners.

Bernard Thomas started his career at Renault in 1975 to develop vehicle structural analysis. Taking advantage of this knowledge and of the technical advances, Thomas extended simulations to stamping process and to bodywork assembly, since 1988. He became Expert Engineer in the field of CAE for Vehicle Body in 1995.



Virtual crash simulation of a Renault vehicle



Future Renault's digital design process loop

PAMTALK: What is the relationship between PLM and simulation at Renault?

Bernard Thomas: Simulation at Renault is linked to the product digital mock-up, providing numerical data for each part or component. In addition, we are using a set of directories to store simulation data, but we are not currently sharing and managing resource information in a PLM framework.

This subject has been largely discussed and may lead to a decision soon.

PAMTALK: What are the major challenges?

B. Thomas: We have to finalize the integration of digital simulation in the design process.

Major challenges are as follows:

- Quick implementation of digital simulation to provide results allowing decision-making in the early stages,
- Accurate model representation ensured by reliable linking with the digital mock-up and reliability of data (assessment of simulation confidence),
- Tracking and capitalization of simulation results,
- Due to the increasing volume and complexity of simulations, product data management is required more and more frequently

PAMTALK: How is Renault currently working with tier 1 suppliers? What kind of simulation data are they providing to Renault?

B. Thomas: Business relations with our partners are based on mutual confidence. Renault group does not interfere with working methodologies of suppliers in charge of producing organs or vehicle assemblies.

However, Renault group takes special care to specifying numerical exchange rules, in particular for parts or components modeling. Retrieving of simulation results attesting for correct design is sometimes required together with modeling.

Meshing tasks are more and more often sub-contracted; numerical models of parts are transferred to the supplier who provides in exchange the corresponding meshing, in accordance with Renault specifications.

Design externalization of a model belonging to a vehicle range leads to larger simulation data exchanges, including whole models assemblies.

PAMTALK: What is the foreseen solution?

B. Thomas: The implementation of simulation data management system is getting more and more crucial.

Expected capabilities have been basically defined by Renault.



PAMTALK: How are you working with ESI Group in this field? Is this partnership useful, efficient, why?

B. Thomas: We have been working in partnership with ESI Group for more than two years to develop a new computation environment which will be closely linked in the future with a simulation data management system. Due to the exciting launch of the partnership, the extent of the project was slightly underestimated and we are now behind schedule; however, the first part of the project, COMPOSER dealing with virtual digital mock-up is ready.

For other topics more strictly controlled, the partnership worked in a very efficient way.

With the acquisition of EASI's CAE software, ESI Group has significantly strengthened its ability to develop the new jointly defined computation environment.

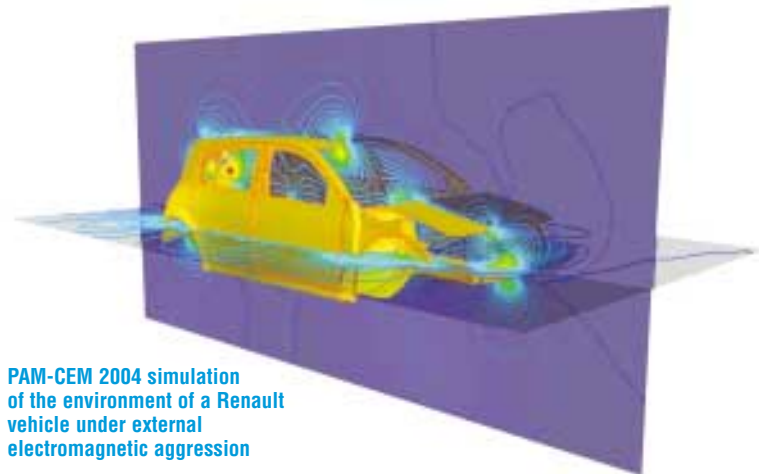
PAMTALK: What are the first benefits? The expected future ones?

B. Thomas: First benefits should be effective from September 2004 with the operational use of COMPOSER. First tests confirm the expected time savings when retrieving and validating the digital mock-up.

The use of new generation data editors linked to COMPOSER and of automatic solving procedures for standard computation chains should generate further time reductions, in the near future.

PAMTALK: What are the next steps?

B. Thomas: The next step is the availability of new generation editors, as I just mentioned, followed by the development of the computation database.



PAM-CEM 2004 simulation of the environment of a Renault vehicle under external electromagnetic aggression

Renault Group: creating automobiles

The Renault group has over 350 industrial and commercial sites in over 40 countries, and employs 130,740 people worldwide. In 2003, the group generated revenues of EUR 37.5 billion, an increase of 3.8%.

The group's profitable growth strategy is based on three main priorities: competitiveness, innovation and international development. Renault's bi-national alliance with Nissan - 5,357,315 vehicles sold in 2003, one of the world's top five automobile manufacturers - is part and parcel of this strategy.

The Alliance owns five brands: Nissan and Infiniti for the Nissan group; Renault, Dacia and Samsung for the Renault group.

COMPOSER

Simulation Data Management module supporting 3G PLM

Realistic physics-based simulation allows decisions to be made earlier using virtual prototypes. Besides product diversity, the evolution of data through the various project phases and the number of virtual tests or load cases largely increases data volume. Simulation data are now getting as important as CAD data. They must therefore be managed in a similar way to preserve their quality and develop efficient model build-up and update processes.

Using COMPOSER application, CAD and simulation data are synchronized for project milestones using CAD meta data and link information. A specific mechanism enables an easier update of simulation models: as a new configuration needs to be tested, COMPOSER module helps the user identify which parts have changed and must be updated.

COMPOSER manages simulation data at a generic level, which includes mesh and link information, before the models are specialized for a given discipline.

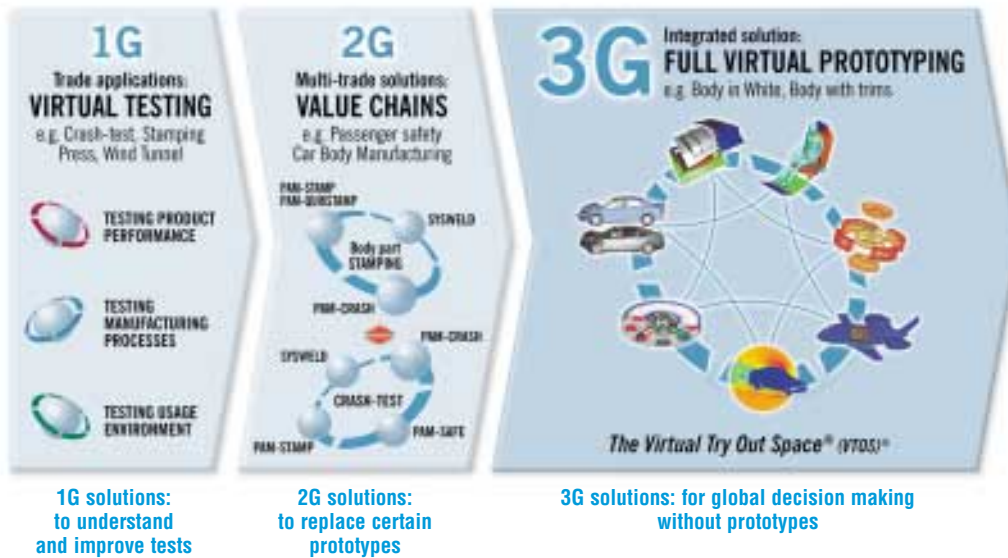
COMPOSER data can be shared across a large range of simulation fields, such as crash, NVH, fatigue, assembly or stamping. These crossed analyses all share the same product definition, but may use different meshes. Simulation data are stored in a specific database, which includes both product models and loading accessories such as crash test dummies or barriers.

In this way, COMPOSER brings a decisive answer to the manufacturing industries' needs for improving the product/process design cycles and accelerating time-to-market.



Renault group, early adopter of the COMPOSER application for Body-in-White finite element model generation and management

ESI Group's 1G, 2G, 3G solutions



Adopting 3G PLM solutions

ESI Group's 3G PLM strategy will allow predictive evaluation and continuous improvement of virtual prototypes and processes, allowing on-line decision-making in synchronization with all the actors of the extended enterprise



ESI Group is delivering a complete solution for the gradual implementation of virtual engineering that can be adapted to industrial companies' methodologies.

"1G applications" or industry-specific simulation software

The objective of single trade applications is to understand, improve and replace specific tests by fundamentally integrating the physics of materials. ESI Group's product portfolio covers all areas of applied mechanics such as:

- Prototype performance (ex. Regulatory tests: crash-test, drop-test, rupture under vibration,...)
- Production process tuning (ex. Stamping, welding, casting, forming,...)
- Real-life usage conditions (ex. Aerodynamics, aeroacoustics, electromagnetic compatibility, virtual human,...)

Renault partnership: from the digital mock-up to the digital prototype

- Deployment of licenses from ESI Group for solutions and related services involving numerical simulation of crash tests and sheet metal stamping.
- Development by ESI Group of several innovative projects relating to modeling and electromagnetic compatibility.
- Implementation of numerical simulation data management, establishing direct communication between the numerical definition, the simulation and subsequently, the physical tests. Based on the technical data management applications already in place at Renault, the new system will make it possible to combine all information relating to the simulation of a vehicle, including static and dynamic calculations, as well as, crash, endurance and acoustic data.

"2G solutions" or multi-trade value chains

Allowing online improvements and decisions, "2G" solutions integrate into optimization loops all "1G" applications for one design discipline, thus targeting the elimination of physical prototypes during the product design and development phases. They are developed in response to manufacturers' needs to achieve coherence between the various types of tests involved in product design, optimization and manufacturing.

Recent customer applications from Karmann, Arcelor, and ACI (cf. pages 4-5) have demonstrated how coupling PAM-CRASH with PAM-STAMP reduces the number of physical prototypes, while increasing accuracy and optimizing the processes.

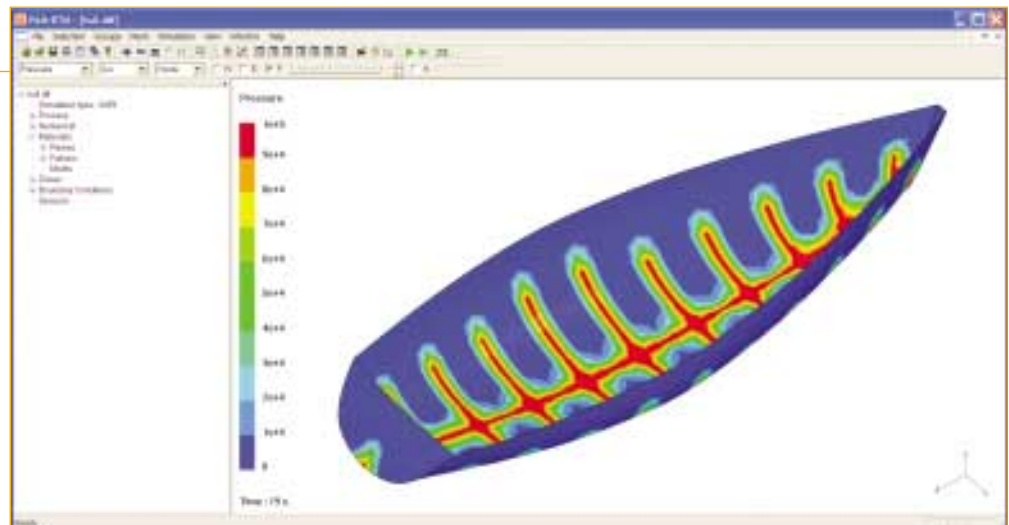
"3G PLM" solution, the advent of the Virtual Try-Out Space

ESI Group's 3G PLM offering involves an integration protocol, currently being developed by ESI Group, which will allow all the company's solutions to work with each other and with solutions developed by other extended enterprise players. By combining multi-trade value chains within the 3G PLM solution, ESI Group is building a global and dynamic decision-making tool. The Virtual Try-Out Space is the "3G" digital environment for the realistic evaluation and continuous improvement of virtual prototypes within the extended enterprise. This solution generates significant benefits in terms of cost, time, quality and innovation for large, international industrial groups, their partners and suppliers. The partnership with Renault Group and the endorsement of Dassault Systèmes' CAAv5 platform are essential building blocks of ESI

PAM-RTM 2004 enables simulation of very large composite structures using the Vacuum Assisted Resin Infusion (VARI) process

Infusion (VARI) simulation of a boat hull with PAM-RTM 2004

Courtesy University of Le Havre



PAM-RTM 2004 provides rapid solutions for preliminary design, as well as, refined calculations for process and mold optimization and final design verification. The product is uniquely suited to simulate a wide range of manufacturing processes, including Resin Transfer Molding (RTM), Vacuum Assisted RTM (VARTM), and now with the 2004 release, Vacuum Assisted Resin Infusion (VARI). VARI is one of the few processes that can be used to efficiently manufacture very large composite parts such as windmill blades, ship decks and hulls, and large aircraft parts. Due to their size, such large structures cannot be manufactured with traditional closed molds. VARI simulation is now possible because the permeability variations caused by the deformation of fibrous reinforcement during resin injection are taken into account.

Availability

PAM-RTM 2004 is available on PCs (Windows NT, 2000, XP), on Unix workstations from IBM, and hardware vendors' supported Linux platforms.

"With PAM-RTM 2004, engineers are now able to anticipate future manufacturing issues or problems that could not be simulated before when designing large components. It helps them drastically reduce manufacturing costs, as any failure would generate tremendous waste due to the large amounts of resin and fibers involved in these projects, not to mention the cost of the mold," said Patrick de Luca, Product Manager, ESI Group.

The optimization of PAM-RTM 2004 CPU management offers a version that is twice as fast as the previous release. Among the many new capabilities found in PAM-RTM 2004, are a new contact resistance for thermal modeling and improved functionality for air bubbles entrapment detection. In addition, users can now define their own viscosity and curing functions, which enables them to simulate new resins as they come to market.

The user-friendly interface, based on Microsoft Windows architecture, offers improved visualization: a model explorer, for instance, helps locate materials or boundary conditions directly on the model. Data output analysis is also further simplified

ESI Group's composite solutions

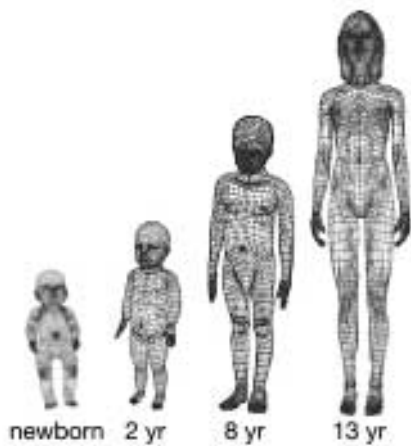
ESI Group's industrial solution for predictive simulation of composite and plastic structures behavior includes:

- SYSPLY for design optimization and composite analysis,
- PAM-FORM and PAM-RTM for process optimization of composites and plastics,
- and specific PAM-CRASH modules for testing of composite crashworthiness behavior.

with the possibility of generating animations.

PAM-RTM 2004 offers a seamless integration of the solver pre and post-processing. Automatic mesh modification is available for runners and injection points. This new functionality offers significant time-saving in the process-tuning and optimization of runners and positioning of injection gates, since the mesh modifications are done directly in PAM-RTM 2004 rather than going back to the CAD model.

Towards legal virtual crash tests for vehicle occupant safety design using human models



Sub-adults and variants of adult average males (average, athletic, fat, thin, elderly)



Virtual testing procedures and human models to replace physical certification tests

From the paper presented by Eberhard Haug, Muriel Beaugonin, Nicole Montmayeur, Christian Marca (ESI Group) and Hyung-Yun Choi (Hong-Ik University, Korea) at the International Crashworthiness and Design Symposium (ICD03)

In the context of virtual testing, current endeavors aim at the establishment of a procedure that permits legal crash tests to be carried out by simulation, instead of performing the physical certification tests presently required for the homologation of new passenger car models.

Currently, the effect of car accident on human occupants is studied from the response of mechanical occupant surrogates (legal crash dummies) during normalized legal crash tests. Passive safety devices must be designed together with the vehicle structure in order to minimize the risk of injury in a car accident. This risk is assessed from force, displacement and acceleration readings taken on the instrumented legal crash dummies used during a



crash test. Regulatory and consumer tests require that the vehicle prototypes are crashed in a number of prescribed legal crash tests. Although the number of tests has increased over time, it must remain limited due to the great amount of cost and lab time required to perform these tests. Legal certification of new car models is granted when the car and dummy successfully pass these crash tests in the laboratory.

On the other hand, virtual testing enables not only crash dummy response simulation in a number of different conditions, but also human response simulation in such events. Comprehensive computational models of cars and crash dummies have contributed greatly to the safety of transport vehicles over the last twenty years by allowing considerable design speedup, but also design optimization, before the expensive prototypes are built and crash-tested. The next challenge is the establishment of legal virtual crash test procedures using dummy and human models.

In order to define validated human models for the simulation of selected legal crash tests and objective criteria to rate the quality of the numerical results, the procedures shall include the following items:

- Human geometry and discretization based on the variety of human anatomy, and according to scaling/morphing/aging and positioning conventions, algorithms and mesh rules
- Biomaterial laws, tests and databases
- Human Injury criteria and validated injury threshold values
- Stochastic rules to cover biomaterial and anatomical scatter
- Validation procedures for component and whole body tests, guidelines for model validation procedures and human model certification procedures
- Objective numerical result rating procedures
- Certified crash scenarios (rules for the utilization of the certified models)

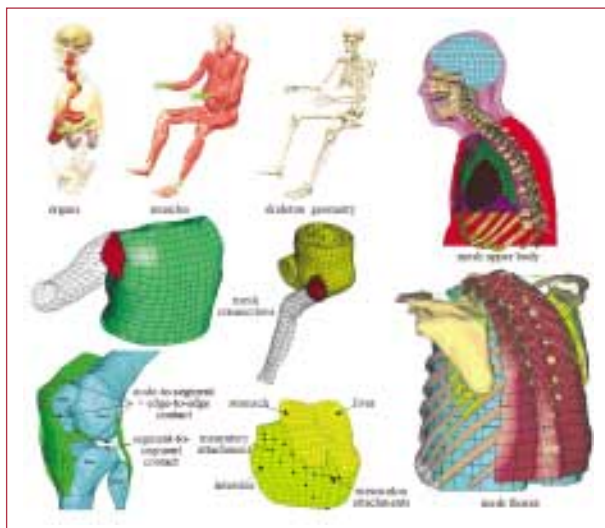
Human geometry and meshing techniques (HUMOS Project)

Human geometry and discretization

Encouraging steps towards human biomechanical models have been undertaken. The organ, muscle and skeleton geometries have been recorded from a frozen cadaver in the frame of the European project HUMOS (HUMAN MOdel for Safety). The recorded geometry data have been standardized and finite element meshes have been prepared according to the prescriptions of the project consortium.

Virtual testing with human models

Virtual testing can be accepted when its procedures, codes and models are universally defined and deposited with legal checking authorities, in future global regulation works, official guidelines, procedure manuals and databases, so that the results of crash simulations become independent of the analyst and software.



These results and prescriptions are a first step in creating a general database and future regulation works. The ongoing HUMOS2 European project will refine the procedures and elaborate algorithms for scaling, morphing and positioning of human geometries, which is part of such works. Similar projects exist and are being mounted in Japan (JAMA / JARI) and in the USA (Consortium lead by GM). In order to reach global virtual test procedures, these projects must coordinate their efforts.

Bio-materials

Biological materials can be linear or nonlinear, isotropic, orthotropic, rate dependent, plastic or hyper-elastic and they are characterized by respective behavior laws. As an example, ESI Group has developed for PAM-SAFE software product, an anisotropic hyper-elastic material model for knee ligaments.

In addition, biomaterial tests are needed to identify the material parameters, in particular, for soft tissues. New test protocols must be worked out and documented to test such tissues according to normalized standard procedures.

Injury criteria

For the more structural bio-materials (bone, tendons), modeling human parts resembles standard engineering analysis, where stress, strain and injury (fracture, rupture) are clearly correlated with biological tissue and organ injury. However, for the soft tissues there may not be any straightforward correlation between the mechanical quantities and injury or impairment of biological functions, in particular for the brain. The matter is complicated by the fact that living soft tissue material properties are influenced by blood pressure, while this must be reestablished artificially in isolated organ tests. The SIMon concept (Simulated Injury MONitor by DOT/NHTSA/NTBRC) provides the engineer with appropriate injury criteria for the head and brain.

ESI Group and IPS-I are jointly working on a new head/neck model, called H-Neck, based on material tests and calibrated on whiplash volunteer tests. This model is part of the ESI Group's H-Model family of human models; it is equipped with active muscle elements

that will permit the study of the influence of muscle pre-tension and activation on the whiplash response of the head/neck complex.

Stochastic rules

Human anatomy and material properties exhibit considerable scatter around "average" values. Human models for transport vehicle occupant safety design should reflect the noted scatter. This can best be achieved by running the required crash simulation scenarios not only with the "average" human models, but also with a number of stochastic variants of the models, where the anatomical and material scatter is treated in a representative way. Rules for dealing with stochastic variants should be stipulated in future regulation works.

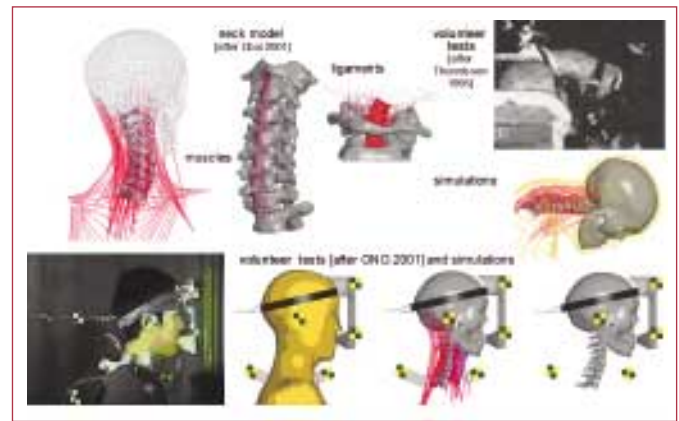
Results

Once the models and procedures are established, calibrated and validated according to the prescriptions of the future regulation works, the models can be employed in simulations of crash scenarios and replace physical tests. At this stage, the use of a dedicated tool such as MODEVAL from PSA and Faurecia can avoid subjectivity of result interpretation, both in the validation process and in exploitation runs, where the results obtained with experiments, different models, crash codes and analysts should be compared objectively.

ESI Group human models for impact biomechanics

ESI Group has developed a range of advanced numerical models with detailed geometrical and material descriptions of bones, flesh, muscles, ligaments, organs and other soft tissues. The models provide deep insight into human body behavior in real-life situations, for a better understanding of biomechanical phenomena and the prevention of injuries.

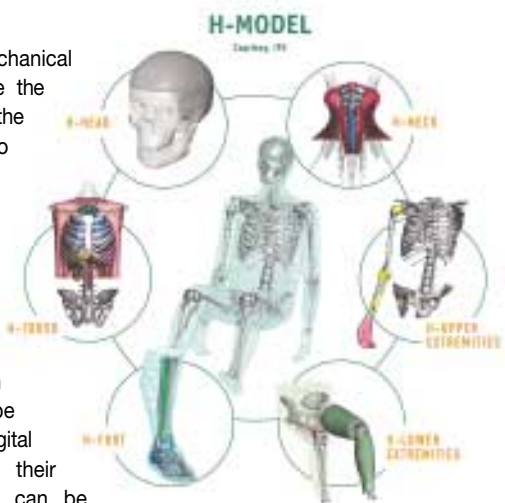
Presently, the H-Model family is being further developed by the Hong-Ik University (Seoul), by IPS-I and by ESI Group, for impact biomechanics and pedestrian impact. ESI Group also has its own encoded version of the HUMOS finite element model for use with PAM-SAFE, and is a partner in the ongoing HUMOS2 project.



Human neck model for whiplash simulation

The H-Model is currently used by the automotive industry, in complement to crash dummy-based analysis, to provide further information about real human kinematics and injury mechanisms. As an example, BMW successfully used the H-Model, in comparison with the EuroSID dummy model, for side impact analysis (cf. PAM TALK 25).

Validated biomechanical human models have the potential - and are the only alternative - to replace legal crash dummies for legal virtual testing as soon as allowed by regulations. Then, more profound investigations of occupant safety in crash tests can be made since the digital simulations and their parametric variants can be performed rapidly once the base line computer models are established. In addition, virtual human models provide direct relevant information on human response and injury.



H-Model: a range of deformable finite element models of the human body

GLOSSARY

- IPS-I: Integrated Professional System International
- NHTSA: National Highway Traffic Safety Administration
- DOT: Dept. Of Transportation
- NTBRC: National Transportation Biomechanics Research Center
- JAMA: Japan Automobile Manufacturers Association
- JARI: Japan Automobile Research Institute

For more information on HUMOS2 project, please visit:

<http://humos2.inrets.fr>

ProCAST helps Umicore to validate the manufacturing tool of a critical foundry component and to successfully move to production

Umicore tunes the manufacturing process of a thin-walled zinc safety spool with ProCAST

Safety spool in zinc alloy developed by Umicore

Using the foundry simulation software package, ProCAST, and based on various internal tests and studies made in the past, Umicore was able to propose to its customers a new solution made of zinc alloy (Zamak), which successfully met the required technical specifications at a very competitive price.

A difficult thin-walled component with stringent safety requirements

Back in the seventies, the spool, a safety component integrated in the safety belt mechanism, was made of zinc weighing between 230 and 270g. Since the mid-eighties, aluminum has replaced zinc because of its lower weight; however, with higher operating temperatures, as aluminum is being processed at over 600°C vs 400°C for

Zamak, the lifetime of the casting mold did not exceed 50,000 cycles and resulted in expensive post-machining operations and increased production costs.

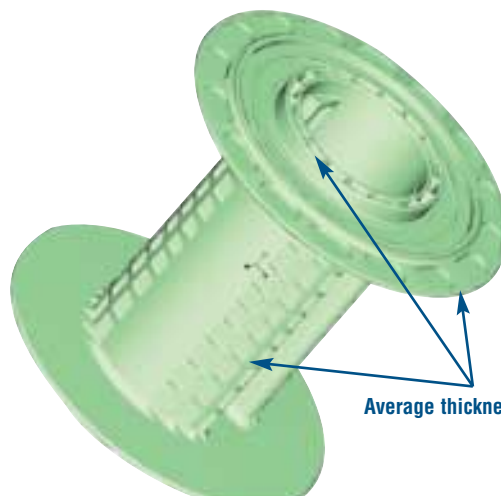
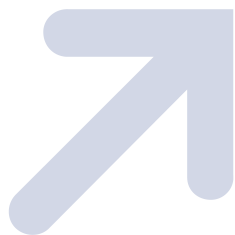
From the initial design of the part's tooling, based at that time on trial-and-error, Umicore successfully developed a new spool weighing less than 120g and meeting the required technical specifications:

- extended operating temperature range from -35°C to 80°C,
- minimum part lifetime of 12 years,
- crash test performance.

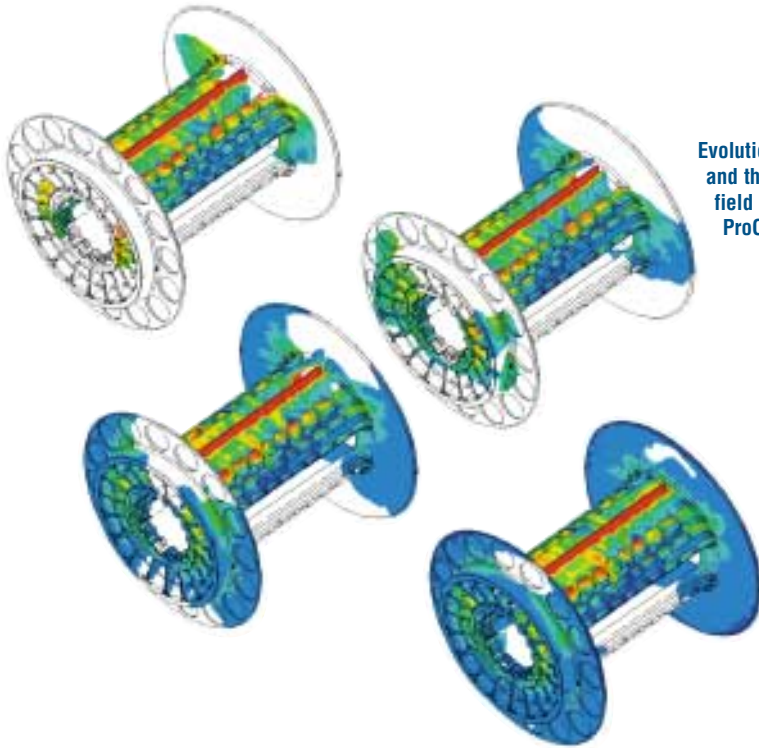
Assessing process feasibility and in-service performance

To successfully manufacture the part in high-pressure die casting, two major difficulties had to be addressed: significantly reduce the overall part thickness for weight reduction, and position spokes to guarantee in-service performance. To meet this challenge, various internal tests and studies were conducted, but important decisions were also based on casting process simulation with the Finite Element casting process simulation solution, ProCAST.

Umicore performed several simulations to optimize the mold design. With the help of ProCAST, the first initial prototype mold proved successful for mold filling; however, twelve additional modifications of the part geometry were necessary to satisfy in-service performance.



Average thickness 0,7 mm



Evolution of the flow front and the temperature field during filling with ProCAST

Optimizing die design with ProCAST

The spool is a complex, non-symmetrical component including numerous small internal geometrical features with an average thickness not exceeding 0.7mm. To successfully develop the high-pressure die casting process, the following issues need to be addressed:

- define the optimal piston velocities,
- design the runner geometry for optimal mold filling,
- determine the position and thickness of the gates,
- prevent the risk of misruns,
- define the size and position of the overflows.

Based on simulation results and using an iterative process improvement approach, all of these issues were investigated with ProCAST. Gate and runners can be optimized so as to provide the most regular flow inside the mold. Misruns or incomplete filling, resulting from excessive alloy temperature drop, can easily be identified from predicted alloy temperatures during the filling phase.

The progression of the metal front inside the cavity can be simulated and overflows can be dimensioned and positioned from the last filling areas to evacuate oxides appearing at the metal front caused by the contact of the alloy with air. Also, metal front junctions combined with temperature fields can be visualized so as to avoid weld lines inside the component, which often result in local defects with poor mechanical resistance.

“ProCAST allowed us to validate the production tooling of this new component produced in more than one million pieces using high-pressure die casting.”



ProCAST benefits

Casting process simulation with ProCAST enabled Umicore to develop and optimize the manufacturing process of a new zinc spool with very thin walls and stringent technical requirements in terms of in-service performance.

The part is now being produced at a very competitive price in Germany, Italy and South Korea for production series of over one million units. Using ProCAST allows decision-making early in the design phase and generates significant time and cost savings for tool development and production.

Another significant competitive advantage of the new zinc spool is linked to the reduced operating temperatures. Because of the lower melting point of zinc, the die lifetime is 10 times longer than what was obtained with the aluminum spool.

UMICORE Producing materials for a better life

Umicore is an international metals and material group. Its activities are centered on five business areas: Precious Metals Services, Precious Metals Products and Catalysts, Advanced Materials, Zinc and Copper. Each business area is divided into market-focused business units.

Umicore focuses on application areas where it knows its expertise in material science, chemistry and metallurgy can make a real difference, be it in products that are essential to everyday life or those at the cutting edge of exciting, new technological developments. Umicore's overriding goal of sustainable value creation is based on this ambition to develop, produce and recycle metals in a way that fulfills its mission: materials for a better life.

The Umicore Group has industrial operations on all continents and serves a global customer base: it generated a turnover of €4.7 billion in 2003 and currently employs some 11,500 people.

More information on: <http://www.umicore.com>

Material properties for process simulation

Predicting thermo-physical material properties for casting process simulation

Throughout the manufacturing industry, process simulation is now accepted as an important tool in product design, process development, improving yield and in solving processing problems. However, the availability of accurate thermo-physical material properties still represents a challenge and has become critical for reliable simulations of the complex solidification and solid phase transformation processes. While most casting process simulation software are provided with standard material properties, these databases are rarely sufficient to include all metallic alloy grades currently used throughout the industry.

Thermodynamic databases

Thermo-physical material properties can be calculated in ProCAST for the following alloys:

- aluminum,
- iron and steel,
- magnesium,
- nickel,
- titanium,

with up to 16 different alloying components. The prediction of the thermo-physical alloy properties is linked to databases provided by the company CompuTherm LLC (www.compuTherm.com) and containing thermodynamic model parameters for each phase of the alloy. The thermodynamic data used has been extensively tested and validated for most commercial alloys. The following properties are calculated:

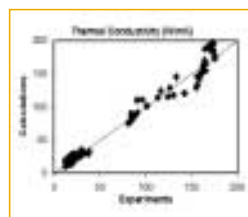
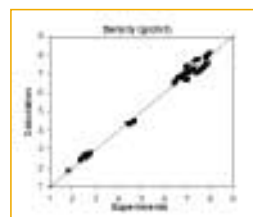
- solid fraction,
- enthalpy,
- density,
- conductivity,
- viscosity.

Based on the alloy chemical composition, Scheil or Lever models are used to obtain fractions of solid and enthalpy data, specific heat and latent heat being extrapolated from the enthalpy. The temperature dependant densities of the liquid and solid phases of the multi-component systems are then calculated using a simple mixture model and the liquid viscosity is calculated using the Andrade's formulation of pure liquid metals. The thermal conductivity is also provided but at this stage limited to aluminum alloys.

Microstructure modeling

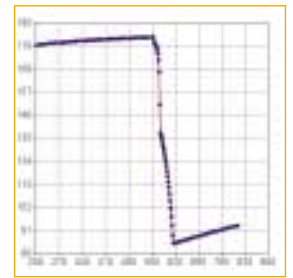
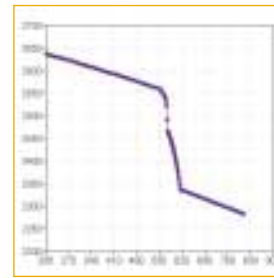
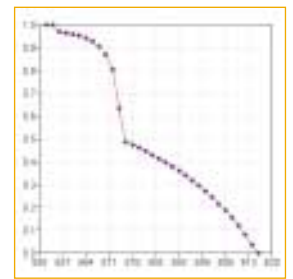
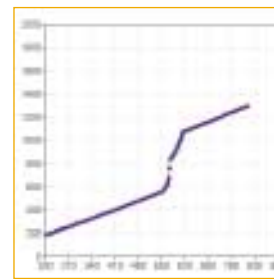
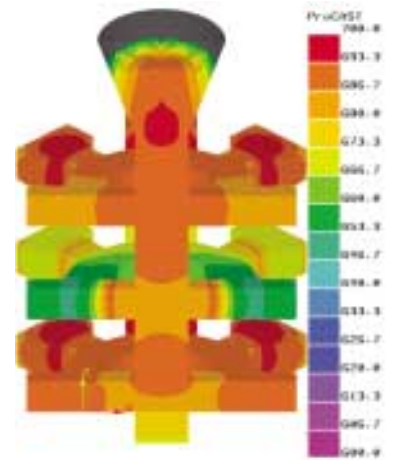
The use of thermodynamic calculations in ProCAST is not limited to providing input data for process simulation. Thermodynamic databases are also used in a multi-component solidification model, coupled with the thermal and flow solvers, for the prediction of microstructures including phase fractions, grain size, nodule count and dendrite arm spacing.

For cast irons, mechanical properties, which are of great interest for in service casting performance, can in turn be predicted from microstructure modeling to provide information on yield strength, tensile strength and hardness.

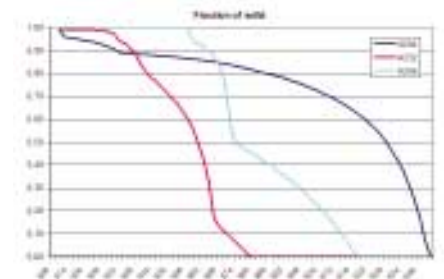


Comparison between calculated and experimental data for various alloys (experimental data from Auburn University).

Yield strength prediction (MPa) of an Inconel 713 investment casting assembly



Calculated enthalpy (a), solid fraction (b), density (c) and thermal conductivity (d) for an A356 aluminum alloy



Fraction of solid evolutions for respectively A204 (AlCu4MgTi), A332 (AlSi11CuMg) and A356 (AlSi7Mg) aluminum alloys

ESI Group's extended casting solutions on show

METEF 2004: meeting point in the extrusion and die casting industry



ESI Group took part in Metef, showcasing its strengthened portfolio and competence in metallurgy and casting processes. ProCAST, CALCOSOFT and PAM-CAST were displayed on ESI Group booth in partnership with HP and the Italian agent Ecotre.

In parallel to the exhibition, the 2nd international High Tech Die Casting Conference was held April 21-22. ESI Group gave a paper on *Stress and fatigue analysis in die casting* within the symposium "Technology for the die". The Conference HTDC

of experts, both academic and industrial.

METEF bi-annual tradeshow is dedicated to aluminum, extrusion, foundry, die casting, machinery,



2004 offered an overview on scientific and technological innovations in the field of die casting, with papers and contributions from a very qualified panel



ProCAST die-cast parts on display (left, courtesy: Karibo)

equipment, products, raw materials and applications. Almost 20,000 visitors, met in Montichiari (Brescia), Italy, on April 21-24 for the biggest European exhibition on technologies and equipment for foundry.

Extrusion and die casting sectors are continuously growing, both at domestic and international levels, and the Brescia surroundings have the highest concentration of operators, which explains the attractiveness of the event.



13th solidification course 2004: at the top of industrial metallurgy

The thirteenth solidification course, organized by Calcom ESI, gathered 37 people from industry and 9 from academics coming from 21 countries. This one week course was held in Les Diablerets, Switzerland, from May 23-28, 2004.

Dedicated to metallurgists and foundry engineers, the solidification course is orientated towards the application of solidification theories to industrial casting processes. Special emphasis is given to the control of microstructural features and to defect reduction like

porosity, cracks and segregation.

This year's edition featured an intensive agenda with lectures presented by renowned personalities from state-of-the-art Swiss, French and American high schools and universities.

Year after year, the solidification course has gained an established reputation. Since its first edition in 1992, the course has gathered 417 participants coming from 161 companies distributed in 29 countries representing all 5 continents.



EuroPAM 2004, an opportunity not to be missed

Preview of the 14th European conference and exhibition to be held October 11-13 in Paris, France

EuroPAM 2004 industry sessions highlights

12 and 13 October

■ Automotive Crashworthiness

- Arno Eichberger - Magna Steyr Engineering
Development of a FEM-procedure for an effective Design of the Car Body in the Rollover Load Case

■ Automotive Manufacturing

- Sébastien Ott - Renault
Use of FE Simulations to Predict Distortions After Welding
- Dr.-Ing. Michael Rethmeier - Volkswagen AG
Vision of VW with Respect to the Usage of Welding Assembly Simulation in Design, Production and Manufacturing

- Sven Roeren - IWB Munich
A Way to Realise the Simulation of the Process Chain Welding-Forming

- Petr Hanák - SIWE
Deep Drawing Die Design Based on Realistic Prediction of Drawpiece-Shape Within Drawing

■ Aerospace

- Nathalie Pentecote - DLR
Crash on Water: a Highly Multi-Physics Problem
- Dr. Michael McCarthy - University of Limerick
Material Modelling of a Fibre Metal Laminate (GLARE) for Soft Body Impact Problems
- Dr. Michael McCarthy - University of Limerick
Bird Impact on a Fibre Metal Laminate (GLARE) Aircraft Leading Edge with an SPH Approach

■ Automotive Occupant Safety

- Karl Koschdon - ESI Group / Bhavik Shah - FTSS
New and Enhanced PAM-SAFE Models of Crash Test Dummies
- Daniel Muñoz - Fundación CIDAUT
Application of FPM Method in the Simulation of the Earliest Stages of Airbags Deployment

■ Fabricated Materials

- Christophe Palloteau - TREVES
Dash Insulator Thermoforming Simulation
- Prof. Christophe Binetruy - Ecole des Mines de Douai
The Potential of the Mixed FE-SPH Method to Simulate the Manufacturing of Polymer Composites

Innovate with simulation; this will be the EuroPAM 2004's motto. In other words, this means moving away from the traditional trial-and-error methodology and embracing Simulation-Based Design, a new paradigm more favorable to innovation. During this three-day event, user conferences (see agenda and details in page 2) and industry session papers will demonstrate how digital simulation and virtual prototypes can progressively replace physical tests in a more effective process for product excellence and reduced time-to-market.

Keynote speeches from Volker Tietz, Head of Department for CAE methods,

Volkswagen AG, and from Yves Courage, Courage Competition, will also draw the audience's attention to the pressing need to quickly introduce new and reliable products for enhanced competitiveness.

Attending EuroPAM 2004 is, more than ever, a major opportunity to hear from respected industry specialists about the latest advances in CAE and high performance computing. As in previous years, the agenda includes executive workshops, a partner panel session and an exhibition area. The high-tech La Villette congress center is the ideal place to meet and share experiences, discuss enhancements and learn about current and future industrial challenges.

Information and on-line registration at:
<http://www.esi-group.com/EuroPAM2004/>

AmeriPAM 2004, all in one event

The sixth annual North American user conference and exhibition will be held November 3-4 near Detroit at the Troy Marriott, in Troy, Michigan, USA.

The first day of AmeriPAM 2004 is dedicated to a half day user's forum, followed by a user conference, with five breakout sessions held in parallel on the following topics:

- Crash & Occupant Safety
- Stamping
- Casting
- Vibro-Acoustics
- CFD.

The second day, AmeriPAM 2004 will feature in-depth presentations on ESI Group's simulation software and real-life deployment in a wide range of applications. Conference topics will cover numerous simulation applications

in product development including biomechanics, material rupture, noise, vibration, harshness, durability, aero-acoustics, electromagnetic compatibility, welding, heat treatment, and forming of composite and plastics. The conference will bring together top executives, managers, engineers and designers representing major American automotive manufacturers and suppliers, as well as a wide spectrum of industries including aerospace, defense, energy and manufacturing.

As in previous years, senior executives, key members of the development team and product managers from ESI Group will be available to listen to the attendees' requests, thus contributing to continuously improving products.



Doctor Eberhard Haug, 31 years of commitment to ESI Group

ESI Group's Scientific Director officially retired in August at the age of 65

Eberhard Haug was responsible for R&D projects concerning the PAM-SYSTEM structural mechanics advanced software range. He holds a PhD in civil engineering from the University of Berkeley (1972) and an engineering degree from the University of Stuttgart (1964). Dr Haug began his career as Research Manager of numerical applications for the design of flexible and deployable structures at the University of Stuttgart, followed by Research Specialist for the Institute for Structural Dynamics (ISD). He joined ESI SA in 1973 to head development projects for PAM-CRASH, PAM-SAFE and PAM-STAMP, and has more recently specialized in the biomechanics field. Eberhard Haug is a co-founder of ESI GmbH (1979).

Eberhard Haug contributed to many papers and lectures (cf. pages 10-11). He is also at the origin of **PAMTALK** magazine, which he intended as a newsletter relating the latest ESI Group's product developments and services and establishing a link between the company, its users and scientific partners.

The whole ESI Group team, having closely worked with Eberhard wishes him a nice and active retirement.



Dr. Eberhard Haug
a passionate supporter of ESI Group and an eminent scientist

Dr. Argiris Kamoulakos

Dr. Argiris Kamoulakos has been nominated this year as Secretary of the ESI Group Scientific Committee. This committee gathers renowned professors to actively contribute in decision-making of ESI Group's best investment strategy in all technological sectors.



Argiris has a prestigious academic background with the highest degrees including: a Bachelor of Science in Aeronautical Engineering (1980) from The City University in London, a Master of Science in Aeronautics and Astronautics and a Master of Science in Mechanical Engineering (1982) from the MIT in the USA, where his studies were financed by a NASA/DOE Research Assistantship. He then obtained in 1987 a PhD in Aeronautical Structures from the Imperial College of Science and Technology in London. He received also in 1980 the Tokaty Award and the Royal Aeronautical Society Prize.

After a professional career dedicated to performing many projects and developments, he joined ESI Group in early 1994 as Deputy Technical Director. For 10 years he was instrumental in the implementation of several developments in the PAM codes like hyperelastic materials, rotating tyre models, fabric composite shell models, Smoothed Particle Hydrodynamics, rupture models.

Argiris also participated in some high profile studies like the hypervelocity impact studies with the European Space Agency (ESA) and the fluid structure interaction studies with Boeing for the American Aircraft Hardening Project in the aftermath of the Lockerbie accident investigation. He is a Fellow of the Royal Aeronautical Society, a Chartered Engineer, and a Senior Member of the AIAA. He is the author of 18 scientific publications and was deeply involved in the implementation of the so-called EWK (ESI-Wilkins-Kamoulakos) rupture model.

All in all, as Argiris said when he arrived at ESI, his real expertise stays in solving problems by using conventional methods in unconventional ways.

Highest distinction awarded to Guillaume Pierrot, ESI Group / Ecole Centrale Paris

Guillaume Pierrot received his PhD after successfully defending his dissertation on *Development and analysis of a meshless method for first order hyperbolic systems* on June 23 of this year. This graduation marks the completion of his engineering degree from Ecole Centrale Paris, one of the most prestigious engineering institutions in France, and of a three-year research work at ESI Group.



Graduation in presence of many renowned professors

The basic motivation for this PhD work was to improve and extend remeshing techniques such as the Smoothed Particle Hydrodynamics (SPH) method to fluid dynamics, with accuracy and consistency. The interest of the scientific community for meshless methods has been growing over the last decade to handle complex geometries or very large deformations.

As an example, ESI Group is currently marketing its Finite Point Method (FPM), a meshless solution for accurate airbag deployment simulation. Guillaume Pierrot has developed a new meshless method for solving first order hyperbolic systems, that appear in many physical problems such as gas dynamics, hyper-elastic materials or magneto-hydrodynamics.

Now Guillaume is working full-time for ESI Group in the CFD team, applying his skills to push away other fluid dynamics boundaries.



ESI Group participates in the following events:

Date	Event	Place
Sept. 20-21	2004 Equipment Expo organized by the Investment Casting Institute	Covington, KY (USA)
Oct. 6-8	HK 2004 60th colloquium for heat treatment, material technology, manufacturing and process technology	Wiesbaden (Germany)
Oct. 11-13	EuroPAM 2004 14th European Conference and Exhibition on Digital Simulation for Virtual Engineering	Paris (France)
Oct. 26-30	EuroBlech 2004 18th International Sheet Metal Working Technology Exhibition	Hannover (Germany)
Nov. 3-4	AmeriPAM 2004 6th North American Conference and Exhibition on Digital Simulation for Virtual Engineering	Detroit, MI (USA)
Nov. 8-9	HanPAM 2004 10th Conference and Exhibition on Digital Simulation for Virtual Engineering	Seoul (South Korea)
Nov. 11-12	PUCA 2004 15th Conference and Exhibition on Digital Simulation for Virtual Engineering	Tokyo (Japan)
Nov. 15-16	ChinaPAM 2004 3rd Conference and Exhibition on Digital Simulation for Virtual Engineering	Beijing (China)

Information and registration on www.esi-group.com

ESI Group reinforces its international leadership

Creation of two subsidiaries in India and China



ESI GROUP INDIA Pvt Ltd Software Publishing division

ESI Group's Indian subsidiary was founded last February, following the acquisition of EASI USA's intellectual property rights to the EASI CAE software. Announced in September 2003, the integration of EASI technology will allow ESI Group to offer a powerful CAE software solution within the overall VTOS simulation environment.

Based in Bangalore, ESI Software India is a wholly-owned subsidiary. A team of 36 high-level engineers, previously employed by EASI India, is developing these efficient and productive CAE software environments. "The majority of our team has graduated from leading universities with post graduate degree and has a strong industrial background, says Nagesh, Managing Director, ESI Software India. "They are skilled at combining users experience in engineering design and analysis to



Opening celebration of ESI Software India. From left to right: J.-L. Duval, Business Development Manager, ESI Group, Nagesh, Managing Director, ESI Group India and O.Philippe, Human Resource Director, ESI Group



The 6th floor of the building hosts the Zhong Guo ESI team in Guangzhou city

serve customer needs and meet the demands of the industry". Through this subsidiary, ESI Group adds complementary remote development know-how, recognized by such major American car makers as GM and Ford, and will provide for existing customers growing needs of support. In order to sustain business growth, the teams will move to a new premises by the end of 2004.

ESI Software India Pvt. Ltd:
213, 3rd Main, 4th Cross. Chamarajpet.
Bangalore 560 018, India.

Zhong Guo ESI Co., Ltd. Distribution and Services division

The take-over of ESTI Engineering Simulation Technology Inc., based in Canton, is part of ESI Group's strategy to build a large distribution network on

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.

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 capacity to build up a customer base, including many Chinese industrial leaders. With a team of seven highly qualified employees, ESTI posted still-modest but fast growing sales of USD 540,000 in 2003. Today, Zhong Guo ESI employs nine people full-time, one of them being based in Beijing, the capital city. A new office should be opened before the end of the year in Shanghai, the largest city of China.

Zhong Guo ESI Co., Ltd:
Unit 608A, Guangdong Soft-Park,
No. 11 Caipin Road,
Complex building,
Guangzhou Science City (GSC),
Guangzhou city 510663, China.

To find the nearest office, please go to www.esi-group.com



What's new at www.esi-group.com?



New computational fluid dynamics and multiphysics solutions acquired from CFDR are now online in a new products section. The Advanced CFD pages include a product description, with an overview of the modules and capabilities for CFD-ACE+, CFD-CADalyzer, CFD-FASTRAN and CFD-TOPO. Many industrial applications in the area of semiconductor, biotechnology, fuel cells, MEMS (Micro Electro Mechanical Systems), plasma, athermics and aerodynamics are presented.

The worldwide conferences and exhibitions on digital simulation for virtual engineering are largely advertised on ESI Group's web site. In particular, EuroPAM 2004, the first of a series of five annual events, allows visitors to access, directly from the home page, the agenda of the dedicated user conferences and industry

sessions, short biographies of keynote speakers and other practical information. AmeriPAM, HanPAM, PUCA and ChinaPAM will be held in November, respectively in Detroit, Seoul, Tokyo and Beijing. Corresponding web sites will be regularly enriched with updated data.

Finally, 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.

Please, come and visit the ESI Group homepage frequently to get the latest news. If you have any suggestions, please do not hesitate to use the info@esi-group.com e-mail address or the contact web page

ESI Group and LSTC to collaborate on future releases of EASi-CRASH DYNA for LS-DYNA

Partnership will enable an enhanced solution for crashworthiness and occupant safety simulation to car manufacturers and automotive suppliers

ESI Group and LSTC announce a multi-year collaborative agreement to continue the development of EASi-CRASH DYNA, a comprehensive CAE environment for multi-body and finite element occupant safety simulations using LS-DYNA.

In 2003, ESI Group acquired the intellectual property rights of EASi's CAE software, including EASi-CRASH, EASi-Vista and EASi-Process.

- EASi-Vista is a software environment that fully exploits the power of object-oriented technology, ensuring high performance and productivity.
- EASi-Process is an advanced technology for creating, automating, and standardizing CAE processes.

ESI Group will reinforce the development of these tools to provide a common user environment for an extended range of CAE applications, including LS-DYNA solver.



EASi-CRASH DYNA, a complete, efficient and productive CAE environment for multi-body and finite element occupant safety simulations using LS-DYNA

EASi-CRASH DYNA will continue to be developed by the same team based in Bangalore, India, and will be sold by ESI Group worldwide.

Together, ESI Group and LSTC will provide simultaneous releases of LS-DYNA and EASi-CRASH DYNA to ensure continuity and the integration of future enhancements to meet market and customer requirements.

LS-DYNA, from LSTC, is a general-purpose transient dynamic finite element program capable of simulating complex real world problems.



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