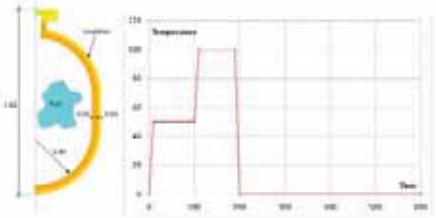
ENGIN SOFT

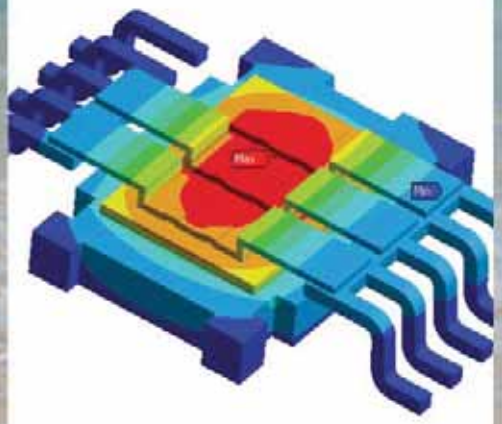
Newsletter

Year 7 n° 2 Summer 2010

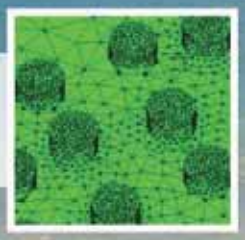
A simple Finite Element Solver for thermo-mechanical problems



ANSYS Workbench: a multidisciplinary FEM approach for PCB equipment



Multi-Objective Optimization of a Ball Grid Array of a capacitive MEMS



Optimization of a Spring Bearing for Gravitational Force Compensation

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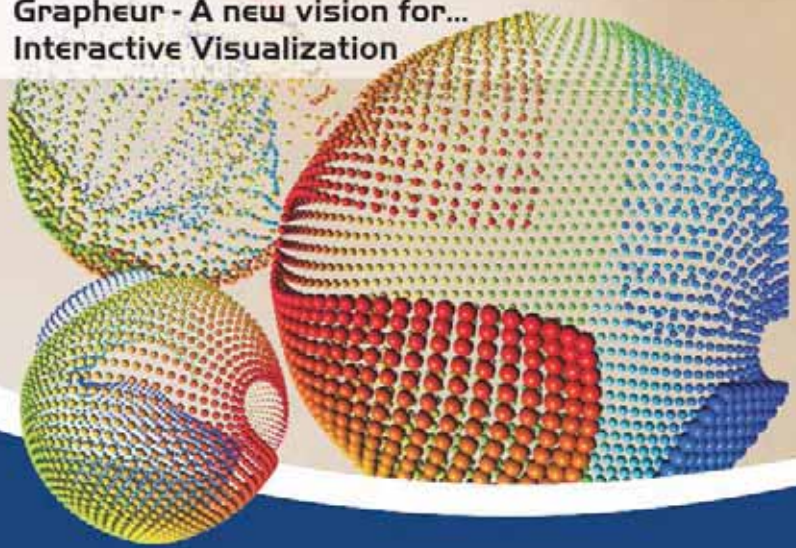


EnginSoft interviews Alessandro Franzoni, CEO of Superjet International

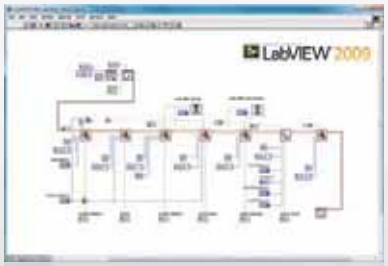
modeFRONTIER

the multi-objective optimization and design environment

Frontier moves forward: hardware-in-the-loop optimization

'Games are most elevated forms of investigation'
Albert Einstein

Hardware-in-the-loop optimization by modeFRONTIER®



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EnginSoft Flash

The 2010 Summer Edition of the Newsletter brings to our readers news from the simulation community, the EnginSoft Network, our partners and customers in Europe and the USA. The articles and reviews on the following pages reflect the diversity of Simulation, CAE and Virtual Prototyping across industry, educational institutions and research. From automotive and aerospace to electronics, from the petrochemical and Oil&Gas sectors to material suppliers, today's product developers and designers count on engineering simulation.

Ing. Stefano Odorizzi
EnginSoft CEO and President

While it is one thing to provide state-of-the-art software and expertise, it is another to be ready to share and pass on our knowledge, and to bring in our partners' ideas, know-how and developments.

At EnginSoft, we communicate constantly with experts inside and outside our Network. We believe that Networking is essential to further grow and deepen our knowledge and hence the portfolio of services and products for our customers. To us: Networking is a key factor for innovation and success.

This is also what drives us to host the annual EnginSoft International Conference, this year from 21st – 22nd October at Fiera Montichiara/Brescia, Italy. The Conference will take place concurrently with the ANSYS Italian Users' Meeting, it will offer to our guests unique insights into current and future values of software technologies, fast ROI Return on Investment, and the latest advancements and developments. The large accompanying exhibition will provide a perfect platform for International Networking.

The Conference will reflect some of the contents of earlier events of 2010 that we also present in this Newsletter: the International modeFRONTIER Users' Meeting, the 4th PhilonNet CAE Conference, the NADIA Conference for the conclusion of the NADIA Project, and METEF, the International Aluminium and Foundry Equipment Exhibition where EnginSoft was awarded the "PREMIO INNOVAZIONE 2010", the prize for Innovation 2010.

Furthermore, this Edition features a captivating interview with Alessandro Franzoni, CEO of Superjet International, Tim Morris and David Quinn of NAFEMS International give us their views on the Future of Engineering Analysis. We hear from APERIO, EnginSoft's representation in Spain, and their collaboration with the Master of Technical Specialization in Racing Industry (METCA). Further news from Spain include a review of the presentation day on process integration and design optimization organized by the AIC Automotive Intelligence Center in Bilbao.

Our case studies show how Continental AG improved cost and magnetic efficiency, VTI Technologies Oy used multi-objective optimization for a Ball Grid Array, the CompMechLab of St.Petersburg's State Polytechnical University applied optimization to a spring bearing. Eurotecnica presents a one-dimensional fluid-dynamic study of a molten salts thermal energy storage system and Sapa Group reports on the successful use of ANSYS for their developments.

Our software column highlights ANSYS Maxwell, ANSYS STR, Scilab for thermo-mechanical problems and Grapheur, a package of tools for modeling and visualizing by Reactive Search.

The corporate news inform our readers about EnginSoft's latest initiative in the United States with Cascade Technologies and the companies' strong ties with Standford University. Aprilia Racing welcomed EnginSoft's engineers at the Superbike World Championship in Monza. This edition also provides updates on the Verdi (Virtual Engineering for Robust manufacturing with Design Integration) and Nadia Projects, our worldwide Event Calendar and other news.

To hear more and to discuss opportunities with EnginSoft and our partners, please meet us on 21st & 22nd October at the Fiera Montichiari in Italy.

We look forward to welcoming you!

Stefano Odorizzi
Editor in chief

EnginSoft Flash

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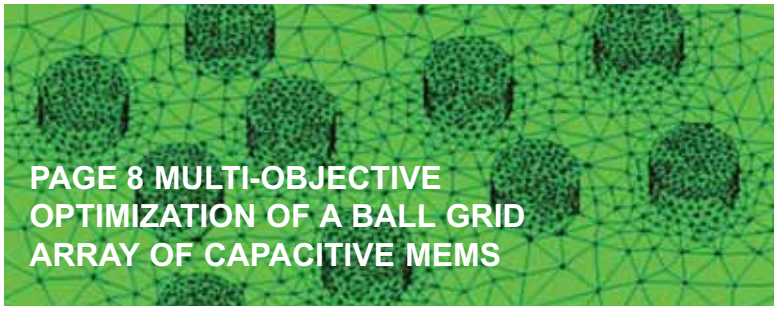

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Year 7 n°2 - Summer 2010

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PRINTING
Grafiche Dal Piaz - Trento

The EnginSoft NEWSLETTER is a quarterly magazine published by EnginSoft SpA

Autorizzazione del Tribunale di Trento n° 1353 RS di data 2/4/2008

2010 ENGINSOFT INTERNATIONAL CONFERENCE

CAE TECHNOLOGIES FOR INDUSTRY

AND ANSYS ITALIAN CONFERENCE

FIERA MONTICHIARI (BS) - ITALY - 21-22 OCTOBER 2010

INVITATION & 2nd ANNOUNCEMENT

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For more than 20 years, the EnginSoft International Conference on "CAE Technologies for Industry" has been the reference event for the VP community in Italy. The Conference offers unique insights into current and future values of software technologies, background trends, outstanding achievements, groundbreaking scientific developments and the visions of those who realize advancements. The Conference reflects and meets industry needs on different levels, from the perspective of managers and decision makers, technical experts, software users up to human resources analysts.

Conference delegates are invited to attend all Program Sessions:
Plenary – Mechanical Engineering – CFD – High Frequency – Optimization Technologies – Design Chain Technologies – Casting Processes – Forging Processes

and additional Conference Highlights which include:

- a Think Tank bringing together executives from industry, research, academia and technology providers, to foster the understanding of engineering simulation and its impact on the future and success of your business;
- a Panel of simulation-based engineering, science and technology experts. The panel will document how recent and future technical developments should improve accuracy, reliability, accessibility and applicability of engineering simulation results, as well as computational speed;
- an exhibition, unprecedented in this sector in Italy, where leading providers of CAE and VP Technologies will showcase their latest solutions and share their visions and strategies;
- an informal environment for delegates, technology providers, managers and experts to meet and exchange experiences, address key industry issues and challenges, and explore new business opportunities.

Do not miss the ideal occasion to discuss today's limitless applications of "simulation based engineering and sciences" in the true sense of the conference motto:
"Believe in innovation: simulate the world"

The conference takes place concurrently with the ANSYS Italian Users' Meeting. ANSYS is the major partner of EnginSoft, and the leading global provider of engineering simulation technologies. The conference will therefore be of utmost interest to the community of ANSYS users.

2010 EnginSoft International Conference
CAE Technologies for Industry
and ANSYS Italian Conference

Fiera Montichiari (BS) - Italy - 21-22 October 2010

Gala Dinner and Conference Social

EnginSoft and ANSYS Italia are delighted to invite all conference attendees to Villa Fenaroli for this year's gala dinner and evening program. Villa Fenaroli is one of the most prestigious villas of the Lombard 18th Century in the immediate vicinity of Brescia.

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Conference Exhibition

The accompanying exhibition will see the world's leading solution providers showcasing products and services covering all aspects of CAE technologies and their successful implementation.

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Multi-Objective Optimization of a Ball Grid Array of a capacitive MEMS

Capacitive MEMS accelerometers may be directly soldered to the printed circuit board by an array of solder balls. Differences in the thermal expansion coefficients of the pertinent materials cause deformations of the accelerometer under temperature change. This may cause a relative movement of the sensing masses with respect to the sensing electrodes, resulting in a change in capacitance and a false acceleration output. A multi-objective optimization was used to find the best location of the solder balls which minimized the measurement error under varying temperature and, at the same time, maximized the expected service life due to fatigue of the solder balls. While the achieved improvement in service life was moderate, an order of magnitude improvement was achieved for the predicted measurement error.

1. Introduction

VTI Technologies Oy develops and manufactures micro electro mechanical systems (MEMS) and the main products are capacitive low-g accelerometers which for instance are used in automotive electronic stability control (ESC) systems. An accelerometer is attached to the printed circuit board (PCB) by an array of solder balls. The attachment type is referred to as a ball grid array (BGA) due to the shape and layout of the solder balls (Figure 1).

The measurement principle for a low-g accelerometer is outlined in Figure 2. A mass is attached to an anchor via a spring, and under acceleration the mass which holds the sensing electrodes moves with respect to the static electrodes. The movement changes the gap and thus the capacitance which is then measured. The final product which is soldered to the PCB includes multiple materials, each with a different thermal expansion coefficient. Unfortunately this may cause the sensing elements to move as change and send out a false acceleration output, referred to as an offset error. Accelerometers are normally exposed to small vibrations which may cause fatigue and failure of the electrical connection between the accelerometer and the PCB. Both the offset error and the fatigue life are affected by the layout of the BGA and the objective of the study is therefore to minimize the offset error and, at the same time, maximize the expected service life.

2. The numerical model

In order to keep the model size reasonable, the active sensor elements were not included in the FEM model. We assume the movement of the anchors can be directly mapped to the offset error, i.e. the larger the movement, the larger the offset error as a function of temperature.

Mesh controls were employed to ensure dense mesh in critical parts of the model and to achieve a consistent mesh between different geometries. Ten noded tetrahedral elements were used in the linear model and typical model size was 400000 elements or 1.65 million degrees of freedom. Plasticity and

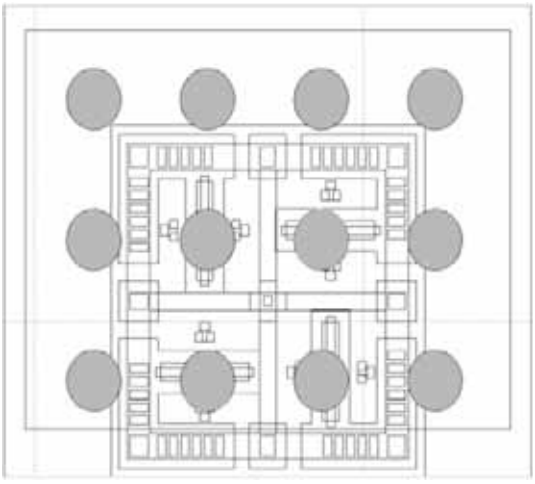

Figure 1 - The baseline design of the ball grid array is evenly spread over the available surface. The MEMS structure may be seen behind the gray solder balls.

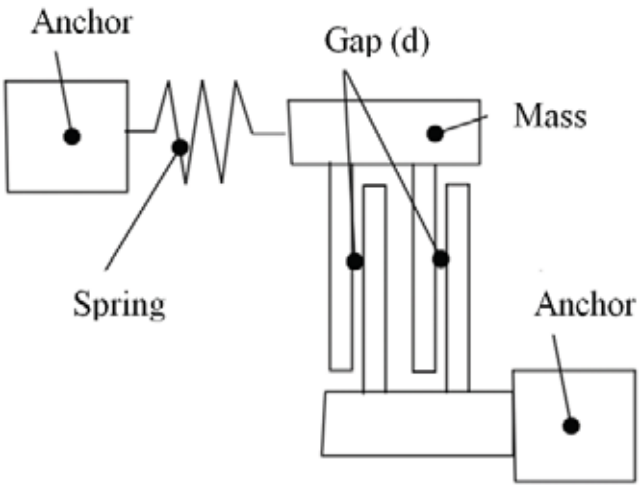

Figure 2 - A low-g accelerometer measures the change in capacitance with varying gap size. The gap, typically 1.5 to 3 µm, changes when acceleration forces move the mass.

Case Studies

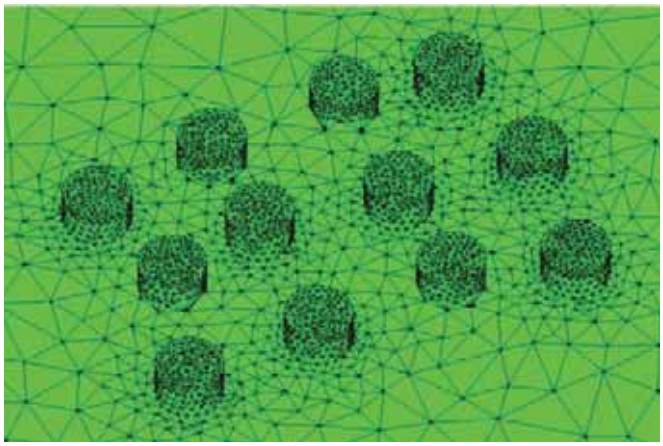

Figure 3 - The solder balls, seen on top of the PCB, have a refined mesh.

creep of the solder was omitted and two load cases with different temperature were used, +85°C and –40°C.
Figure 3 displays a part of the meshed model, the solder balls on the PCB.

3. Multi-objective optimization

The general multi-objective optimization software modeFRONTIER was used to automate the design evaluations and steer the process towards its optimum. The generalized process has been outlined in Figure 4 and consists of setting input parameters, running the simulation, reading the results and deciding which design to evaluate next. The loop is then repeated until the optimum has been found or, more commonly, good enough results are obtained and resources are needed better elsewhere.

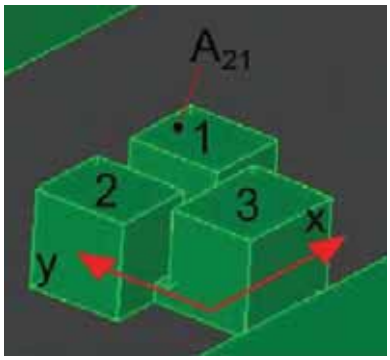

Figure 5 - Anchors and their numbering within one of the sensors measuring in the y-direction.

3.1 What to measure

An optimization task always starts with the definition of the objectives and how to measure them. The selected result should in a single number capture how well the design performs with respect to the objective. In this case the value function F_{tot} was a measure of the relative movement of the anchors of the sensing and static electrodes:

$$F_{tot} = \left|F(D_{1j}) + F(D_{3j})\right| + \left|F(D_{2j}) + F(D_{4j})\right| \quad (1)$$

where the average displacement of the top surface of an anchor is defined as

$$D_{ij} = \frac{1}{A_{ij}} \int_{A_{ij}} u_{ij}(x, y)\,dy\,dx$$

The sensor was identified through i=1,2,3,4 and j=1,...,6 identifies the anchor within the sensor, see figure 5. Sensors i=1,3 measure in the x-direction and sensors i=2,4 in the y-direction. u is the x-displacement for i=1,3 and the y-displacement for i=2,4.
To maximize the service life, one aims to minimize the solder fatigue through minimizing the peak stress in the solder balls.

3.2 Parameterization of the BGA layout

It was desirable to investigate a large design space which included fundamentally different designs compared to the baseline, see figure 6. For that reason the parameterization had to be very general, allowing each solder ball to move freely over most of the surface, see figure 7.

In order to take manufacturing constraints into account, the minimum allowed distance between center to center of two solder balls was increased from 330 µm, respecting only the solder balls, to 500 µm.

3.3 Process automation

Each design candidate was evaluated in an automatic process, including import of CAD geometry and moving each solder ball to the specified location. The design was then meshed, solved and the offset error, as well as the stresses, was extracted. Based on the log files, a command file in Matlab format was assembled which carried out the process above. The command file included the move command of each solder ball as well as a set of custom postprocessing commands. Besides saving the specified results to an ascii file, several plots of interesting results were saved for continuous monitoring.
In order to capture designs where solder balls were located too close, a collision detection check was implemented directly in modeFRONTIER. As can be seen in figure 8, each design candidate is first checked for collisions. Only designs with zero collisions are passed on to the solver for evaluation.
The optimization was run on a 64-bit Linux system and the solution time for a design evaluation varied from 9 to 15 minutes.

4. Optimization strategy

In order to allow BGA design layouts which were very different from the baseline design, the range of each input parameter had to be wide. It was therefore not possible to avoid collisions. As the collision check stops impossible designs from being evaluated, the learning process of the optimization algorithm is slowed down.

A good choice for this type of situation is the Multi-Objective Genetic Algorithm (MOGA-II), one of the most popular algorithms available in modeFRONTIER. By using a population of designs, it mimics the genetic mechanisms

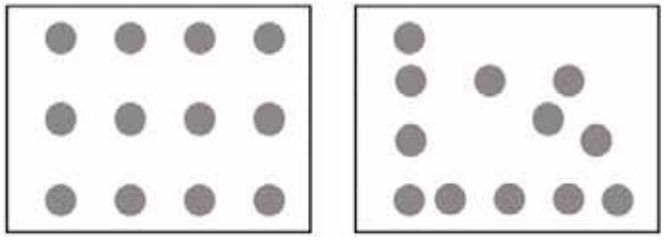

Figure 6 -- t was desirable to try out very different BGA layouts such as the example on the right, compared to the baseline design to the left.

Case Studies

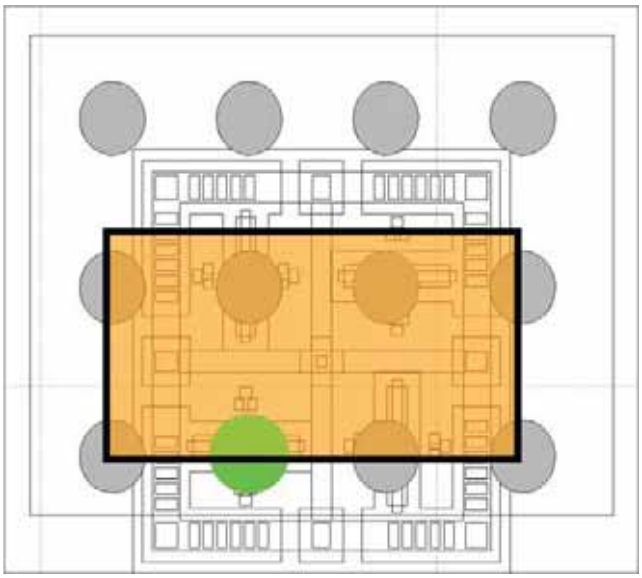

Figure 7 - In order to realize probably every possible design configuration, the parameter ranges of each solder ball had to be generous. The orange rectangle shows the parameter space of the green solder ball.

found in nature to search for the best designs. Here, an initial population of about 50 designs would be suitable.

4.1 Creating the initial population

The initial population may be created by setting up a large Design of Experiments (DoE), running the collision test and then selecting 50 well separated designs from those who pass. Unfortunately, a Sobol space filler DoE of 256000 designs was executed in 1.5 hours without finding a single feasible design. In this 24 dimensional input parameter space, collisions between the solder balls are obviously common.

In the second attempt, 6 interesting and different BGA layouts were designed manually. Unfortunately, only the baseline design solved without errors. A later investigation revealed that the root cause was the mesh control settings but at this stage, the model was not changed.

The third attempt used the baseline design as a starting point for the Multi-Objective Game Theory (MOGT) algorithm. Despite being a pretty efficient and sensitive algorithm, MOGT evaluated 168 designs in 5 hours before it was manually stopped. Out of the 168, 140 designs failed to evaluate, mainly due to colliding solder balls, but some 5 percent due to geometry, meshing and solver errors.

Figure 9 shows the two conflicting goals where the utopia point, located in the lower left corner, implies a vanishing offset error at the lowest peak stress possible. The best designs with respect to the conflicting objectives are called the Pareto set (marked by green rings), and are located at the Pareto front (orange line). As a welcome side effect in our search for a suitable initial population for MOGA, we found a design which had 2% lower stress and 74% lower offset error than the baseline design.

4.2 Multi-objective optimization

Good initial designs are one of the most efficient ways to speed up the optimization process for obvious reasons. Another is to reduce the size of the design space which is being searched. In this case, the reduction of possible combinations was not the main reason. Instead, smaller parameter ranges decreased the risk of collisions and hence increased the possibility for the algorithm to learn.

Using the parallel coordinates chart, see figure 10, the variation between the current Pareto designs was evaluated for each input parameter. In order not to limit the performance of the best solutions, a margin of approximately the same size as the variation was added when each input parameter got a new reduced range.

It was decided not to follow the recommended size of the initial population but rather use a significantly smaller set. The main reason for this was the inability to create an initial

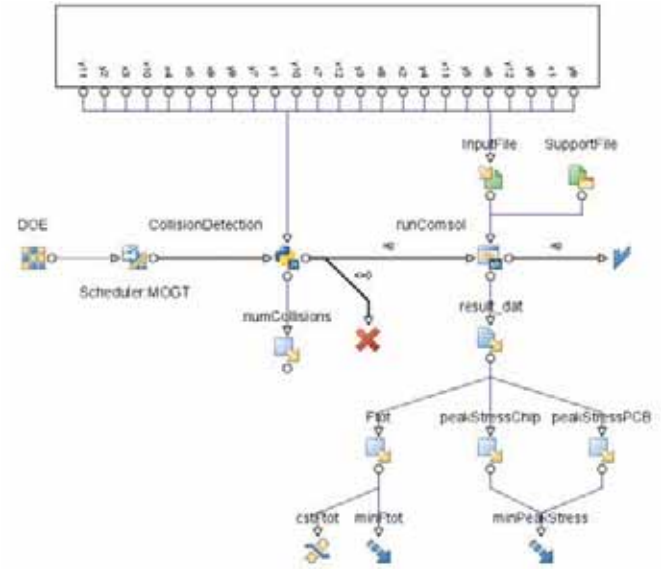

Figure 8 - The optimization logic is visualized by the modeFRONTIER workflow. At the top there are 24 input variables and under the bold process line we find extraction of results and specification of constraints and objectives. Each design is checked for collisions and only zero-collision designs are passed on to the solver.

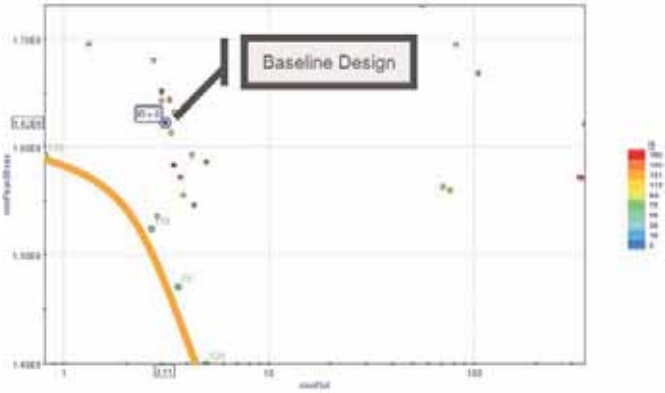

Figure 9 -Starting from the baseline design, the Multi-Objective Game Theory algorithm was able to find significantly improved designs in 5 hours. The orange line marks the Pareto front between the conflicting objectives: minimization of offset error (x-axis) and minimization of peak stress (y-axis).

Case Studies

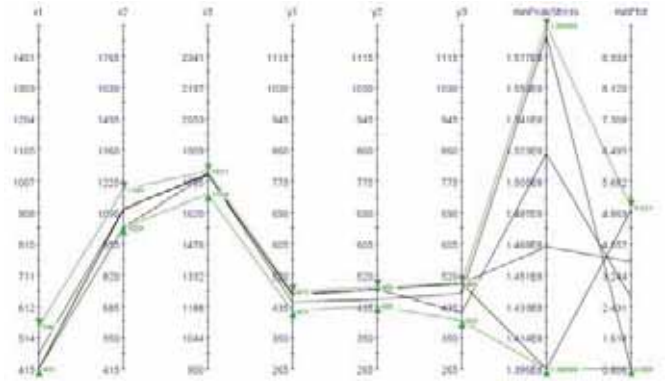

Figure 10 - The parallel coordinates chart shows both objectives and the input parameters in the same diagram for the 4 Pareto designs. Compared to the specified input ranges, showed by the full height of the axes, the Pareto designs are concentrated to a narrow zone. Based on this, the parameter ranges were reduced before starting the MOGA optimization.

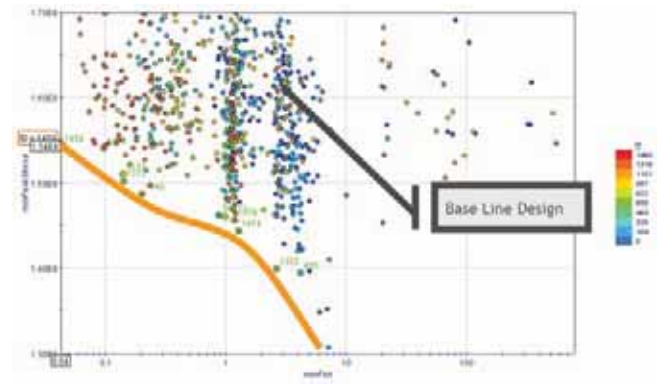

Figure 11 - The multi-objective optimization aims to reveal the Pareto front, marked by the orange line. The marked designs in the lower left corner represent the best trade-off designs between offset error and service life. Note the two zones with accumulation of designs which indicate some issue with the analysis.

population with non-colliding BGA layouts from all regions of the input design space. The 10 best designs of the MOGT optimization were therefore chosen, trusting that MOGA would make a steady evolution towards better designs while avoiding colliding BGA layouts.

The strategy worked and MOGA evaluates 990 new designs of which 759 completed successfully in 5 days. As can be seen in figure 11, the Pareto front has been stretched out and filled with more designs. While the stress levels were moderately improved compared to the first optimization, the offset error was now close to being eliminated.

5. Results

An extended Pareto front was found which showed improvements in both objectives compared to the baseline design. As always in multi-objective optimization, there is no single best design but rather a set of trade-off designs between the conflicting objectives. The best design with respect to peak stress had 14% lower stress and 15% lower offset error. The best design with respect to offset error had 5% lower stress and 99% lower offset error compared to the baseline design.

Figure 12 shows the shear stress in two planes, close to the PCB and close to the MEMS chip. Close to the chip, the stresses appear to concentrate on the balls in the corners of the grid.

The achieved reduction in the offset error by two decades is a significant improvement to the temperature stability in comparison with the base line design.

Conclusions

The presented work has showed that the offset error may be close to eliminated. In order to increase the accuracy of the model a capacitance calculation should be included. This enables minimization of computed offset error in acceleration units instead of the current anchor displacements.

Manufacturability may also be studied by analysing the sensitivity of the results due to small changes in the location of the solder balls. In other words, we are looking for a robust global optimum.

An order of magnitude improvement in measurement error was achieved which may validate the sensor to a wider range of applications which are demanding with respect to specified offset error.

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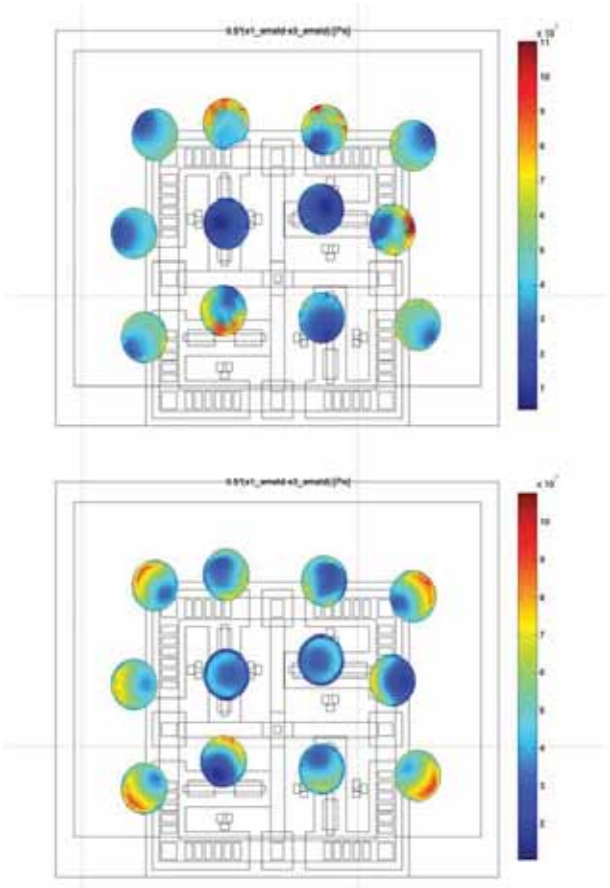

Figure 12 - Shear stress in the plane close to the PCB (upper) and the MEMS chip (lower)

Case Studies

Design for Improved Cost & Magnetic Efficiency

Performance Optimization of a Gasoline Injector

Due to the worldwide economic crisis and falling production numbers in the automotive industry, many suppliers have implemented new strategies and actions with the aim of reducing costs and the impact of the crisis on their plants. In this context, Continental defined and started a "Design-to-Cost Project" for the latest Continental Solenoid Direct Gasoline Injector (XL2).
A number of possible modifications were identified with a new Injector Layout. This new Layout included important changes in the components of the magnetic circuit of the injector. At the beginning, due to weak magnetic performances, the new Design-to-Cost Layout was not acceptable from a technical point of view. However, after a first development phase, modeFRONTIER was implemented in order to reach the targets for the Complete Layout magnetic performances. A parametric magnetic circuit model of the injector in Emag (ANSYS) and a Workflow in modeFRONTIER were created.
This new approach helped the Continental Engineering Team to achieve best performances of the magnetic behavior of the new layout and to obtain technical approval for further development. The project also revealed the advantages of using modeFRONTIER, an automatic CAE optimizer, for reducing time and cost, in comparison with the previous standard procedure.

Gasoline Injector
The injector is a valve that has to control and adjust the gasoline flow in order to generate the required mixture for the Engine Control Unit (ECU).

The Gasoline injectors are mainly divided into two different groups: low pressure and high pressure applications depending on if the injection is performed into the manifold, or directly into the combustion chamber in the pressurizing phase.

The most common injector technology is Solenoid activated. A current signal (ECU control) (I(t)) generates a magnetic field into a magnetic components circuit (ø(t)) which generates a force between two components (F(t)). This force generates the movement of a movable component (lift(t)) which opens a nozzle generating the Flow rate (Q(t)) and Spray (Fig. 1).
In this work, we studied the current Continental Solenoid injector for Direct Gasoline Injection, named XL2 (Fig. 1), and some of the possible variations.

Figure 1 - SDI XL2 Injector

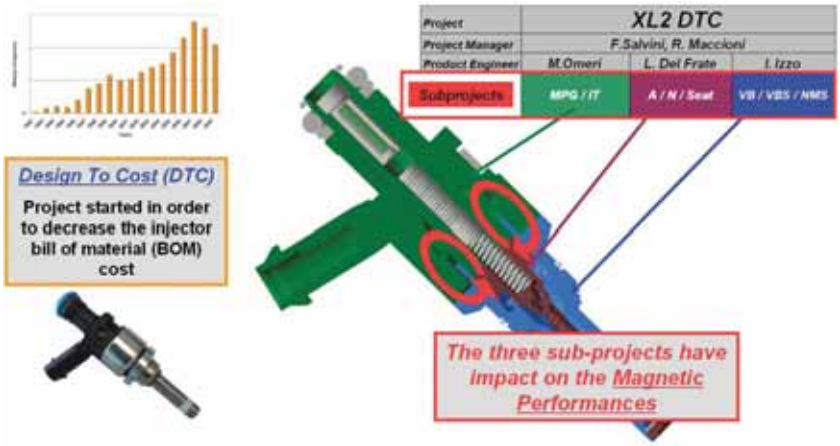

Figure 2 - XL2-DTC Project – Organization & Risks

Case Studies

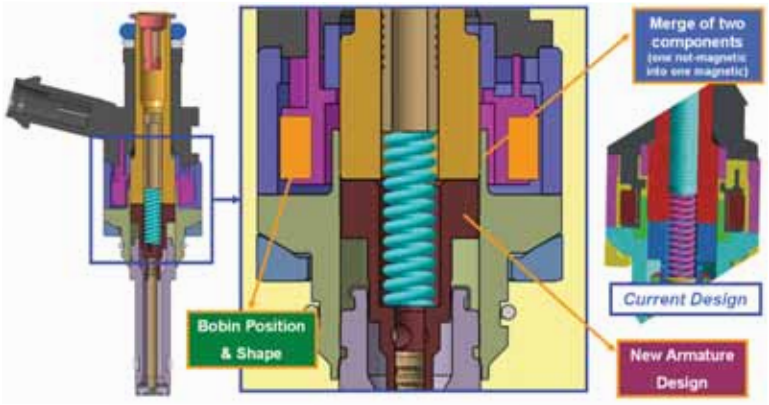

Figure 3 - Design To Cost Changes description

Project & Risks

With the economic crisis and fallen production numbers in the automotive industry in mind, Continental started a Design-to-Cost Project (DTC) with the primary objective to decrease the material cost of the injector, the XL2 SDI product.

Their Project Manager and the three Product Engineers (PE) responsible for the three different component sub-groups (Fig. 2) defined a Project Chart.

It was clear that the design work of all three component sub-groups would have a strong impact on the magnetic performances of the injector. Hence, the risk was that if each PE would work on its own, not sharing results with the others, it might be impossible in the end to define guidelines which match the other PE's strategies.

To avoid this, after a preliminary development phase without sufficient reliable results, a Complete Layout Optimization was suggested to solve the problem.

Continental could benefit immediately from the advantages of this new approach:

- low mistake rate due to automated processes,
- possibility to reach best performances with an optimization algorithm,
- high number of simulations and low number of samples reducing time and cost of the Concept Definition phase.

Technical Activities

A package of changes was defined which is described in Fig.3. Two components with different magnetic characteristics (1 non-magnetic) were merged into one magnetic component. The shape of the merged component was modified from the initial one and new dimensions were defined for another component (Armature). Moreover, the possible impact on coil shape and position was identified. These changes delivered by the DTC also proved to have a considerable impact on the magnetic performances of the injector.

Fig. 7 highlights the performances of the current product (left red bars) and the previous injector. When we look at the initial performances of the DTC Layout compared to the current product (Fig. 7 left red bars), it is obvious that the previous design was not feasible and a magnetic optimization was needed. A Parametric Model was defined using 12 parameters as described in Fig. 4.

The Simulations were done with an axial-symmetric model in ANSYS Emag using different B-h curves (magnetic characteristics) of each material. The input of a generic simulation was a current signal (I(t)), and the output is the force profile at constant lift (F(t) at lift=cost.) (Fig.1 and Fig.5). While, in this way, it is not possible to compute the complete dynamics of the injector, the magnetic performances of the configurations could be compared. For

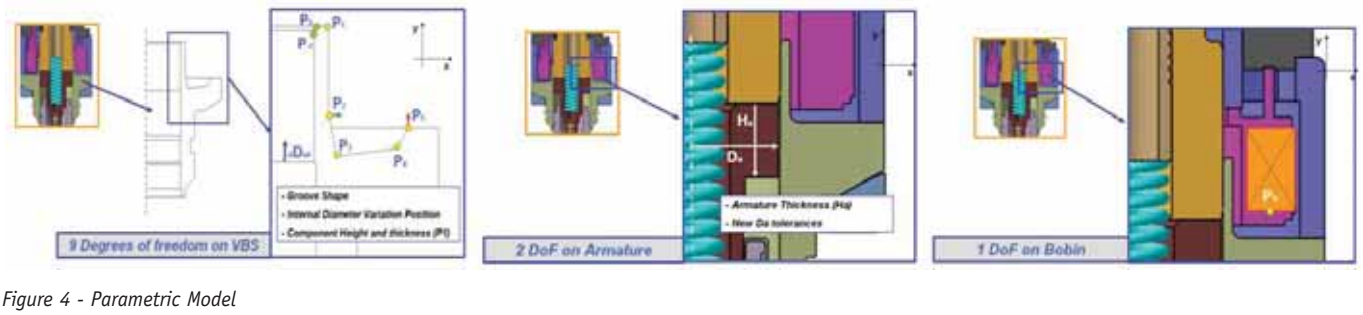

Figure 4 - Parametric Model

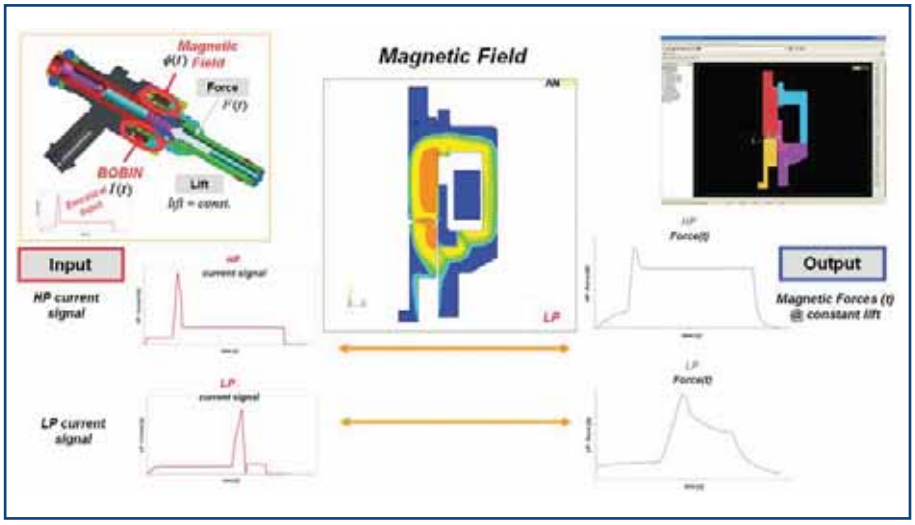

Figure 5 - Simulation Description

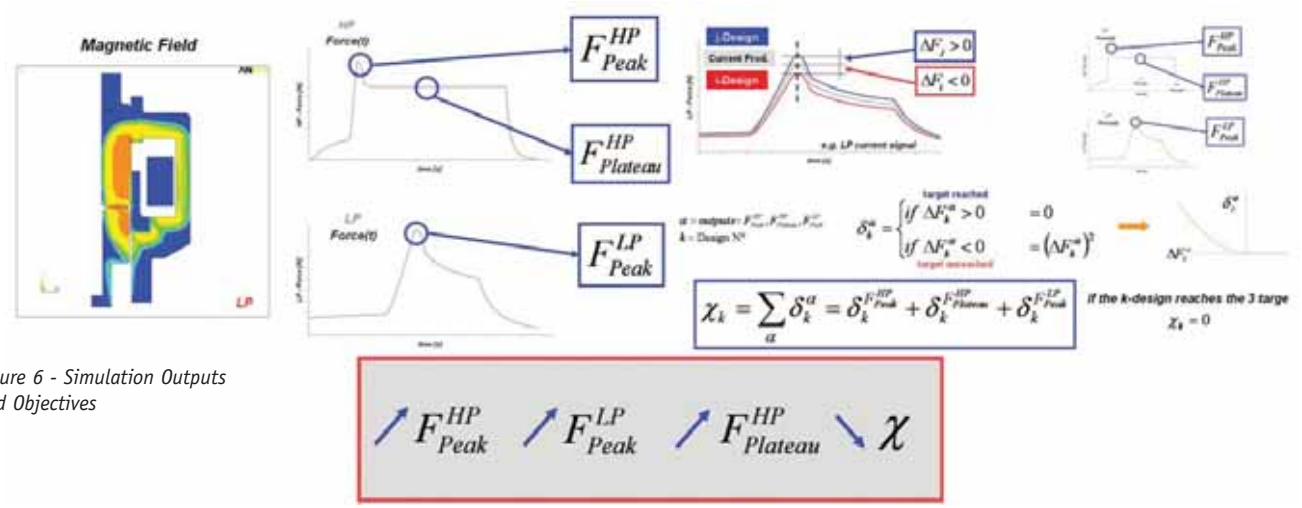

Figure 6 - Simulation Outputs and Objectives

each configuration, two simulations were performed with two different current signals as shown in Fig. 5. The Outputs of the two simulations (F(t)) were characterized by three parameters typical of the force history shape (Fig. 6).
The target of the DTC Layout was to reach at least the current product performances and to maximize them. The data was converted into a modeFRONTIER workflow which maximized the three simulation outputs.

It also defined a function, named chi, to identify the distance (for lower performance cases only) of a generic configuration from the current product's magnetic targets. This chi function is also a way to guide the optimization loop in the design space as well as a quality index of a generic design (Fig. 6).

Results

Managed by the MOGA II algorithm and by modeFRONTIER's Workflow, 936 simulations were performed on 418 configurations.
A design family which delivers higher performances than the current product (chi=0) could be defined as well as the best magnetic design for each target. Fig. 6 highlights the comparison between the best DTC Layout, and the initial DTC Layout compared to the current product.The optimization procedure finally led to a feasible DTC Layout in terms of magnetic behavior.
A time saving configuration was identified, some samples were built and tested on experimental benches.

The targets of the magnetic optimization are not directly measurable experimentally, but the results of the sample benches showed many analogies with the simulations performed.

Conclusions

A complete Layout Magnetic Optimization was used as a new methodology in the concept development phase.
The completed Layout Magnetic Optimization delivered a more efficient and effective procedure in comparison with the "standard" methodology based on single component development, a trial & error approach and many samples (Design-to-cost method).

Despite different layouts, it was possible to identify a number of configurations with higher performances than the current design, and several DTC technically feasible layouts.

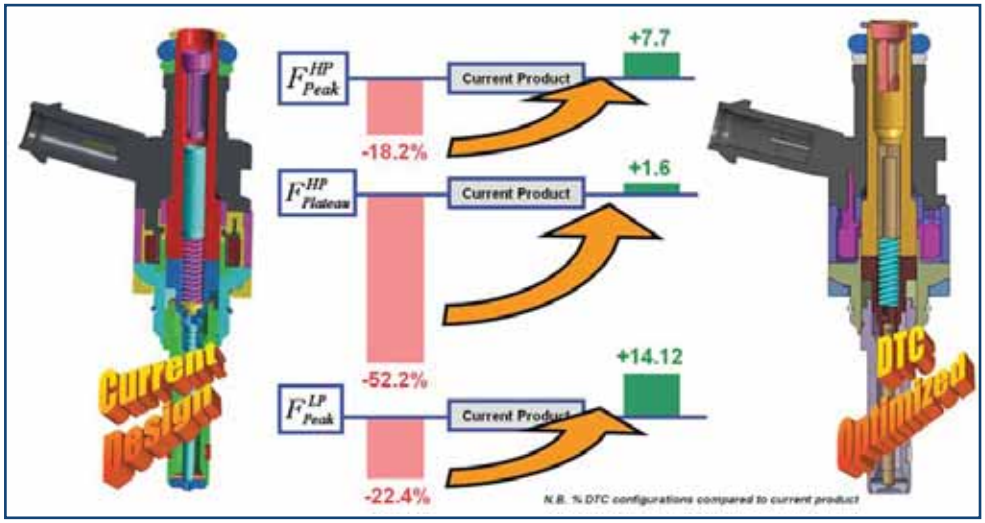

Figure 7 - Comparison between initial (red) and optimized (green) DTC configurations

The comparative simulation showed results aligned with experimental benches.

The validation with Continental's automotive customer is currently in progress and will implement some beneficial changes in the design and development cycles.

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Case Studies

Optimization of a Spring Bearing for Gravitational Force Compensation

In the petrochemical industry, catalytic cracking is one of the major steps in the process of splitting large hydrocarbon molecules into smaller, more useful components for gasoline and jet fuel. The cracking system itself consists of a reactor and a regenerator that are interconnected by a catalyst pipeline network [1, 2]. Spring bearings are necessary to decrease the gravitational loads acting on the nose pieces.

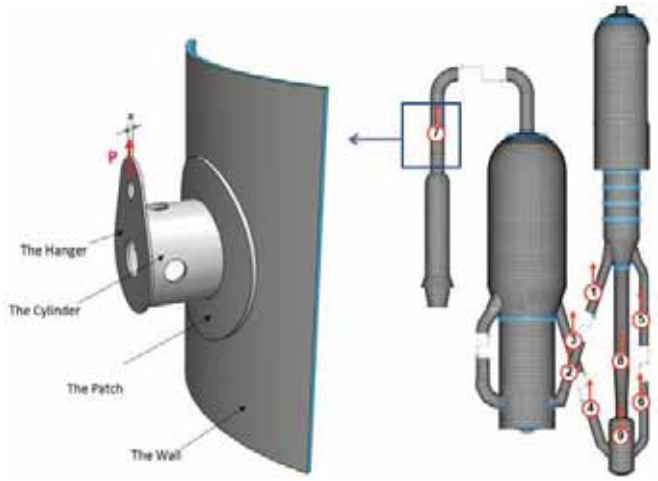


Figure 1 - Typical spring bearing (left). 1-9 (right) - Location of the spring bearings for gravitational force compensation

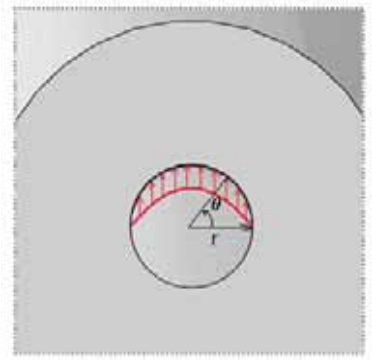


Figure 2 - The area of the loading

The whole construction has 9 spring bearings. Spring bearing consists of the Hanger (for suspension), the Cylinder with holes and the Patch between the Wall and the Cylinder (Fig. 1).

One of the goals of the optimization was to minimize the mass of most of the loading bearings, by changing a few parameters of the Cylinder, the Hanger and the Patch.

All the edges of the wall have been fixed.

The force has been applied to the internal surface of the upper half of the hole in the hanger, assuming that this distribution will be in accordance with the sine law (Fig. 2):

$$\sigma = \int_0^{\pi} \frac{P}{\pi * r * a} \sin\theta d\theta$$

All variable parameters are illustrated in Fig. 3. The total area of 4 holes in the Cylinder has to be greater than 12000 mm² in order to provide the ventilation. The radiuses of the opposite holes have to be equal in pairs (all the holes of the initial configuration have equal radiuses).

According to the Russian State Standard Specification (GOST), the strength of the construction has to be estimated based on two criteria:

1. The maximum value of the Average Membrane Stress (σm) has to be less than 162 MPa;
2. The maximum value of the Average Membrane plus Bending Stress (σm+σb) has to be less than 211 MPa.

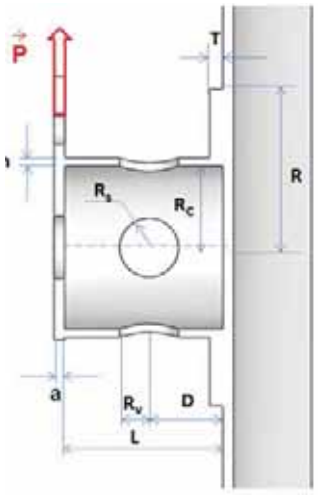


Figure 3 - Design Parameters of the Model

In this case the stress intensity around the area of the load has not been considered. Stresses σm and σb have been calculated by the procedure of stress linearization through the thickness which has been performed for the regions with the highest stress intensity (Fig. 4).

Taking into account that the values of σm and (σm+ σb) could not be calculated near a stress singularity point, the stress linearization procedure has been performed at some distance from it.

To satisfy the requirements of the total area of the holes, the initial designs of experiments have been chosen using CSPmethod (Constraint Satisfaction Problem). The Algorithm

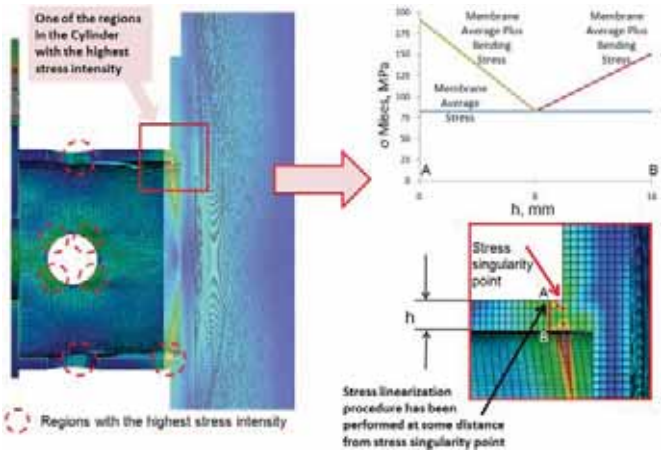


Figure 4 - Stress Linearization through thickness

Case Studies

MOGA-II has been used for the optimization (Fig. 5). The mass of the spring bearing of the new configuration is 2,9 times less than the spring bearing's mass of the initial configuration (Fig. 6). The comparison of the stress distribution of the initial and optimal configurations shows that the optimal bearing is much closer to a full-strength construction (Fig. 7) and it has fewer regions with low stress intensity.

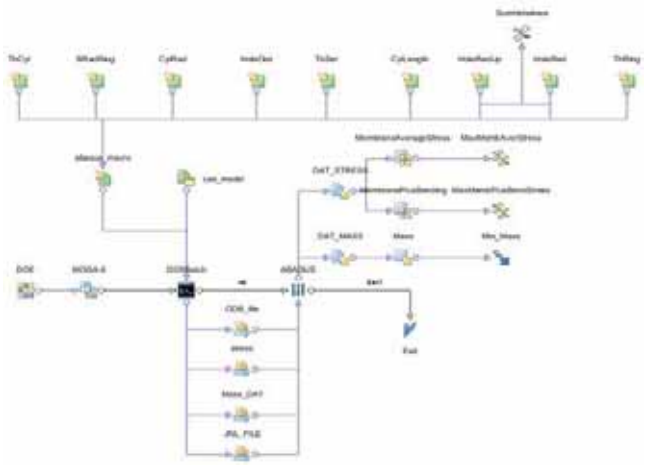


Figure 5 - Optimization Workflow in modeFRONTIER

The average Membrane Stress (σm) and the Average Membrane plus Bending Stress (σm+ σb) of about 80% of the obtained designs exceed the permissible value. The majority of feasible designs has been calculated for the constructions with the lesser mass which underlines the good performance of the MOGA-II algorithm (Fig. 8).

The end-point analysis shows that the Thickness and the Length of the Cylinder and the size of the Patch have the greatest influence on the mass (Fig. 9).

Figure 6 - Initial and optimal configurations

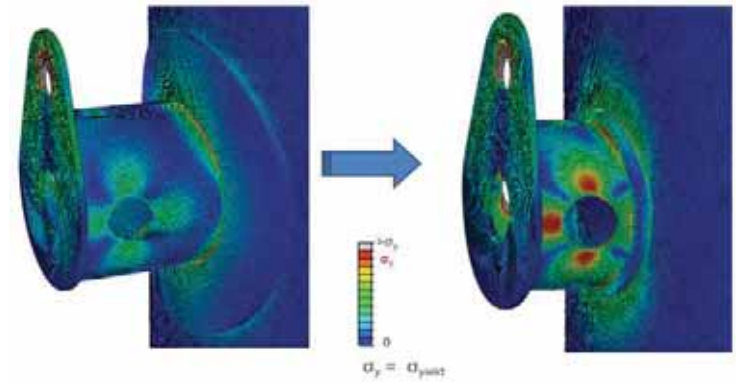
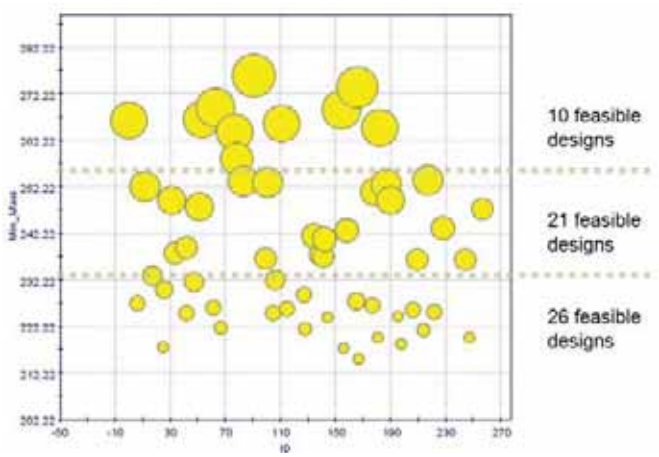


Figure 7 - Stress Intensity of the Initial and Optimal Configurations



Distribution of feasible designs: the majority of the designs have been calculated by MOGA-II for constructions with the least mass

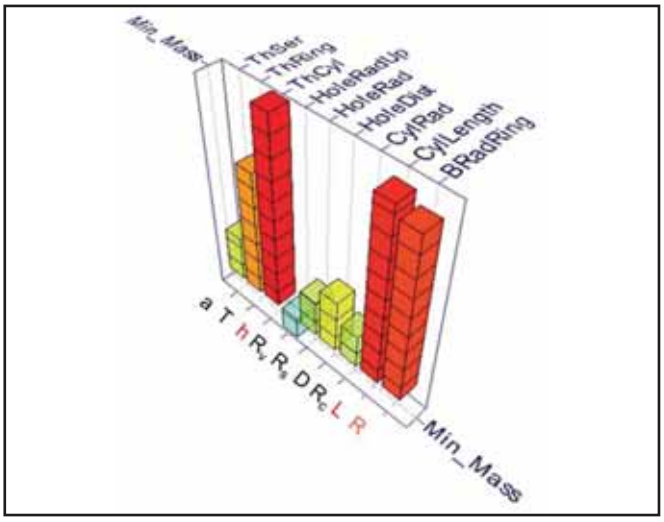


Figure 9 - The importance of each variable on the overall project

References

[1] Michailov A.A., Voinov I.B. Borovkov A.I. Designing safe crackers. ANSYS advantage. 2008, Vol. II, Issue 4, 38-39.

[2] Michailov A.A., Voinov I.B. Borovkov A.I. Designing safe crackers. CAD CAM Report Nr.5, 2009, pp. 20-21.

By Master Student Svetlana Orlova
(under the guidance of Prof. A. Borovkov and
Leading Engineer A. Michailov)

About CompMechLab

Computational Mechanics Laboratory (CompMechLab) was founded in 1987 at the Mechanics and Control Processes Department of the Physics and Mechanics Faculty of Leningrad Politechnical Institute (now St.Petersburg State Polytechnical University).
CompMechLab is a member of The International Association for the Engineering Analysis Community NAFEMS and research engineers of CompMechLab are regularly performing R&D by request of leading industrial companies in Russia, the USA, Japan, Korea, Germany, Italy - Boeing, Airbus, Ford, Siemens, Ferrari are only some of them.

Case Studies

One-Dimensional Fluid-Dynamic Study of a Molten Salts Thermal Energy Storage System

Eurotecnica is an international engineering and contracting company active in the fields of melamine, chemicals, refinery and solar. A staff of more than 100 highly skilled employees is the core of the company. To date Eurotecnica has successfully carried out more than 130 projects, implemented all over the world. Eurotecnica is the world leader in melamine plants and technologies and is now actively investing in solar power plants.

The world is bustling with new projects for solar power stations. Solar power station can get energy from the sun during daytime only, but the energy requirements from the grid have different timing and the turbines in the power island cannot be operated on a continuous stop and go basis. The solution to that is to store the thermal energy from the sun in the form of a mixture of molten nitrates, to be held in huge tanks, and then use it during night. While the idea seems simple, putting it into practice is not that easy because the scale of the system is far bigger than what has been experienced up to now: storage capacity is expressed in terms of tens of thousands metric tons of molten salts and the size of all the equipment and machineries is huge. On the other hand, a faulty thermal energy storage systems may jeopardize an entire solar power project. For these reasons absolute reliability is paramount.

In the present work the detailed study of different operating conditions of a molten salts thermal energy storage system is presented. In particular, the emergency closure of a valve is studied in two different conditions, namely the beginning and the end of the cycle. Target of the simulations is to find the minimum valve closing time that guarantees the safety of the system, i.e. the minimum time for which the peak pressure is below the maximum allowable pressure for the system. The system is simulated by means of Flowmaster, the thermo-fluid system simulation software.

The System

The system to be studied is composed by two tanks of about 15 m height and 40 m diameter. In each tank there is an immersed pump and a distribution torus. The two tanks are connected by a pipeline in which there are mainly two valves and six heat exchangers in between. Each valve is in the proximity of a tank. During the day hot molten salt, warmed up indirectly by parabolic troughs via the six heat exchangers, is pumped from one tank to the other one. During the night molten salt is pumped the other way round and, being still warm enough, it releases the heat accumulated during the day through the six heat exchangers. In the present work the tank from which molten salt is pumped will be called Tank 1 while the tank into which molten salt is pumped will be called Tank 2; similarly, the valve near Tank 1 will be called Valve A while the valve near Tank 2 will be called Valve B. In the present work the flow of molten salt from Tank 1 to Tank 2 is considered (the reverse flow being symmetrical) and the emergency closure of Valve B in two different operating conditions is studied. The system is studied at the beginning of the cycle when Tank 1 is full and Tank 2 empty and at the end of the cycle when Tank 1 is empty and Tank 2 full. In these simulations molten salt is at a temperature of 286°C and has a density of 1907 kg/m3; under these conditions the speed of propagation of sound wave is about 1850 m/s. The high density and the high sound speed of molten salt are likely to produce a severe pressure surge when Valve B closes. For this reason an accurate fluid-dynamic study is mandatory in order to prevent serious safety problems. The focus of this study is in the pressure surge phenomena and not in the heat transfer phenomena that occur in the system.

In Figure 1 the Flowmaster network used for modelling the molten salts thermal energy storage system is presented. Each component of the network is characterised by

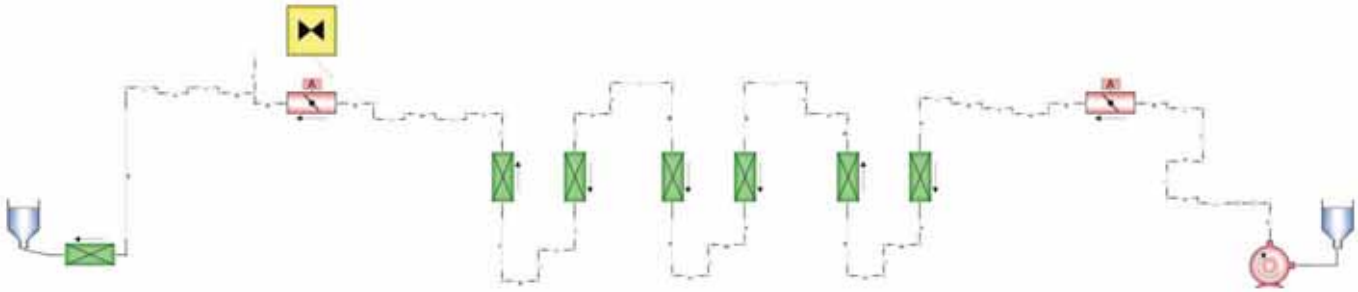


Figure 1 - Flowmaster network modelling molten salts thermal energy storage system. From right to left it is possible to note Tank 1, the immersed pump, Valve A, the six heat exchangers (green rectangles), Valve B controlled by a controller (yellow component), the distribution torus and Tank2.

Case Studies

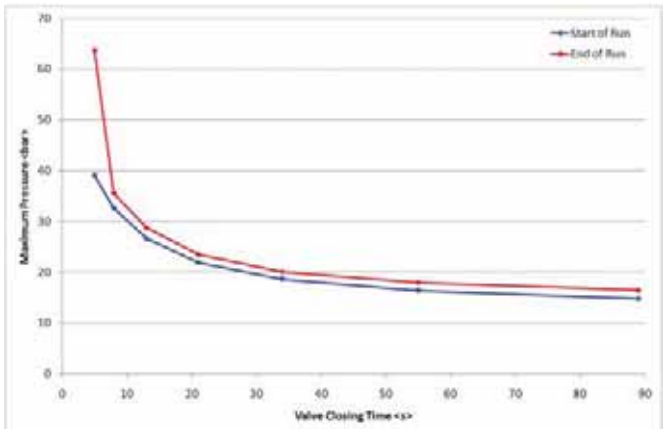


Figure 2 - Results of the parametric analyses: maximum pressure as a function of the valve closing time for the start of run and the end of run.

geometrical and performance data provided by the manufacturer. Moreover, since in the simulations heat transfer phenomena are neglected, each heat exchanger is modelled by means of a discrete loss (green rectangles in Figure 1) as well as the distribution torus. Finally, the closure of Valve B is controlled by an appropriate controller component (yellow component in Figure 1). All the fittings (bends, junctions, diffusers) connecting these components are modelled in the network. The system presents also an important vertical deployment; the maximum height of the system being about 20 m. This is an important factor to be accounted for in the simulation of pressure surge phenomena. The system is designed to work between vacuum condition and a maximum relative pressure of 25 bar. Since ambient pressure is 0.888 bar, the maximum allowable absolute pressure is 25.888 bar.

The Simulations

In order to evaluate the valve closure time that meets safety standards, two sets of parametric analyses were performed for the start of run and the end of run conditions. In Figure 2 the results of the two parametric analyses are presented. It can be noted that the maximum absolute pressure decreases significantly as valve closure time increases until about 20 seconds; after that, maximum absolute pressure decreases very slowly. The valve closing time to be used in the case of an emergency manoeuvre needs to be unique for the entire cycle and needs to guarantee a reasonable safety margin. A valve closure time of 20 seconds guarantees good safety margins for both start and end of run conditions.

In Figure 3 and in Figure 4 the detailed results of the simulations performed with a valve closure time of 20 seconds at the start and at the end of the cycle are presented. In particular the maximum pressure in the system, the pressure at the pump outlet and the mass flow rate at the pump outlet are presented together with the valve closure time. In both cases a strong pressure surge is established, nevertheless the maximum pressure in the system never exceeds the maximum allowable pressure for the system. Moreover, it can be noted that the peak pressure is larger at the end of run. Finally, in both cases a reverse flow at the pump occurs.

Conclusions

The one-dimensional fluid-dynamic simulations performed with Flowmaster allowed to study the detailed behaviour of the system early in the design phase considering different operating conditions. Specifically, the present work allowed for the precise definition of emergency manoeuvres that guarantee the safety of the system during the entire operating cycle. The precise definition of the valve closure time also allows for the identification of the appropriate motor to be used for manoeuvring the control valve. This work demonstrates the importance of numerical simulation early in the design phase of a large plant in which absolute reliability is paramount.

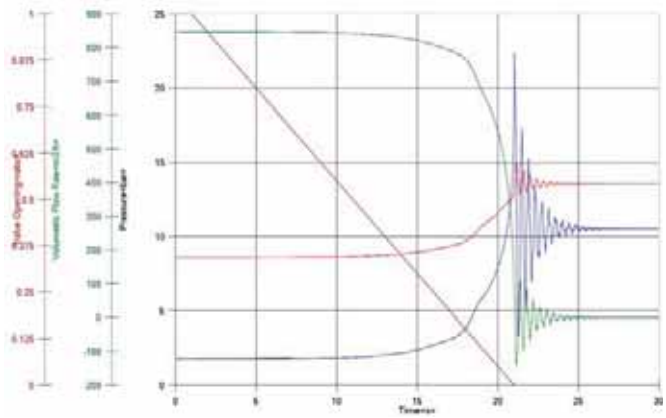


Figure 3 - Detailed results for the simulation of the start of run: valve closure (brown), maximum pressure in the system (blue), pressure at the pump outlet (red) and volumetric flow rate at the pump outlet (green).

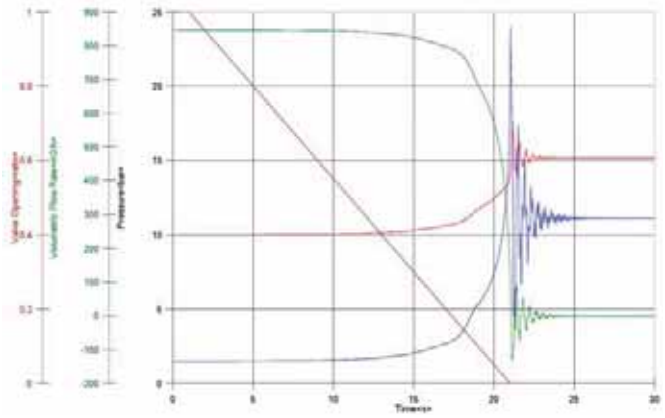


Figure 4 - Detailed results for the simulation of the end of run: valve closure (brown), maximum pressure in the system (blue), pressure at the pump outlet (red) and volumetric flow rate at the pump outlet (green).

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Simulazione CFD di un filtro di Profondità per Trasfusioni

Fresenius Hemocare Italia ha utilizzato con successo ANSYS per la valutazione delle performance di un filtro di profondità per trasfusioni

Fresenius Hemocare Italia SRL

Fresenius Hemocare Italia SRL è leader nella produzione di filtri trasfusionali per la leucoplezione ematica. La rimozione dei leucociti responsabili dell'insorgenza di reazioni trasfusionali, dal sangue raccolto dai donatori è la mission aziendale.

Fresenius Hemocare Italia appartiene al gruppo multinazionale Fresenius Kabi (www.fresenius-kabi.com) e all'interno di esso è l'unico sito impegnato nella progettazione e produzione dei filtri per leucodplezione. Questo ha dato, negli anni, la possibilità al sito di mantere il suo carattere distintivo e una buona autonomia, grazie anche alla consolidata esperienza e ai successi conseguiti. Nello stabilimento di Cavezzo (MO) si fa anche molta ricerca sia nell'ambito biochimico che tecnico ingegneristico.

In sostanza, tutto ciò che viene prodotto, è di fatto concepito, studiato e sviluppato interamente nel centro ricerche di Cavezzo. È in questo contesto che Fresenius ha voluto esplorare le potenziali modifiche e migliorie al suo più consolidato filtro di profondità, prodotto in alcuni milioni di esemplari l'anno.

Introduzione

In questo breve articolo viene presentato lo studio condotto da FHI per confrontare due diversi design del guscio di distribuzione di un filtro di profondità per trasfusioni. Lo studio si inserisce in un più vasto progetto nato per individuare linee di miglioramento della fluidodinamica generale del filtro di profondità in esame.

Scopo dell'attività di simulazione svolta, è stato quello di valutare quanto la conformazione della camera di ingresso del filtro, incaricata di convogliare il sangue sul materiale filtrante, potesse da un lato in qualche modo stressare le cellule ematiche e dall'altro aiutare il massimo sfruttamento della superficie filtrante.

La progettazione dei filtri trasfusionali, e più in generale la progettazione dei dispositivi in ambito biomedicale, è particolarmente delicata poichè dal loro corretto funzionamento spesso dipende la vita del paziente. L'analisi delle performance fluidodinamiche di questi dispositivi è difficilmente approcciabile con tecniche di misura tradizionali, mentre l'utilizzo di modelli numerici permette di visualizzare punto per punto il comportamento del flusso e riesce a fornire importanti indicazioni utilizzabili industrialmente. In questo caso il modello CFD del filtro ha permesso di confrontare due diverse geometrie del guscio, in termini di estensione delle aree di ristagno, uniformità del flusso e picchi di sforzo di taglio, consentendo agli ingegneri di FHI di prendere decisioni progettuali in maniera consapevole. La costruzione della geometria e della griglia di calcolo sono state eseguite utilizzando il codice ANSYS ICEMCFD mentre l'analisi fluidodinamica è stata eseguita utilizzando il solutore ANSYS CFX.

Modello CFD

Il sistema modellato è composto da un guscio di distribuzione, un materassino filtrante e una camera di estrazione (Figura 1). Il sangue afferisce al guscio di distribuzione tramite una cannula di imbocco per poi passare attraverso il materassino filtrante dove, attraverso i noti meccanismi della separazione solido-liquido nella filtrazione di profondità ma anche per effetto di interazione cellulare, vengono rimossi i leucociti responsabili dell'insorgenza delle reazioni trasfusionali. A valle del materassino il sangue viene convogliato nella camera di estrazione da cui poi viene inviato alla sacca di raccolta, per le successive manipolazioni (ad esempio centrifugazione per la scomposizione dei vari emocomponenti) o stoccaggio in frigo emoteca.

La figura 2 mostra le differenze geometriche tra i due design del guscio di alimentazione. Per ciascuno di questi è

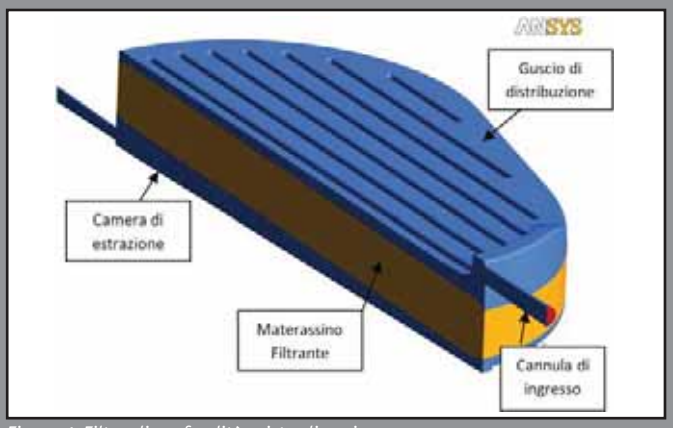


Figura 1 Filtro di profondità: vista di assieme

Case Studies

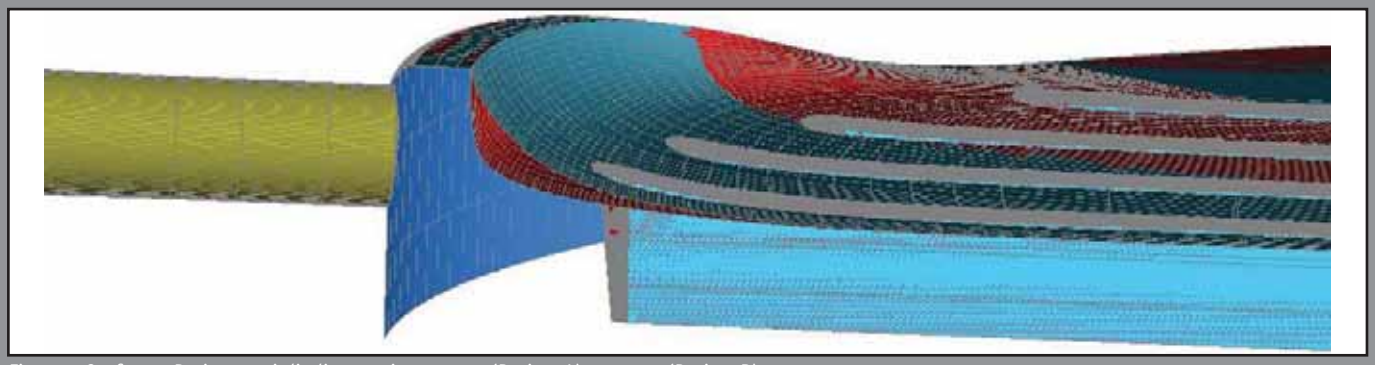


Figura 2 Confronto Design gusci di alimentazione: rosso (Design_A), azzurro (Design_B)

stata eseguita un'analisi stazionaria ed un'analisi transitoria le cui caratteristiche e motivazioni sono di seguito spiegate.

Analisi stazionaria

L'analisi stazionaria ha come fine di valutare le condizioni di funzionamento a regime del dispositivo.

Il sangue è stato modellato come un fluido newtoniano omogeneo a densità costante. A seguito di test numerici preliminari si è deciso infatti di non utilizzare modelli reologici più complessi, ampiamente descritti in letteratura, perché messi a punto per condizioni di moto molto più particolari (ad esempio moto pulsato confinato da pareti elastiche, tipicamente quello cui il sangue è sottoposto nelle arterie) e quindi non applicabili a quelle in esame.

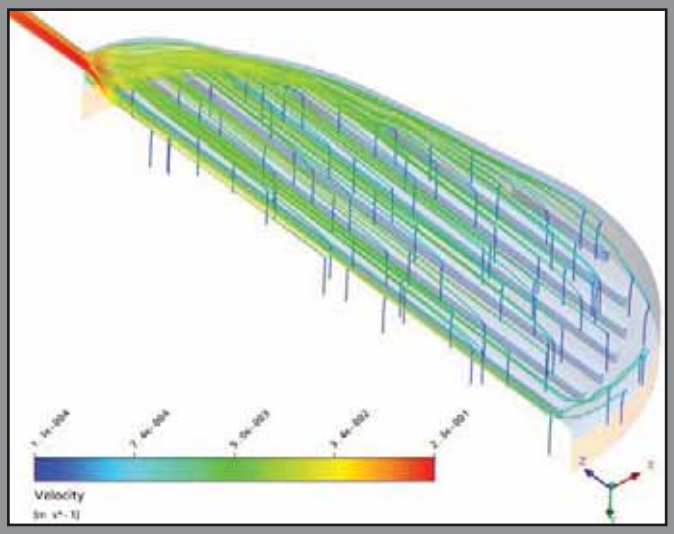


Figura 3 Linee di flusso Design_B

Il materassino filtrante è stato modellato utilizzando un mezzo poroso ortotropo che introduce una caduta di pressione equivalente al materassino reale. La caduta di pressione è stata calcolata mediante la legge di Darcy e i valori di permeabilità utilizzati fanno riferimento a dati sperimentali misurati da FHI, con sangue reale, su appositi prototipi.

Analisi transitoria

L'analisi transitoria ha lo scopo di valutare la dinamica di riempimento del dispositivo sotto l'ipotesi che questo sia inizialmente pieno di aria e verificare la persistenza di eventuali bolle gassose

Vista la natura del fenomeno oggetto dello studio, Il fluido è stato modellato come bifase: la fase gas (aria) è trattata come un gas a proprietà termofisiche costanti mentre la fase liquida (sangue) ha le stesse caratteristiche utilizzate nella simulazione stazionaria. Per risolvere in modo accurato l'interazione tra la fase liquida e la fase gas è stato utilizzato un modello multifase non omogeneo, che è in grado di risolvere i fenomeni di mescolamento, separazione e trasporto tra le due fasi tenendo conto della tensione superficiale e dell'effetto della gravità.

Il materassino filtrante è stato modellato come un mezzo poroso ortotropo in pieno accordo con le ipotesi fatte per l'analisi stazionaria.

Risultati

Il primo aspetto analizzato, nel confronto delle prestazioni dei due design a regime, è rappresentato dalla distribuzione della portata tra i canali del filtro cui è legato il corretto/efficace sfruttamento della superficie utile del materassino filtrante. Il confronto ha mostrato come i due design hanno performance estremamente simili e non presentano criticità. Figura 3 mostra le linee di flusso per uno di design oggetto dello studio.

Altra variabile di interesse nell'analisi delle prestazioni a regime è rappresentata dallo shear stress (sforzo di trascinamento). Gli elementi corpuscolari del sangue (in particolare i globuli rossi) sono infatti sensibili agli sforzi di taglio agenti su di essi e in funzione del tempo di esposizione possono danneggiarsi o rompersi (emolisi). Sono stati

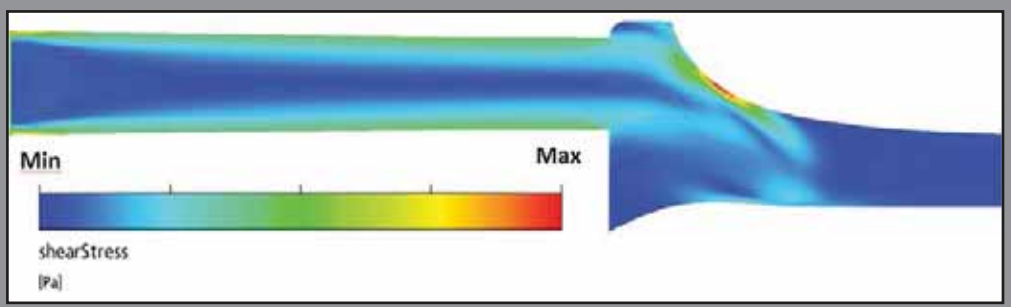


Figura 4 Shear stress nel condotto di ingresso (Design_A)

Case Studies

dunque stimati gli shear stress sulla base del campo di moto ed entrambi i design hanno evidenziato valori elevati di shear stress in corrispondenza dei condotti di ingresso e di uscita dove il campo di moto è fortemente disuniforme (vedi Figura 4). Al contrario valori decisamente bassi di shear stress sono stai riscontrati in corrispondenza del materassino filtrante (fino a due ordini di grandezza inferiori rispetto alle zone di ingresso e di uscita).

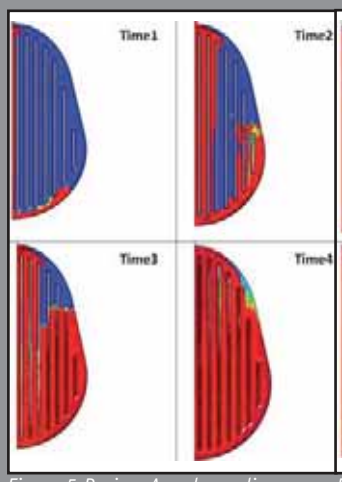


Figura 5 Design_A: volume di sangue nel distributore

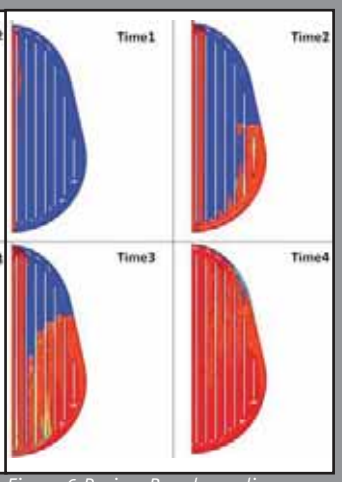


Figura 6 Design_B: volume di sangue nel distributore

Infine l'analisi qualitativa del transitorio di riempimento illustrata nelle figure 5 e 6 ha facilitato la comprensione della dipendenza tra la dinamica del sangue e i diversi design del guscio. La variabile di maggior interesse nel caso specifico è rappresentata dalla frazione di volume del sangue che permette di individuare il fronte di avanzamento del sangue stesso. L'evoluzione temporale del fronte fornisce un'idea chiara di come il sangue tende a distribuirsi sul materassino filtrante e di quali siano le zone critiche per la formazione di bolle d'aria.

Conclusioni

Lo studio condotto ha permesso di valutare l'influenza del design del guscio di distribuzione sulle performance complessive del filtro. L'analisi delle condizioni a regime ha mostrato come entrambi i design sono parimenti performanti da un punto di vista fluidodinamico e che la configurazione geometrica del guscio non condiziona in maniera apprezzabile il funzionamento del filtro. Il transitorio di riempimento ha invece mostrato dinamiche leggermente differenti con uno sfruttamento più marcato del canale di alimentazione centrale da parte del design_B.

Le indicazioni fornite dalle simulazioni CFD hanno consentito ai progettisti FHI di individuare, relativamente alla camera di ingresso, la configurazione che meglio soddisfa i criteri di successo stabiliti per il progetto.

Questa, insieme alle altre linee di miglioramento individuate, contribuiranno a definire la configurazione dei futuri filtri di profondità per leucodeplezione di Fresenius.

Davide Savorani
Fresenius Hemocare Italia

NIDIATA - An IMS-MPT Action promoted by EnginSoft

IMS is an industry-led, international research and development initiative established to develop the next generation of manufacturing and processing technologies. Companies and research institutions from the 27 member countries of the European Union, Japan, Korea, Switzerland, and the United States of America participate in this initiative.

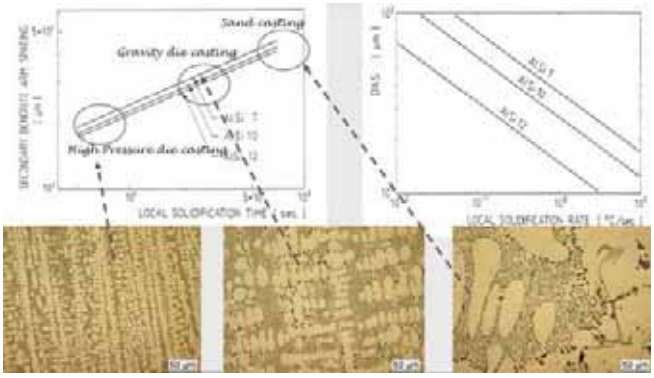
Three years ago, IMS has successfully launched the Manufacturing Technology Platform (MTP) program for researchers designed for easier global collaborations for new and on-going research. In fact MTPs are knowledge sharing platforms for researcher groups that are already engaged in a specific R&D domain. To reduce overlap and duplication in research that is conducted, an MTP initiative seeks cooperation to conduct joint research in projects that are already running. This ultimately saves resources for the "golden nuggets" of their research, and finds common solutions to manufacturing challenges in the process.

The established manufacturing technology platforms are focused in the areas of sustainability, energy efficiency, key technologies, standards, and education. IMS envisions that likely outcomes from this global program will be the stimulation of new collaborative R&D as well as creation of new networks and global-level recommendations on standards, skills, and policy.

Sustainability and Safety: Sustainable manufacturing is a platform for development of innovative manufacturing technologies that address world-wide resources shortages and excess environmental load to enable an environmentally benign life cycle. Measurement and assessment technologies and methodologies to ensure occupational safety including ergonomics, industrial disaster prevention and mitigation and in particular safety of nanomaterials and related manufacturing processes are also addressed in this platform

Energy Efficiency: Energy Efficient manufacturing is a platform for improving efficiency and reducing the carbon footprint in energy utilization for manufacturing and operational processes. The energy efficiency platform will result in reduced manufacturing costs and global warming impact.

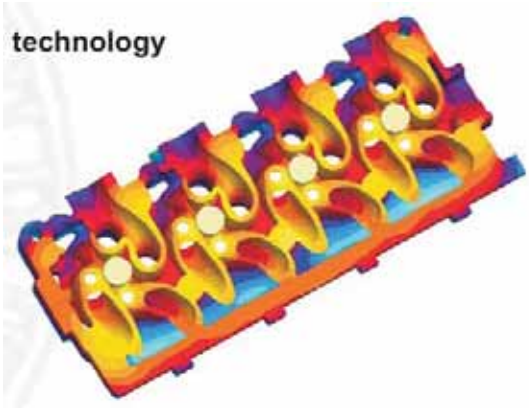
Case Studies



Key Technologies: Key Technologies is a platform that includes those technologies that will yield a high impact on the next generation of manufacturing. These technologies include Model Based Enterprise, nanotechnology, smart materials and innovative process and production technologies.

Standards: Standards is a platform that will focus on manufacturing research issues that can benefit from standardization to create open manufacturing and product standards that are accessible to everyone and enhance innovation globally. IMS involvement in standards would also focus on key areas where the lack of standards is impeding progress in any of the other MTP areas.

Education: Education is a platform for educational programs designed for an information based knowledge worker environment that supports manufacturing in the future. Research listed under this platform will contribute to the development of a coherent vision of manufacturing education across the whole vocational and professional community.



EnginSoft supported the IMS-MTP initiative since the beginning, since when Dan Nagy, the IMS Programme Manager, was a key-note speaker at the EnginSoft Conference in 2007.
Today EnginSoft is a representative of the EC in the frame of the initiative and is responsible of the NIDIATA project. NIDIATA (Education Network on Integrated and Multi-Scale Design of Innovative Light Alloys Castings for Transport Applications) is a rather unique MTP-action, since it is about education. The main Objective of the Project is to accelerate the process of knowledge-transfer in the field of light alloys castings for transport applications. Such a target will be achieved via some intermediate objectives, including:

- setting up a network of Research Institutions and Industrial Partners carrying out worldwide research activities in the field of integrated design and production of innovative light alloys castings;
- setting up educational tools, both conventional (meetings, students and personnel exchange) and innovative (web-based), in order to make available materials and design "frontier" information to students and engineers;
- supplying, by means of the above mentioned tools, innovative knowledge to students and engineers.

These actions will finally lead to an efficient exchange of information and knowledge among Partners having, in their respective region, a key role in light alloy casting, design and engineering, product optimization.
Partners of the initiative include, the Tohoku University, Advanced Institute for Materials Research (Japan), the Worcester Polytechnic Institute (US), as well as most of the European partners of the NADIA project.

Activities carried out so far include:

- web-based courses on: introduction to metals and alloys, solidification of metals, aluminum and magnesium foundry alloys, cast iron, metal matrix composites, component casting, metallurgy of welding processes, as well as subsidiary courses on fundamentals in linear elastic fracture mechanics, advanced applications of nonlinear crack models, structural damage mechanisms interpreted by acoustic emission, fracture mechanics and complexity sciences
- an international mini-master on advanced casting design of automotive components (topics covered include: Intelligent Processing, Fundamentals of solidification of light alloys, Basics of casting technology, Processing, microstructure and properties of cast light alloys, Heat treatment of cast light alloys, Fundamentals of casting processes simulation, Fundamentals of heat treatment process simulation, Micromodelling of light alloys microstructural evolution, CAE Integrated tools for the development of automotive components, Optimization tools in automotive design, Automotive components by Intelligent Processing

Lecturers and trainers of the faculty are leading experts from industry and academia (NTNU Norway, University of Padova, Fiat Research, MATFEM Germany, Tekniker Spain, MAGMA Germania, CIE Automotive Spain, Teksid Aluminum Italy, Daimler Germany, INGUS Sweden, Ford Germany, University of Jönköping, Sweden.

Most of the courses are also available on the web-site of TCN and improve.

For more info:
www.improve.it - www.consorziotcn.it - www.ism.org

Case Studies

ANSYS Workbench: a multidisciplinary FEM approach for PCB equipment

To control the heat generated by the electrical components of a Printed Circuit Board (PCB), the design engineers at STMicroelectronics srl focus on the structural problems and their solutions. The overall aim is to design reliable and robust devices for several different applications.

In order to completely analyze the system, a typical approach is to verify the different physics involved in the problem and how they interact with each other.
The multiphysics analysis aims at the evaluation of deformations and stresses on the device. These are strictly correlated with the temperature distribution on each component and the electric current flowing into the device. The electric analysis calculates the ohmic losses while the thermal analysis provides the temperature distribution as function of the metallization and the geometry. Finally, the structural analysis allows to evaluate the stresses and the deformations depending on the imposed constraints and the thermal loads, in order to detach the possible fault of the device. Given the complexity of the investigated systems, numerical simulation is a good approach to handle all the different physical variables and to determine the behavior of a device. ANSYS Workbench 12.1 offers excellent support to designers for the multidisciplinary analysis of complex systems where several physics are involved in the same phenomenon.
In this article, we present the electro-thermal-structural analysis of a Power SO10 device, developed in collaboration with STMicroelectronics. The aim is to prove the effectiveness and efficiency of a multiphysics approach.
Power SO10 is a surface mounting device. Its chip was made with VIPower technology.
In the device, the power and the driver are integrated; they are intended for driving four independent resistive or inductive loads with one side connected to ground. Active current limitation avoids dropping the system
power supply in case of shorted load, and built-in thermal shut-down protects the chip from over-temperature and short circuit. The open drain diagnostic output indicates over-temperature conditions. Each I/O is pulled down when an over-temperature of the relative channel is detected.
These applications are often used in the automotive sector.

Multiphysics analysis
Let us now look at figure 1 and consider the geometry of the investigated Power SO10 device.

The analysis has been performed in ANSYS Workbench 12.1, the different physics have been linked in order to correctly define the input and output depending on the investigated problem. For the sake of clarity, the state flow of the performed multiphysics analysis is shown in figure 2. Once the electric characteristics of each component have been defined, the electric analysis provides the thermal power due to the Joule effect as input for the thermal analysis. The latter has been carried out by taking into account the transient effects based on the on-off state of the circuit connected to the device. The output of the transient thermal analysis is represented by the temperature distribution in the geometry. Subsequently, the static structural analysis allows us to evaluate the stress and deformation due to the applied thermal loads. Moreover, the obtained results permit to determine the possible malfunctioning of the device.
ANSYS Workbench allows to automatically define the contact regions by imposing a proper proximity tolerance among the surfaces. The single contact couples are characterized by given structural, thermal and electric behaviors. The thermal conductivity of the contacts in particular could be properly determined in the analyzed model.
Afterwards, the model mesh has been generated by means of closed elements to each physical contact (Figure 3).
As mentioned above, the first step of the electrostatic analysis has been carried out by evaluating the dissipated power on the geometry due to the Joule effect. From an

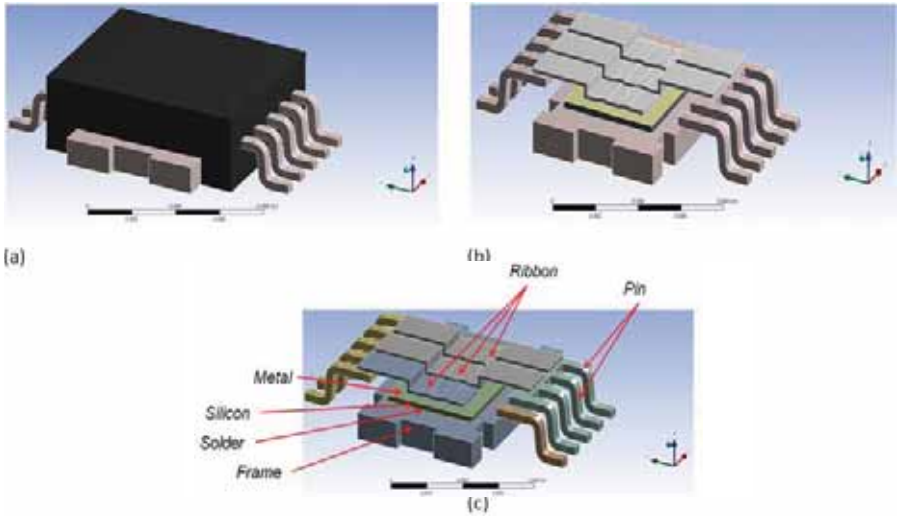


Figure 1 – Analyzed geometry: the overall system (a), the system without case (b) and the particulars (c)

Figure 2 – state flow of the multiphysics analysis

electric point of view, the system reaction time is actually faster than required to obtain a thermal variation. Therefore, a static analysis is sufficient to obtain the ohmic losses to be imposed as input load for the thermal analysis. The excitation current has been applied on the lower part of the frame, inward directed as indicated in figure 4. A zero potential has been imposed as boundary condition on the device pins.

The current has been modeled as a pulsed square wave with 4.1 s of period; the current is not zero for 50 ms. The power dissipated during the on phase of the device has been imposed as load for the thermal analysis, performed in time-domain. That thermal load has been imposed for a period of exactly 50 ms while the circuit was on, instead of a zero load considered for the rest of the time. It is possible to verify if five loops are sufficient to reach the working conditions where the temperature assumes a periodic function without any substantial variations.

The last step of the study is a static structural analysis, performed by imposing several load steps and by applying the temperature obtained during the last on off loop, on each of them.

Results

As explained before, the electrostatic analysis allows to evaluate the ohmic power due to the electric current. The electric current density and the dissipated power distribution are shown in figure 6 and 7.

When we consider the previous figures, it is important to note that the flux of the electric current is consistent with the excitation, in particular the current flows from the frame towards the pins through the silicon and the ribbons. Furthermore, it is possible to observe that the maximum dissipated power is close to the interface between the silicon and aluminum layers. This effect is due to different electric conductivity and resistance of the two materials.

Therefore, in the indicated areas, a combined effect of the electric current and the dissipated power can be observed.

By imposing a proper thermal constraint and assigning the output of the electrostatic analysis as thermal load, the temperature distribution has been evaluated for several time steps. Figure 8 shows the results evaluated at 16.45s.

The maximum temperature has been obtained at the end of the 5th switching on phase.

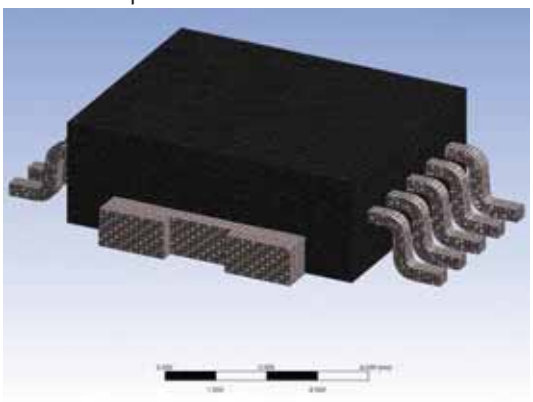


Figure 3 – mesh of the model

The last step of the multiphysics analysis is the structural simulation. In order to represent the thermal load of the last on-off phase, some time steps of the thermal analysis have been taken into account. For each time step the temperature field has been imposed to a series of static structural analyses in order to calculate the stresses and deformations. In figure 9, the plots of the structural post-processing are shown.

The structural analysis clearly confirmed the integrity of the device.

Conclusions

A multiphysics analysis of a Power S010 device has been presented in this article with the aim to evaluate the stress and the deformations of the structure.

In order to obtain accurate results, the electric effects, both in terms of dissipated power and current density, have been evaluated as a first step of the analysis. The output has then

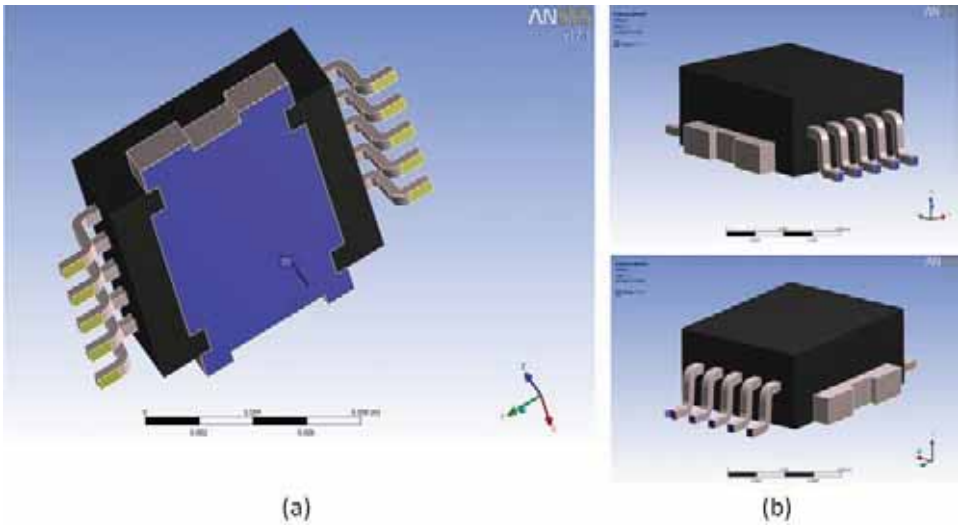


Figure 4 – Current (a) and voltage (b) applied to the model

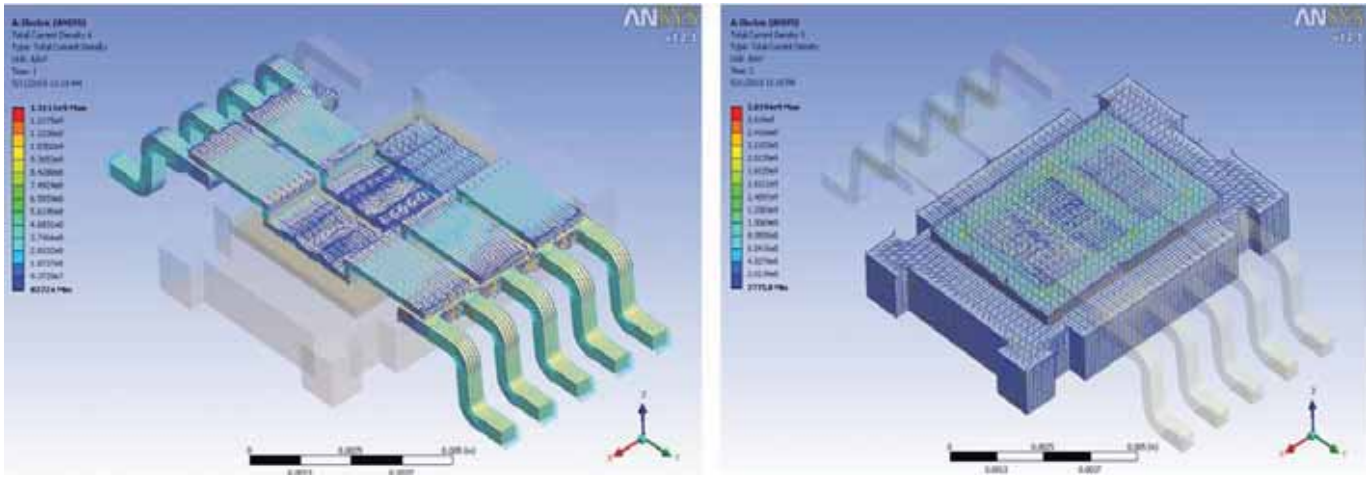


Figure 5 – electric current density

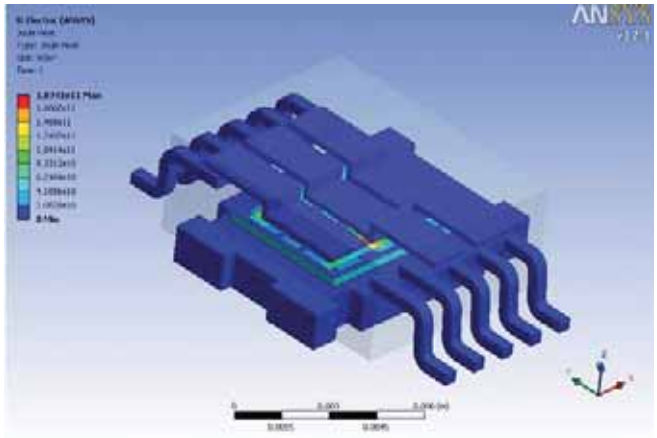


Figure 6 – dissipated power distribution due to the Joule effects

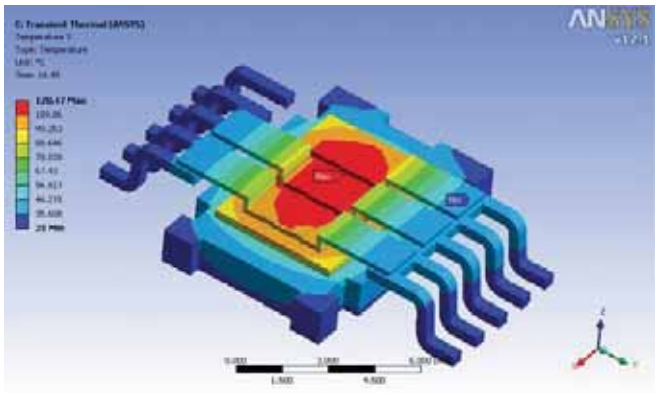


Figure 7 – temperature distribution at 16.45 s

been applied as input for the subsequent transient thermal analysis; the obtained temperature distribution depended on the on-off state of the device. As last step of the study, the stress and deformations have been evaluated by means of a static structural analysis by imposing the thermal loads.
For this and similar applications, ANSYS Workbench 12.1 is a highly efficient software to perform the multiphysics analysis where several phenomena, such as electric, thermal and structural, are depending on each other.

Future work

With the aim to provide a more exhaustive structural study of the device, further analyses will be performed with a focus on:

- Non-linear and orthotropic properties of some materials, such as plastic curves or viscoplastic models.
- A thorough study of the contact to take into account the gluing of the parts; a submodel analysis is suggested for this purpose. ANSYS Workbench in particular allows to insert contact properties to assess local detaches.
- a fatigue evaluation.

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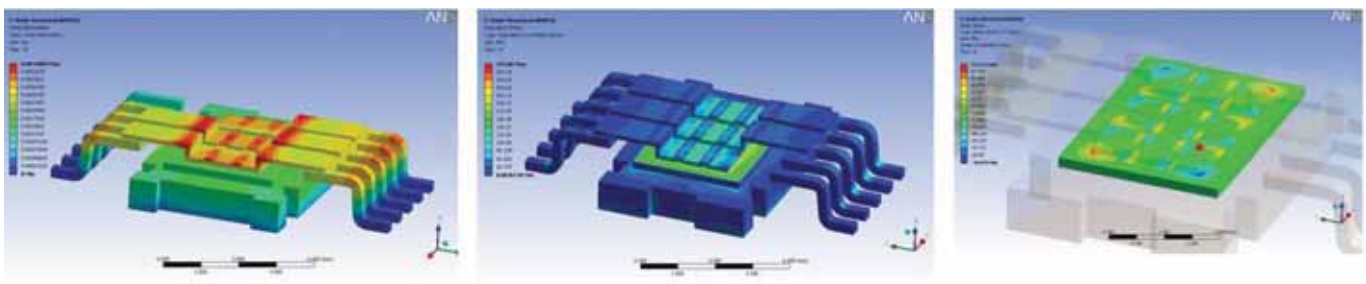


Figure 8 – total deformation, Von Mises stress and shear stress

Grapheur - A new vision for ...Interactive Visualization

It's obvious, you can see it!

Philosophy is written in this grand book - the universe - which stands continually open to our gaze, but it cannot be understood unless one first learns to comprehend the language in which it is written. It is written in the language of mathematics, and its characters are triangles, circles, and other geometric figures, without which it is humanly impossible to understand a single word of it; without these, one is wandering about in a dark labyrinth

(Galileo, Il Saggiatore, 1623)

The sciences do not try to explain, they hardly even try to interpret, they mainly make models.
By a model is meant a mathematical construct which, with the addition of certain verbal interpretations, describes observed phenomena. The justification of such a mathematical construct is solely and precisely that it is expected to work.

(Johann Von Neumann)

Think about how many times you intuitively associate clarity and real understanding with vision. The word intelligence itself derives from the Latin verb intelligere (coming from intus legere, "reading into something", a close cousin of "insight"), again related to reading and seeing.
The Grapheur product from Reactive Search SrL in partnership with EnginSoft unites in the same package tools for modeling and for visualizing data and models. The Grapheur Team focuses on explanations of our world which can be used to predict. This means measuring objects and events, mining and analyzing massive amounts of data, and discovering interesting relationships emerging from them. Visual analytics is the name of the field, focused on analytical reasoning facilitated by interactive visual interfaces.
The so-called laws of nature, such as Newton, are a paradigm with a long history. For example, one starts from measurements of objects falling to the ground, abstracts the relevant characteristics by filtering irrelevant details, proposes a law of gravitation unifying descriptions of how an apple falls and how the moon rotates around the earth. Laws are to be validated by experiments, and possibly falsified and substituted by more accurate models. e.g., when we think about the Michelson Morley experiment bringing strong evidence against the theory of a luminiferous aether. Still,

Grapheur Una nuova visione... interattiva

Si vede, è ovvio!

«La filosofia è scritta in questo grandissimo libro che continuamente ci sta aperto innanzi a gli occhi (io dico l'universo), ma non si può intendere se prima non s'impara a intender la lingua, e conoscer i caratteri, ne' quali è scritto. Egli è scritto in lingua matematica, e i caratteri son triangoli, cerchi, ed altre figure geometriche, senza i quali mezzi è impossibile a intenderne umanamente parola; senza questi è un aggirarsi vanamente per un oscuro labirinto.»

(Galileo, Il Saggiatore, 1623)

Le scienze non cercano di spiegare, in effetti provano a malapena ad interpretare, principalmente producono modelli. Per modello si intende una costruzione matematica che, accompagnata da alcune interpretazioni verbali, descriva il fenomeno osservato. L'unico supporto a un tale costrutto matematico è solamente e precisamente che funzioni.

(Johann Von Neumann)

Pensate a quante volte avete associato intuitivamente chiarezza e comprensione con la vista. La stessa parola "intelligenza" deriva dal verbo latino intelligere (a sua volta composto di intus legere, "leggere in qualcosa"), il quale, del resto, non è molto diverso dall'inglese "insight" (traducibile anche come "conoscenza"), termine nuovamente legato al campo semantico della lettura e della visione.
Grapheur, prodotto da **Reactive Search SrL** in collaborazione con EnginSoft, unisce in un unico pacchetto gli strumenti necessari per creare, manipolare e visualizzare dati e modelli. Grapheur ha l'obiettivo di aiutare a scoprire interpretazioni dei dati che possono essere usate per previsioni e scelte razionali. Questo implica la misurazione di oggetti ed eventi, il rastrellamento e l'analisi di grandi quantità di dati, cercando di individuare relazioni interessanti. **Visual analytics** è il nome del campo di studio, focalizzato sul ragionamento analitico supportato da interfacce interattive.
Esempi notevoli di data mining nei tempi passati hanno portato alle cosiddette leggi di natura, come quella di Newton. Si può iniziare semplicemente misurando un oggetto che cade a terra, si procede astraendo le caratteristiche rilevanti filtrando i dettagli inutili, e si finisce poi proponendo una legge di gravitazione che unisca le osservazioni sulla caduta di una mela e sul moto rotatorio

we are also settling for models which are less clean and precise than the laws of nature; for instance: empirical models to explain the meaning of relevant documents in the web, models to predict if a customer would like a movie from data collected by other customers, models to cluster entities (e.g.,to cluster a large number of design solutions), identify prototypes and study them, models to gain insights from massive data produced by CAE software tools.
In addition to modeling and visualizing data or information, Grapheur helps the user to strengthen the power of abstraction. Without the support to simplify and find commonalities among superficially different phenomena, one is easily lost among a sea of details. Vice versa, understanding abstraction means discovering that - in science and technology - to explain often means: to unify !
If you think objectively, the law of gravitation does not explain why objects are falling (it does not explain the deep philosophical reasons), it simply explains how they fall, covering an infinite number of cases in an extremely well summarized manner. It sounds, and it actually is superficial, not to touch the essence of phenomena, but it is for sure effective, reproducible and successful.
Pragmatically, abstraction and use of basic mathematical tools is an excellent way to be able to solve challenging new problems by discovering some abstract resemblance to known cases. For example, if one understands linear algebra one may use it to discover new ways of analyzing huge collections of documents, such as, for example, the web and to create extremely successful and profitable search methods, just as Google did! If one knows basic minimization techniques, e.g. steepest descent, one may use it to build powerful and flexible machines which learn from examples, such as neural networks with error back-propagation or similar machine-learning methods.

An example: Partitioning a mesh for parallel computing in Computational Fluid Dynamics

Data: Complex physics simulations as common in Computational Fluid Dynamics require huge computational

della Luna attorno alla Terra. Le leggi hanno bisogno di essere sostenute e validate dagli esperimenti, e magari confutate e sostituite da modelli più accurati (pensiamo al risultato negativo dell'esperimento di Michelson Morley contro la teoria dell'etere luminifero).
A volte i modelli si rivelano meno semplici e precisi delle leggi di natura. Ad esempio si considerino i modelli empirici utilizzati per spiegare la rilevanza delle pagine web, quelli di "collaborative recommendation" che tentano di predire se un cliente apprezzerà un prodotto sulla base dei dati raccolti da altri acquirenti, quelli per aggregare elementi (ad esempio soluzioni di progettazione), ed individuarne dei prototipi, o modelli per visualizzare soluzioni prodotte da software CAE.
Oltre alla visualizzazione ed analisi dei dati e delle informazioni, Grapheur aiuta l'utente a rafforzare le sue **capacità di astrazione**. Se non si cercano somiglianze fra fenomeni apparentemente simili, è facile perdersi nel mare dei dettagli. Spiegare in senso scientifico vuol dire unificare. Se si riflette un attimo, la legge di gravità non spiega perché gli oggetti cadano (non ne sviscera le profonde ragioni filosofiche), tenta semplicemente di illustrare come questi oggetti precipitano, coprendo un numero pressoché infinito di casi attraverso un'ottima sintesi. Sembra, ed in realtà è, una spiegazione superficiale: non tocca l'essenza del fenomeno, ma è sicuramente un metodo efficace, riproducibile e vincente.

Nella pratica, l'astrazione e l'uso degli strumenti matematici di base costituiscono un modo eccellente per risolvere problemi nuovi ed impegnativi, trovando somiglianze astratte all'interno dei casi noti. Per esempio, se si comprende l'algebra lineare si può utilizzarla per trovare nuovi modi per analizzare grandi gruppi di documenti, ad esempio delle pagine web, riuscendo in questo modo a trovare metodi efficaci per effettuare delle ricerche, esattamente come fa Google! Se si conoscono anche le tecniche più basilari di ottimizzazione, come la discesa lungo il gradiente, si possono costruire macchine flessibili quanto potenti che possano imparare per esempi, come una rete

Figure 1 - Computational grid for computing airflow over a wing. Flow is left to the right, the wing is 1.4 degrees from horizontal. The grid is adaptive in two ways: the size of the triangles controls the spatial resolution of the simulation, and the grid is also split into pieces for parallel execution by 32 processors, so that each gets the same number of triangles. Refinement is based on the gradient of the pressure, especially at the leading edge (left) and at the shock. The shock is above the airfoil, 2/3 back. However, there is no shock below the wing: thus the aerodynamics is visible through its effect on the adaptive grid.
Credit: Roy Williams, Geoffrey Fox, California Institute of Technology

Figura 1 - Griglia di calcolo per la valutazione del flusso d'aria, direzionato da sinistra a destra, su un'ala con inclinazione di 1.4° orizzontale. La griglia è adattativa in due direzioni: la grandezza dei triangoli controlla la risoluzione spaziale della simulazione, mentre l'intera superficie è suddivisa in sezioni, rappresentanti le 32 unità computazionali per il calcolo in parallelo, in modo da garantire ad ogni processore lo stesso numero di triangoli. Gli effetti aerodinamici infatti sono facilmente visibili sulla griglia adattativa.
Credito: Roy Williams, Geoffrey Fox, California Institute of Technology

resources. Parallel computing can speed up simulation runs. The original space of the simulation is covered by a discrete mesh, and the mesh is partitioned into a set of disjoint domains. Each domain is associated to a different computer. The mesh partitioning problem has multiple objectives: one aims at a well-balanced partition (sub-domains containing a similar number of nodes) and at a cut of minimum size (the number of edges which are cut is proportional to the number of messages that must flow between different processors, i.e. to the cost of communication).

Objectives of data mining and visualization:

1. To couple visualization with an iterative mesh-partitioning (graph-partitioning) technique, so that the user starts with a partition into two domains, and then iteratively splits each domain into two.
2. To visualize the tree of solutions. The root of the tree corresponds to the entire mesh. The children of a node correspond to different ways of splitting each domain of the partition corresponding to the parent node.
3. To identify a proper trade-off between balance and cut size of the partitions.

The navigation mode can visualize the multiple levels of the partitioning. By starting from the root and by double-clicking on a node, the user can visualize the nodes' children. By double-clicking on the background, the user visualizes the entire set of solutions. Trade-offs can be studied in the parallel coordinate display or through the scatterplot visualization feature.

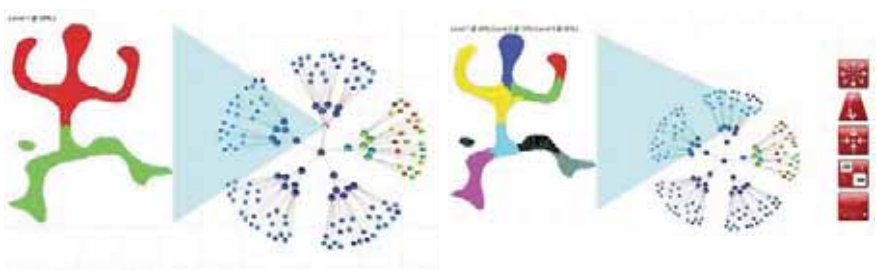


Figure 2 - Visualizing a multi-level mesh partitioning method with Grapheur: A mesh covering a domain is partitioned into two (right) and eight (left) parts.

Figura 2 - visualizzazione di un metodo di partizionamento mesh multilivello con Grapheur. Una mesh comprendente un dominio è suddiviso in due (destra) e poi otto (sinistra) parti.

For more information:

Many examples in different areas are already available at: http://grapheur.com/info/cases/

If you do not find a relevant example for your case, we are ready to accept a sample of your data and your wildest visualization desires! We will get back to you with some example visualizations, see also our Thomas service (http://grapheur.com/info/thomas/). Special purpose vertical applications can also be realized on demand.

We encourage you to download a free evaluation copy from the web site www.grapheur.com. Enjoy your navigation!

neurale con retro propagazione dell'errore o metodi simili di "machine-learning".

Un esempio: Suddividere una mesh per il calcolo parallelo in Computational Fluid Dynamics

Dati: simulazioni fisiche complesse, ad esempio comuni in Computational Fluid Dynamics, richiedono grandi risorse di elaborazione. Il calcolo parallelo è usato solitamente per ridurre il tempo della simulazione: lo spazio originario della simulazione è coperto da una mesh discretizzata, suddivisa in domini indipendenti, ognuno associato ad un computer diverso. Il problema del partizionamento della mesh ha vari obiettivi: uno punta alla suddivisione bilanciata della griglia (punta cioè ad avere un numero simile di nodi per dominio), mentre un altro tende a creare confini di dimensioni ridotte (il numero degli archi tagliati è proporzionale alla quantità di informazioni che devono fluire fra i vari processori; quindi al costo della comunicazione).

Obiettivi delle tecniche di data mining e visualizzazione:

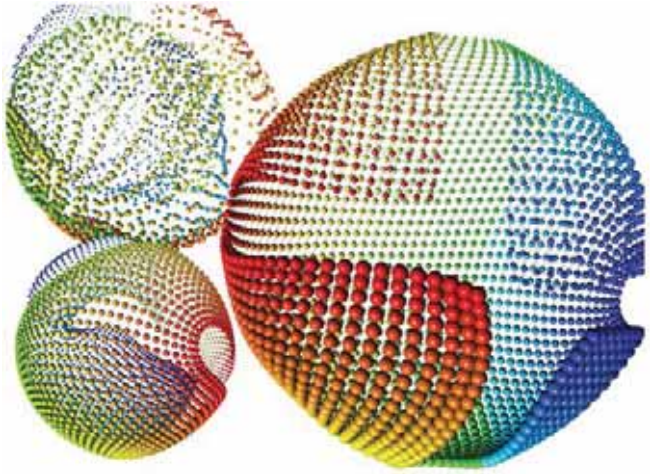
- Collegare più visualizzazioni con una tecnica sequenziale di partizionamento dei grafi per permettere all'utente di partire con una situazione a due domini e successivamente proseguire suddividendo ognuno dei due in due parti.
- **Visualizzare le tre soluzioni**. La radice dell'albero corrisponde alla mesh completa. I figli di un nodo corrispondono invece a differenti modi di suddividere ogni dominio della partizione associata al nodo genitore.
- Identificare un giusto **compromesso fra bilanciamento e lunghezza del taglio** delle partizioni.

La modalità "navigazione" può visualizzare livelli multipli di partizionamento. Partendo dalla radice e facendo doppio-click su un nodo, l'utente potrà vedere i nodi figli relativi. Facendo doppio-click sullo sfondo, si visualizza invece l'intero gruppo di soluzioni. Le soluzioni possono essere studiate utilizzando le coordinate parallele o tramite la visualizzazione a scatterplot.

Per altre informazioni:

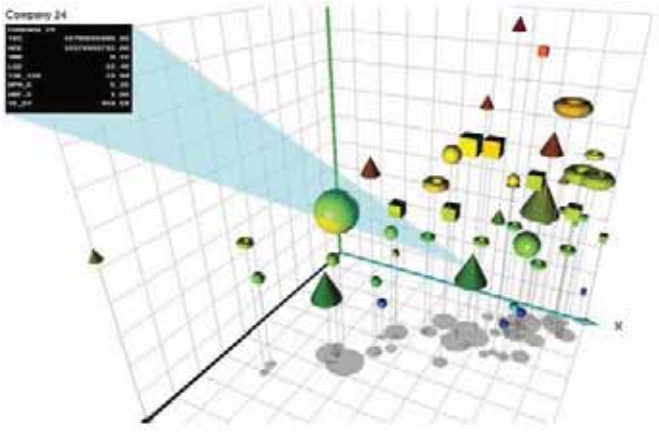
Molti esempi in campi differenti sono già disponibili all'indirizzo: http://grapheur.com/info/cases/ Se non trovate un esempio che si adatti al vostro caso d'uso, siamo disponibili a ricevere un campione dei vostri dati ed i vostri più segreti desideri di visualizzazione! Vi risponderemo con alcuni esempi che dimostrano cosa potete fare con i vostri dati: date un'occhiata al nostro servizio "Thomas" (http://grapheur.com/info/thomas/) e ricordate che le applicazioni verticali possono essere sviluppate al volo, a seconda delle vostre necessità.

Vi consigliamo di scaricare la vostra copia di valutazione gratuita dal nostro sito web www.grapheur.com. Enjoy your navigation!



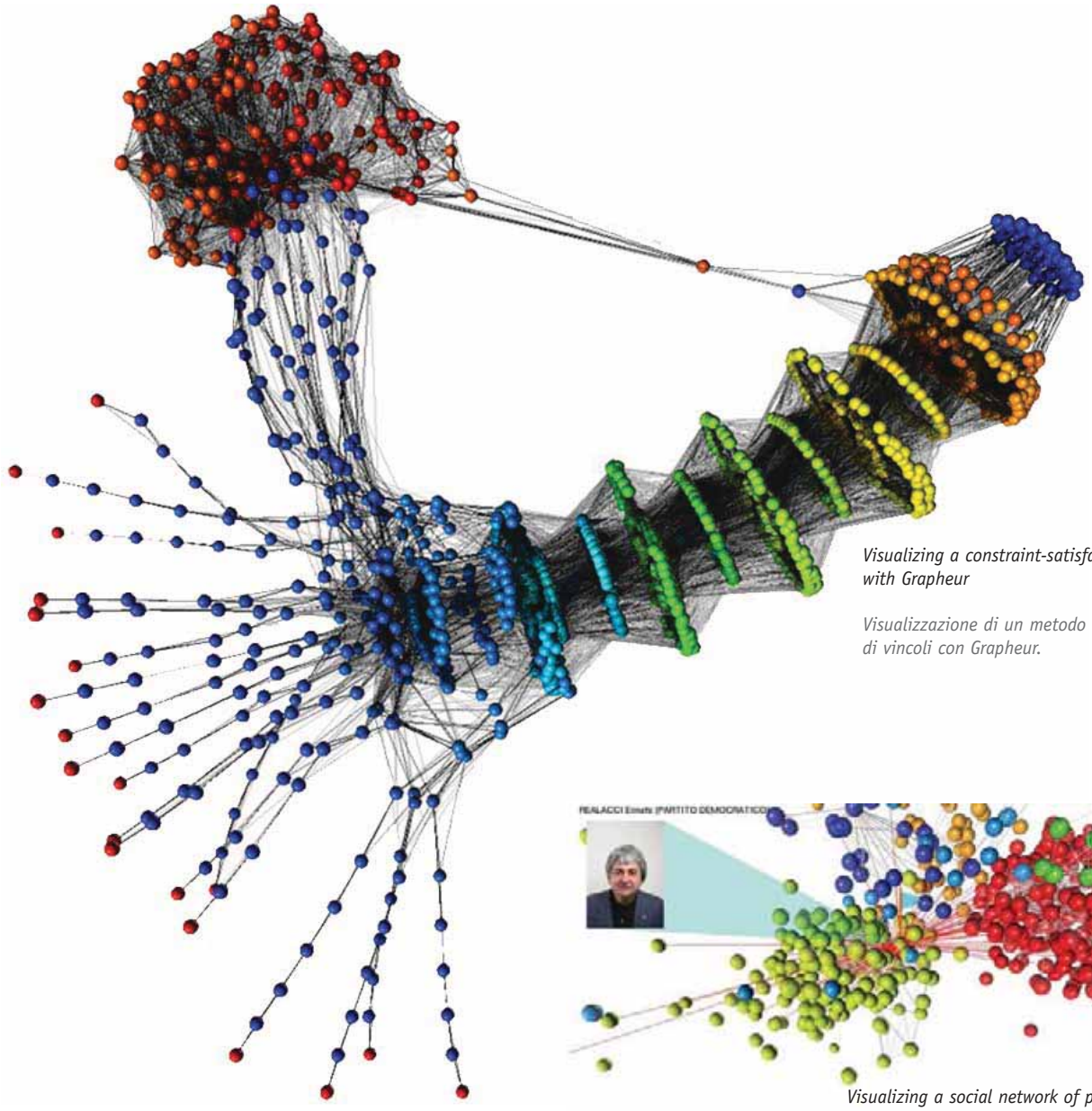
Order from chaos: discovering a regular grid after starting from local information about distances (Grapheur).

Ordine dal caos: come scoprire una griglia regolare partendo da informazioni locali sulle distanze (Grapheur).



Visualizing the financial performance of companies with Grapheur's 7d plot

Prestazioni finanziarie di varie aziende con la visualizzazione 7d plot di Grapheur.



Visualizing a constraint-satisfaction method with Grapheur

Visualizzazione di un metodo di soddisfazione di vincoli con Grapheur.

Visualizing a social network of politicians with Grapheur

Una rete sociale di politici visualizzata con Grapheur.

A simple Finite Element Solver for thermo-mechanical problems

In this paper we would like to show how it is possible to develop a simple but effective finite element solver to deal with thermo-mechanical problems. In many engineering situations it is necessary to solve heat conduction problems, both steady and unsteady state, to estimate the temperature field inside a medium and, at the same time, compute the induced strain and stress states.
To solve such problems many commercial software tools are available. They provide user-friendly interfaces and flexible solvers, which can also take into account very complicated boundary conditions, such as radiation, and nonlinearities of any kind, to allow the user to model the reality in a very accurate and reliable way.

However, there are some situations in which the problem to be solved requires a simple and standard modeling: in these cases it could be sufficient to have a light and dedicated software able to give reliable solutions. Moreover, other two desirable features of such a software could be the possibility to access the source to easily program new tools and, last but not least, to have a cost-and-license free product. This turns out to be very useful when dealing with the solution of optimization problems.

Keeping in mind these considerations, we used the Scilab platform and the gmsh (which are both open source codes: see [1] and [2]) to show that it is possible to build tailored software tools, able to solve standard but complex problems quite efficiently.

Of course, to do this it is necessary to have a good knowledge basis in finite element formulations but no special skills in programming, thanks to the ease in developing code which characterizes Scilab.

In this paper we firstly discuss about the numerical solution of the parabolic partial differential equation which governs the unsteady state heat transfer problem and then a similar strategy for the solution of elastostatic problems will be presented. These descriptions are absolutely general and they represent the starting point for more complex and richer models. The main objective of this work is certainly not to present revolutionary results or new super codes, but just and simply to show that in some cases it could be feasible, useful and profitable to develop home-made applications.

Feature	Commercial codes	In-house codes
Flexibility	It strongly depends on the code. Commercial codes are thought to be general purpose but rarely they can be easily customized.	In principle the maximum flexibility can be reached with a good organization of programming. Applications tailored on a specific need can be done.
Cost	The license cost strongly depends on the code. Sometimes a maintenance has to be paid to access updates and upgrades.	No license means no costs, except those coming out from the development.
Numerics and mathematics knowledge required	No special skills are required even if an intelligent use of simulation software requires a certain engineering or scientific background.	A certain background in mathematics, physics and numerical techniques is obviously necessary.
Programming skills	Usually no skills are necessary.	It depends on the language and platform used and also on the objectives that lead the development.
Performance	Commercial codes use the state-of –the-art of the high performance computing to provide to the user very efficient applications.	The performance strongly depends on the way the code has been written.
Reliability of results	Usually commercial codes do not provide any warranty on the goodness of results, even though many benchmarks are given to demonstrate the effectiveness of the code.	A benchmarking activity is recommended to debug in-house codes and to check the goodness of results. This could take a long time.

Table 1 - A simple comparison between commercial and in-house software is made in this table. These considerations reflect the author opinion and therefore the reader could not agree. The discussion is open.

The thermal solver

The first step to deal with is to implement a numerical technique to solve the unsteady state heat transfer problem described by the following partial differential equation:

$$\rho c \frac{\partial T}{\partial t} - \nabla \cdot (k \nabla T) = f \qquad in\ \Omega \tag{1}$$

which has to be solved in the domain Ω, taking into account the boundary conditions, which apply on different portions of the boundary ($\Gamma = \Gamma_T \cup \Gamma_Q \cup \Gamma_C$). They could be of Dirichlet, Neumann or Robin kind, expressing a given temperature $\bar{T}$, a given flux $\bar{Q}$ or a convection condition with the environment:

$$\begin{aligned} T &= \bar{T} \quad on\ \Gamma_T \\ -k\frac{\partial T}{\partial \hat{n}} &= \bar{Q} \quad on\ \Gamma_Q \\ -k\frac{\partial T}{\partial \hat{n}} &= h(T - \bar{T}_E) \quad on\ \Gamma_C \end{aligned} \tag{2}$$

being $\hat{n}$ the unit normal vector to the boundary and the upper-lined quantities known values at each time. The symbols "$\nabla\cdot$" and "∇" are used to

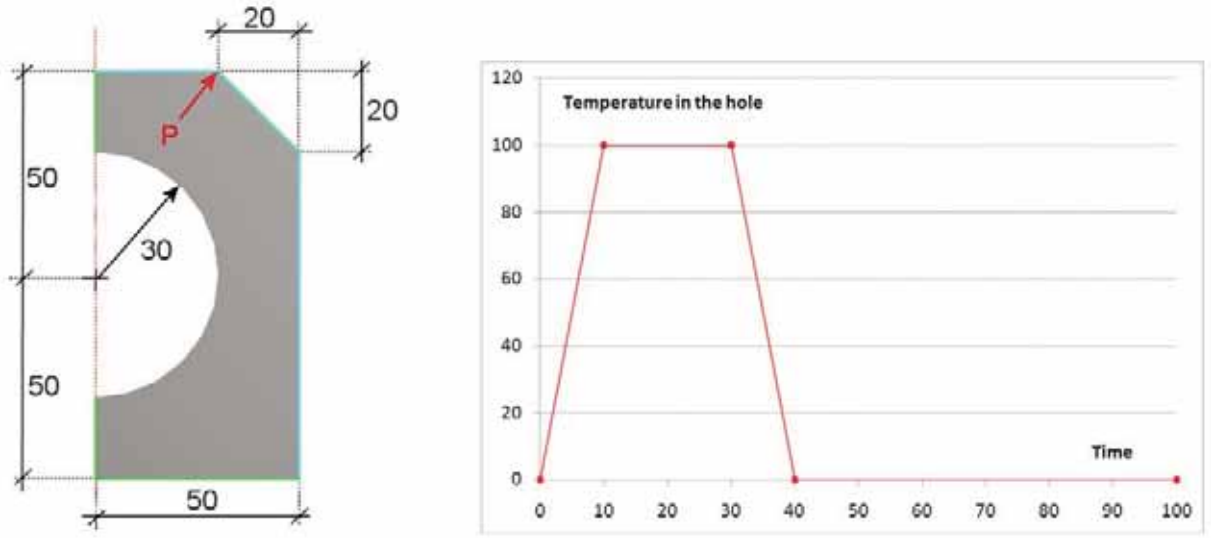


Figure 1 - In view of the symmetry of the pipe problem we can consider just one half of the structure during the computations. A null normal flux on the symmetry boundary has been applied to model symmetry as on the base line (green boundaries), while a convection condition has been imposed on the external boundaries (blue boundaries). Inside the hole a temperature is given according to the law described on the right.

indicate the divergence and the gradient operator respectively, while *T* is the unknown temperature field. The medium properties are the density ρ, the specific heat *c* and the thermal conductivity *k* which could depend, in a general case, on temperature. The term *f* on the right hand side represents all the body sources of heat and it could depend on both the space and time.

For sake of simplicity we imagine that all the medium properties are constant; in this way the problem comes out to be linear, dramatically simplifying the solution.

For the solution of the equations reported in (1) we decide to use a traditional Galerkin residual approach. Once a discretization has been introduced, we obtain the following expression, in matrix form:

$$[C]\{\dot{T}\} + [K]\{T\} = \{F\} \tag{3}$$

where the symbols [·] and {·} are used to indicate matrices and vectors.

A classical Euler scheme can be implemented. If we assume the following approximation for the first time derivative of the temperature field:

$$\vartheta\{\dot{T}_{n+1}\} + (1-\vartheta)\{\dot{T}_n\} = \frac{\{T_{n+1}\}-\{T_n\}}{\Delta t} \tag{4}$$

being ϑ=[0,1] and ΔT the time step, we can rewrite, after some manipulation, equation (3) as:

$$\left(\frac{[C]}{\Delta T} + \vartheta[K]\right)\{T_{n+1}\} - \left(\frac{[C]}{\Delta T} + (\vartheta-1)[K]\right)\{T_n\} = \\ = \vartheta\{F_{n+1}\} + (1-\vartheta)\{F_n\} \tag{5}$$

It is well known (see [4]) that the value of the parameter ϑ plays a fundamental role. If we choose ϑ=0 an explicit time integration scheme is obtained, actually the unknown temperature at step n+1 can be explicitly computed starting from already computed or known quantities.

Moreover, the use of a lumped finite element approach leads to a diagonal matrix [C]; this is a desirable feature, because the solution of equation (5), which passes through the inversion of [C], reduces to simple and fast computations. The gain is much more evident if a non-linear problem has to be solved, when the inversion of [C] has to be performed at each integration step.

Unfortunately, this scheme is not unconditionally stable; the time integration step Δt has actually to be less than a threshold which depend on the nature of the problem and on the mesh. In some cases this restriction could require very small time steps, giving high solution time.

On the contrary, if ϑ=1, an implicit scheme comes out from (5), which can be specialized as:

$$\left(\frac{[C]}{\Delta T} + [K]\right)\{T_{n+1}\} - \frac{[C]}{\Delta T}\{T_n\} = \vartheta\{F_{n+1}\} \tag{6}$$

In this case the matrix on the left involves also the conductivity contribution, which cannot be diagonalized trough a lumped approach and therefore the solution of a

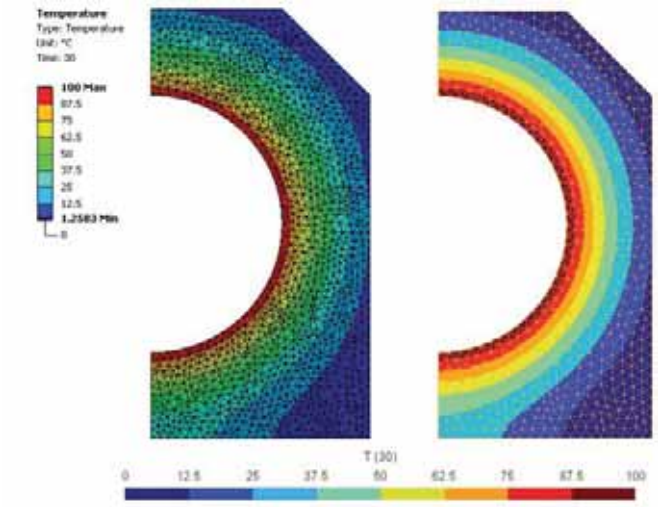


Figure 2 - Temperature field at time 30 The ANSYS Workbench (left) and our solver (right) results. A good agreement can be seen comparing these two images.

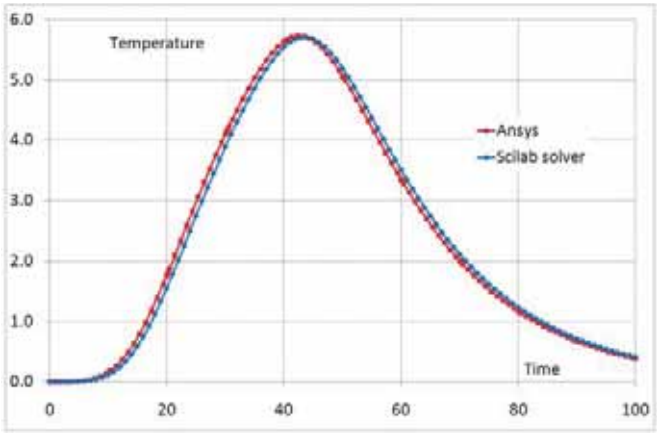


Figure 3 - Temperature field in the point P plotted versus time. The ANSYS Workbench (red) and our solver (blue) results. Also in this case a good agreement between results is achieved.

system of linear equations has to be computed at each step. The system matrix is however symmetric and positive definite, so a Choleski decomposition can be computed once for all and at each integration step the backward process, which is the less expensive from a computational point of view, can be performed.

This scheme has the great advantage to be unconditionally stable: this means that there are no restriction on the time step to adopt. Obviously, the larger the step, the larger the errors due to the time discretization introduced in the model, according to (4).

In principle all the intermediate values for ϑ are possible, considering that the stability of the Euler scheme is guaranteed for ϑ > 1/2, but usually the most used version are the full explicit or implicit one.

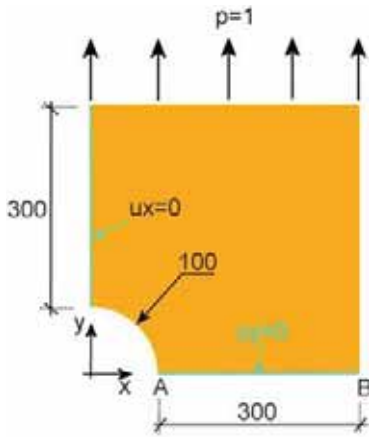


Figure 4 - The holed plate under tension considered in this work. We have taken advantage from the symmetry with respect to x and y axes to model only a quarter of the whole plate. Appropriate boundary conditions have been adopted, as highlighted in blue.

In order to test the goodness of our application we have performed many tests and comparisons. Here we present the simple example shown in Figure 1. Let us imagine that in a long circular pipe a fluid flows with a temperature which changes with time according to the law drawn in Figure 1, on the right. We want to estimate the temperature distribution at different time steps inside the medium and compute the temperature of the point P.

It is interesting to note that for this simple problem all the boundary conditions described in (2) have to be used. A unit density and specific heat for the medium has been taken, while a thermal conductivity of 5 has been chosen for this benchmark. The environmental temperature has been set to 0 and the convection coefficient to 5.

As shown in the following pictures there is a good agreement between the results obtained with ANSYS Workbench and our solver.

The structural solver

If we want to solve a thermo-structural problem (see [3] and references reported therein) we obviously need a solver able to deal with the elasticity equations. We focus on the simplest case, that is two dimensional problems (plane strain, plane stress and axi-symmetric problems) with a completely linear, elastic and isotropic response. We have to take into account that a temperature field induces thermal deformations inside a solid medium. Actually:

$$\varepsilon_{ii}^{TH} = \alpha(T - T_{REF}) \tag{7}$$

where the double index i indicates that no shear deformation can appear. The T_{REF} represents the reference temperature at which no deformation is produced inside the medium.

Once the temperature field is known at each time step, it is possible to compute the induced deformations and then the stress state.

For sake of simplicity we imagine that the loads acting on the structure are not able to produce dynamic effects and therefore, if we neglect the body forces contributions, the equilibrium equations reduce to:

$$\nabla \cdot \boldsymbol{\sigma} = 0 \quad \text{or, with the indicial notation} \quad \frac{\partial \sigma_{ij}}{\partial x_j} = 0 \tag{8}$$

The elastic deformation ε can be computed as the difference between the total and the thermal contributions as:

$$\boldsymbol{\varepsilon} = \boldsymbol{\varepsilon}^{TOT} - \boldsymbol{\varepsilon}^{TH} \tag{9}$$

which can be expressed in terms of the displacement vector field *u* as:

$$\boldsymbol{\varepsilon} = \frac{1}{2}(\nabla \boldsymbol{u} + \nabla^t \boldsymbol{u})$$

or, with the indicial notation $\varepsilon_{ij} = \frac{1}{2}\left(\frac{\partial u_j}{\partial x_i} - \frac{\partial u_i}{\partial x_j}\right)$ (10)

A linear constitutive law for the medium can be adopted and written as:

$$\boldsymbol{\sigma} = \boldsymbol{D}\boldsymbol{\varepsilon} \tag{11}$$

where the matrix D will be expressed in terms of μ and λ which describe the elastic response of the medium. Finally, after some manipulation involving equations (9), (10) and (11), one can obtain the following governing equation, which is expressed in terms of the displacements field *u* only:

$$(\lambda + \mu)\nabla(\nabla \cdot \boldsymbol{u}) + \mu\nabla^2 \boldsymbol{u} - \alpha(3\lambda + 2\mu)\nabla T = 0 \tag{12}$$

As usual, the above equation has to be solved together with the boundary conditions, which typically are of Dirichlet (imposed displacements $\bar{\boldsymbol{u}}$ on Γ_u) or Neumann kind (imposed tractions $\bar{\boldsymbol{p}}$ on Γ_p):

$$\begin{aligned} \boldsymbol{u} &= \bar{\boldsymbol{u}} \quad on \quad \Gamma_u \\ \boldsymbol{\sigma} \cdot \hat{\boldsymbol{n}} &= \bar{\boldsymbol{p}} \quad on \quad \Gamma_p \end{aligned} \tag{13}$$

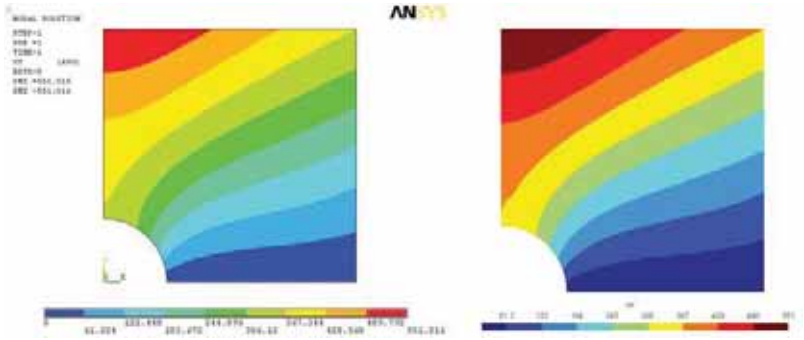


Figure 5 - The displacement in y direction computed with ANSYS (left) and our solver (right). The maximum computed values for this component are 551.016 and 551.014 respectively.

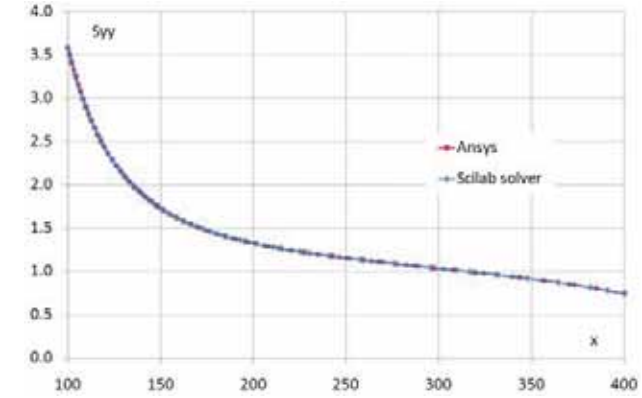


Figure 6 - The y-component of stress along the vertical symmetry line AB (see Figure 4). The red line reports the values computed with ANSYS while the blue one shows the results obtained with our solver. No appreciable difference is present.

under tension with a hole, as shown in Figure 4. A unit Young modulus and a Poisson coefficient of 0.3 have been adopted to model the material behavior. The vertical displacements computed with ANSYS and our solver are compared in Figure 5: it can be seen that the two colored patterns are very similar and that the maximum values are very closed one another (ANSYS gives 551.016 and we obtain 551.014). In Figure 6 the tensile stress in y-direction along the symmetry line AB is reported. It can be seen that there is a good agreement between the results provided by the two solvers.

Thermo-elastic analysis of a pressure vessel

In the oil-and-gas industrial sector it happens very often to investigate the structural behavior of pressure vessels. These structures are used to contain gasses or fluids; sometimes also chemical reactions can take place inside these devices, with a consequent growth in temperature and pressure.

For this reason the thin shell of the vessel has to be checked taking into account both the temperature distribution, which inevitably appears within the structure, and the mechanical loads. If we neglect the holes and the nozzles which could be present, the geometry of these

Material	Density [kg/m^3]	Specific heat [J/kg°C]	Thermal conductivity [W/m°C]	Young modulus [N/m^2]	Poisson ratio [---]	Thermal expansion coeff. [1/°C]
Steel	7850	434	60.5	$2.0 \cdot 10^{11}$	0.30	$1.2 \cdot 10^{-5}$
Insulation	937	303	0.5	$1.1 \cdot 10^{9}$	0.45	$2.0 \cdot 10^{-4}$

Table 2 - The thermal and the mechanical properties of the materials involved in the analysis.

The same approach described above for the heat transfer equation, the Galerkin weighted residuals, can be used with equation (12) and a discretization of the domain can be introduced to numerically solve the problem.
Obviously, we do not need a time integration technique anymore, being the problem a static one. We will obtain a system of linear equations characterized by a symmetric and positive definite matrix: special techniques can be exploited to take advantage of these properties in order to reduce the storage requirements (e.g. a sparse symmetric storage scheme) and to improve the efficiency (e.g. a Choleski decomposition, if a direct solver is adopted). As for the case of the thermal solver, many tests have been performed to check the accuracy of the results. Here we propose a classical benchmark involving a plate of unit thickness

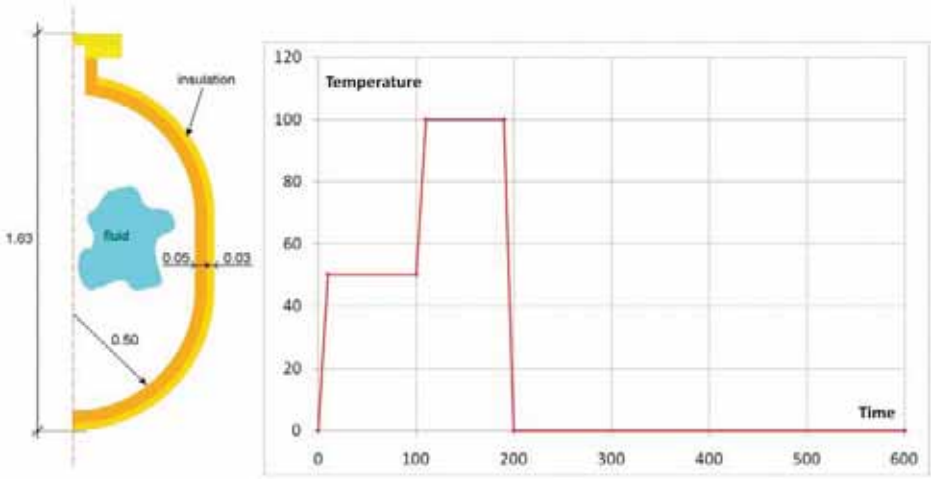


Figure 7 - A simple sketch illustrates the vessel considered in this work. The revolution axis is drawn with the red dashed line and some dimensioning (in [m]) is reported. The nozzle on top is closed thanks to a cap which is considered completely bonded to the structure. The nozzle neck is not covered by the insulating material. On the right the fluid temperature versus time is plotted. A pressure of 1 [MPa] acts inside the vessel.

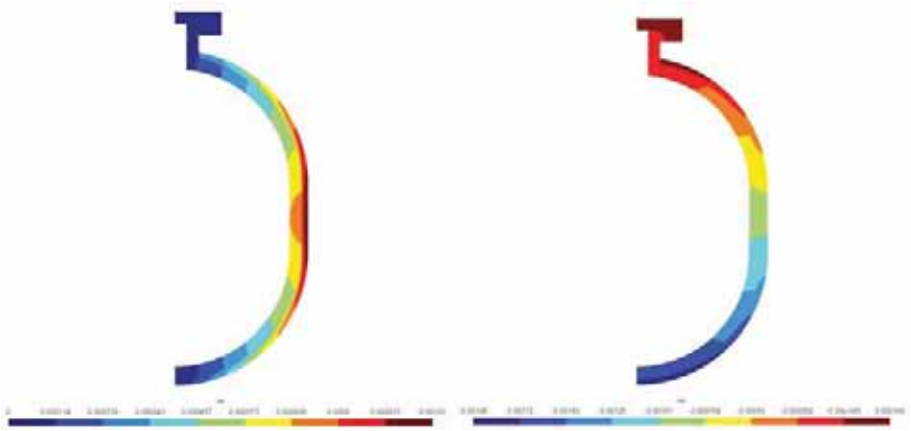


Figure 9: The radial (left) and vertical (right) displacement of the vessel.

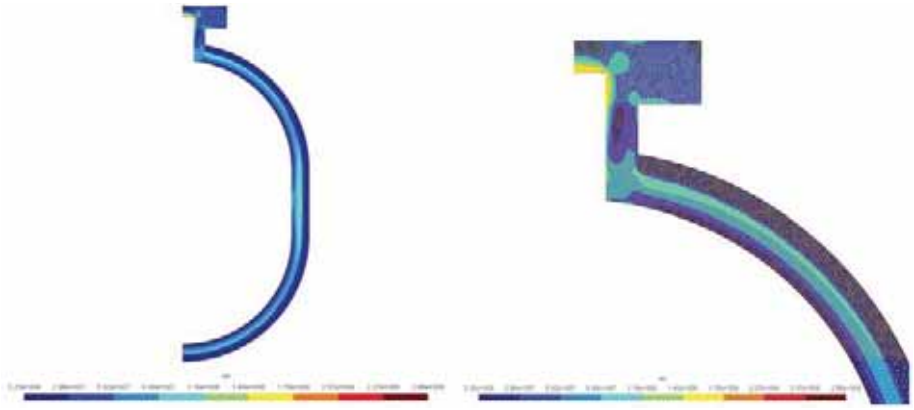


Figure 10: The von Mises stress and a detail of the neck, on the right, together with the structural mesh.

structures can be viewed, very often, as a solid of revolution. Moreover, the applied loads and the boundary conditions reflect this symmetry and therefore it is very common, when applicable, to calculate a vessel using an axi-symmetric approach.

In the followings we propose a thermo-mechanical analysis of the vessel shown in Figure 7. The fluid inside the vessel has a temperature which follows a two steps law (see Figure 7, on the right) and a constant pressure of 1 [MPa]. We would like to know which is the temperature reached on the external surface and which is the maximum stress inside the shell, with particular attention to the upper neck.

We imagine that the vessel is made of a common steel and that it has an external thermal insulating cover: the relevant material properties are listed in Table 2.

When dealing with a thermo-mechanical problem it could be reasonable to use two different meshes to model and solve the heat transfer and the elasticity equations. Actually, if in the first case we usually are interested in accurate modeling the temperature gradients, in the second case we would like to have a reliable estimation of stress peaks, which in principle could appear in different zones of the domain. For this reason we decided to have the possibility to use different computational grids: once the temperature field is known, it will be mapped on to the structural mesh allowing in this way a better flexibility of our solver.

In the case of the pressure vessel we decided to use a uniform mesh within the domain for the thermal solver, while we adopted a finer mesh near the neck for the stress computation.

In Figure 8 the temperature field at time 150 [s] is drawn: on the right a detail of the neck is plotted. It can be seen that the insulating material plays an important role, the surface temperature is actually maintained very low. As mentioned above a uniform mesh is employed in this case. In Figure 9 the radial (left) and the vertical (right) deformed shapes are plotted. In Figure 10 the von Mises stress is drawn and, on the right, a detail in proximity of the neck is proposed: it can be easily seen that the mesh has been refined in order to better capture the stress peaks in this zone of the vessel.

Conclusions

In this work it has been shown how it is possible to use Scilab to solve thermo-mechanical problems. For sake of simplicity the focus has been posed on two dimensional problems but the reader has to remember that the extension to 3D problems does not require any additional effort from a conceptual point of view.

Some simple benchmarks have been proposed to show the effectiveness of the solver written in Scilab. The reader should have appreciated the fact that also industrial-like problems can be solved efficiently, as the complete thermo-mechanical analysis of a pressure vessel proposed at the end of the paper.

References

[1] http://www.scilab.org/ to have more information on Scilab

[2] The Gmsh can be freely downloaded from: http://www.geuz.org/gmsh/

[3] O. C Zienkiewicz, R. L. Taylor, The Finite Element Method: Basic Concepts and Linear Applications (1989) McGraw Hill.

[4] M. R. Gosz, Finite Element Method. Applications in Solids, Structures and Heat Transfer (2006) Francis &Taylor.

[5] Y. W. Kwon, H. Bang, The Finite Element Method using Matlab, (2006) CRC, 2nd edition

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EnginSoft interviews Alessandro Franzoni, CEO of Superjet International

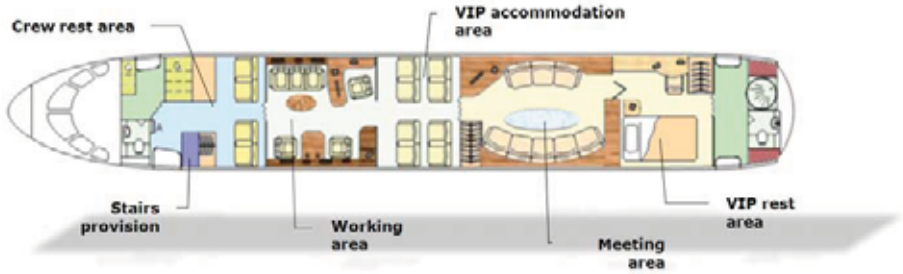
Superjet International was established in 2007 as a powerful "joint-venture" between Alenia Aeronautica, a West European organization, and Sukhoi Holding, a Russian-based company. From the beginning, the partnership has been based on a well-structured joint initiative in the aeronautic field.
The primary objective is to market the new Sukhoi Superjet 100, a shortrange aircraft (100 seats). Today, its 4 prototypes are actually in the development and certification stage; the aircraft is expected to be in regular operation in the second half of 2010.
Superjet International is based at Venice's Marco Polo International Airport.
Roberto Gonella of EnginSoft had the pleasure to interview Alessandro Franzoni, a veteran of 22 years in Alenia Aeronautica. Since its foundation, Mr Franzoni has been the CEO of Superjet International. Prior to that, he supported Alenia Aeronautica where he hold the position of Chief Technical Officer for 3 years.

1. Which is the role (or should be the role) of innovation in the industrial and entrepreneurial world?
Innovation has a primary role in all industrial and non-industrial sectors: the most successful companies are always the ones whose first ambition is to innovate their product. This can also be clearly observed in the aeronautical sector. It is extremely important to define the sphere of innovation in our typical application areas: for example, it is not sufficient to base our technology innovation on new product manufacturing; instead, it is essential to include all development, production, support and management processes in our innovation endeavors.
The historical actors in the aeronautical fields (the client and its supplier) are emerging from their ancient and well-structured relationship to become new global companies, so-called global extended enterprises. This way, client, partnership and supplier are establishing a new "complete" company on a worldwide scale.
In our environment, guidelines for a new aircraft are changing, evolving with time. We would not succeed if we consider multi-disciplinary integration only in the single

EnginSoft intervista l'ing. Franzoni di Superjet International

SuperJet International nasce nel 2007 come risultato della prima collaborazione strutturale in campo aeronautico tra un'azienda occidentale, Alenia Aeronautica, ed una russa, Sukhoi Holding, nel campo dell'aviazione commerciale.
L'obiettivo è quello di commercializzare nel mondo occidentale, predisporre e realizzare le configurazioni Cliente e fornire supporto logistico globale al nuovo Sukhoi Superjet 100, velivolo regionale a getto da 100 posti di nuova generazione, attualmente in fase di prove di sviluppo e certificazione con i suoi 4 prototipi e atteso all'entrata in servizio entro il 2010.
La società è basata a Venezia.
L'ing. Alessandro Franzoni, 22 anni in Alenia Aeronautica, è dall'inizio di questa impresa l'Amministratore Delegato di SuperJet International, dopo aver ricoperto per 3 anni il ruolo di Chief Technical Officer in Alenia Aeronautica.

1. Che spazio ha (e dovrebbe avere) l'innovazione nel mondo industriale/impresariale?
È ormai riconosciuto in tutti i settori che l'innovazione ha un ruolo primario: le aziende che dimostrano la maggior capacità di innovare risultano quelle di maggior successo. Questo vale anche nel settore aeronautico. Piuttosto è interessante definire l'ambito dell'innovazione nel campo delle nostre attività: è certamente riduttivo vedere l'innovazione limitata alle tecnologie per la realizzazione di nuovi prodotti, occorre considerare anche l'insieme dei processi, sia quelli di sviluppo, produzione e supporto ma anche quelli di management. La struttura delle collaborazioni in campo aeronautico sta rapidamente evolvendo da rapporti Cliente/Fornitore o Prime/Sub a quella delle cosiddette



company. It clearly needs the new global company to operate 24 hours a day without interruption using the most advanced simulation systems for our product development and manufacturing.
The new dynamic rules between the client and his provider also require a high level management relationship. In my business and logistics support groups, "Power by the Hour" delivers daily positive results based on flexibility and cost solutions. We have achieved our goals by using the "new deal" for engine providers.
The positive impact of innovation and technology on consumer products, can be witnessed also in our daily lives; for example: we can buy goods on-line during a flight and pick them up upon our arrival at the destination airport.
A clear example of the positive impact of different technologies in the aeronautical field, is the capability of synthesizing more functionalities into a single structure. The wide use of advanced nanomaterial technologies will allow to increase performances, reduce weight and to lengthen the life of our future aircrafts; in other words, nanotechnology is an excellent example of cross-sectoral activities in industry.
Finally, I always encourage my co-workers to be more curious about the events in sectors close to ours. In my opinion the most innovative contents for the future of our industry will probably come from non-aeronautical sectors.

2. Which are the strategies for innovation and what pushes them forward?

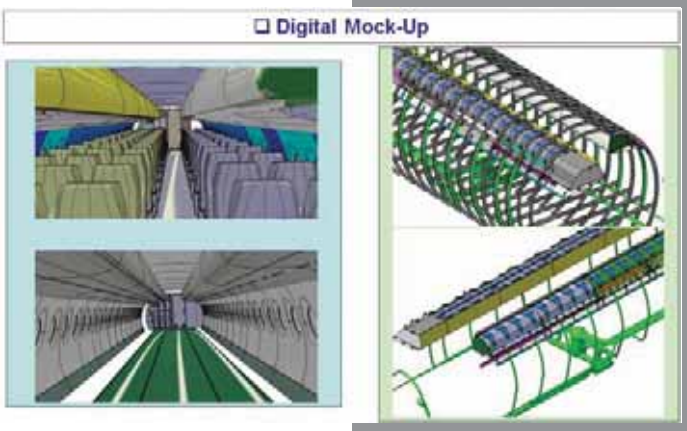
Innovation is pushed forward by growing demands, we are forced to innovate our product while a series of boundary conditions has to be met.
First of all, business knowledge is essential, and we have to be able to predict changes in our business.
Our business sensitivity should be activated by various sensors: our client, its attitude and demands. Quite often though, the client is inclined to be conservative, at least until he/she unfortunately faces challenging technical problems. Then, their policy naturally is to hand over the problem to their supplier.
I strongly believe that we have to learn our lessons, exchange and share our knowledge. We have to be curious, versatile, look at other sectors, other businesses: somebody once said: to innovate means to copy in a better way… but first of all, innovation should be about motivation. People, their enthusiasm, their believes, their excitement about

"Global Extended Enterprises", cioè aziende "estese", che includono Clienti, partners e fornitori su scala mondiale. Su questi temi altri settori industriali ci hanno preceduto, basti pensare all'automotive. Ma è già cambiato il modo di progettare i nuovi velivoli. In questo senso oggi parlare di integrazione multidisciplinare non più e non solo all'interno della singola azienda ma nell'azienda globale estesa, utilizzando i più avanzati sistemi di simulazione real time, consente veramente di operare praticamente senza soluzione di continuità nelle 24 ore.
L'integrazione tra fornitore e cliente finale ha raggiunto livelli molto alti ed oggi, parlando nello specifico del settore di cui mi occupo, gli aerei regionali, la nostra performance è determinante per i risultati dei nostri Clienti, le compagnie aeree, ed anche il modo con cui ci si rapporta è cambiato moltissimo: una delle innovazioni principali nella struttura del business, il supporto logistico "Power by the Hour", fu il risultato di un problema di costi e flessibilità operativa delle aerolinee interpretato in chiave innovativa da un fornitore di motori…
Per quanto riguarda i prodotti si registra sempre di più una contaminazione tra tecnologie ed innovazioni provenienti da altri settori (pensiamo come le più avanzate tecnologie di comunicazione hanno cambiato e stanno cambiando non solo le prestazioni degli aerei commerciali ma anche la fruizione del mezzo aereo che ognuno di noi sperimenta giornalmente, con la possibilità ormai disponibile di fare tranquillamente acquisti on line durante il volo e magari trovare la merce acquistata all'aeroporto di arrivo…).
Del resto le tecnologie chiave del futuro sono quelle che consentiranno di integrare più funzionalità all'interno di singole strutture o sistemi, le strutture funzionalizzate attraverso l'utilizzo di nano materiali consentiranno di aumentare le prestazioni, ridurre i pesi e aumentare la vita degli aerei futuri. E le nanotecnologie sono un esempio eccellente di cross-industry.
Quello che raccomando sempre a chi lavora con me è di avere curiosità per quello che avviene in settori contigui al nostro, il maggior contenuto di innovazione per il futuro della nostra industria verrà probabilmente da settori non aeronautici.

2. Quali sono le strategie per essere innovativi e quali valutazioni spingono all'innovazione?

La spinta all'innovazione viene dalla necessità di crescere. Si è costretti ad innovare. Per saper innovare occorrono molte condizioni. Una condizione essenziale è conoscere il proprio business ma soprattutto anticiparne i cambiamenti. Per questo occorre avere molti sensori: i principali sono i Clienti, ma spesso i Clienti tendono ad essere conservatori, almeno fino a quando non incontrano grossi problemi che allora cercano di ribaltare sui fornitori! Occorre saper imparare, occorre gestire e condividere la conoscenza.

their work and future are essential for innovation: the manager should be able to set the conditions for a creative working environment.
Remember that innovation is quite different from technology: you can be a great innovator without developing any technology, but predicting or even creating general requirements or expectations, like Apple and other providers teach us.



3. Which are the roles of CAE and Virtual Prototyping?
These are strong instruments with two different aims: first, to make our daily work easier and, on the other hand, to stimulate our technical ideas and understanding.
Time to market and cost reductions are the main reasons for applying CAE and VP in our sector. Multidisciplinary integration and speed development capabilities deliver excellent responses for economic optimization because many trade-off configurations are able to reduce time and cost.
In other words, it is better to approach the global technical problem in a parallel way rather than in a sequential one and, if you work in a multidisciplinary way, the technical philosophy is right.

4. How did the user's demand change in the last year?
Now, the user's demand is to realize multidisciplinary integration and often, to work in real time.

5. What are the benefits that you have experienced and how has your work changed in the design and production domains?
The most important factor is to cultivate our network and to organize collaborative design methodologies. The defense of company knowledge is gradually substituted by an attitude of developing and sharing the same know-how with each other. It really is a cultural jump which should be supported by effective tools, and these tools should be integrated for the handling of information: Product Life Cycle Management, and also for multidisciplinary integration and virtual prototyping.

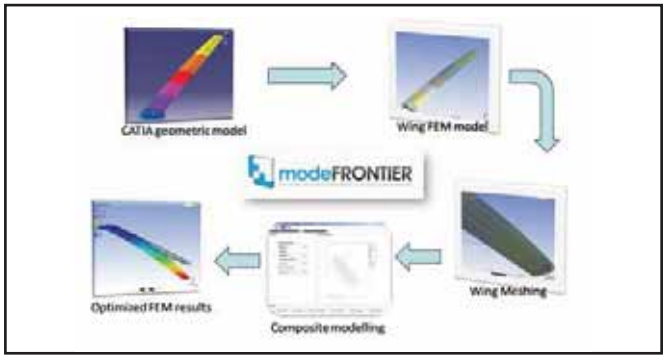
6. In what way has EnginSoft contributed to increase the value, the quality and the capabilities of your company?
I have always appreciated EnginSoft because of its capabilities to provide effective and convincing solutions; for example Multi-disciplinary Optimization Software - modeFRONTIER - developed by ESTECO EnginSoft Tecnologie per l'Ottimizzazione and it is widely used in aerospace companies.
Clearly, companies are looking for partners that are able to provide added value and not for providers that are only

Occorre avere curiosità e trasversalità, guardare altri settori, altri business: c'è chi dice che innovare significa copiare al meglio…
Ma l'innovazione va anzitutto stimolata. Le persone, il loro entusiasmo, il credere e la passione nel loro lavoro sono essenziali per l'innovazione: occorre perciò lavorare per creare le premesse per un ambiente creativo. E ricordiamoci che innovazione è diverso da tecnologia: si può essere grandi innovatori anche senza "inventare" tecnologie, ma anticipando o addirittura creando dei bisogni o delle aspettative, come insegnano Apple e alcuni altri…

3. Che ruolo ricoprono gli strumenti CAE e di prototipazione virtuale in tal senso?
Sono sia dei facilitatori che degli stimolatori.
Laddove la riduzione del time to market (attraverso il superamento di quella fase intermedia tra sviluppo e produzione che è la cosiddetta industrializzazione) e la riduzione dei costi di sviluppo rappresentano obiettivi primari nel nostro settore, tutto ciò che favorisce l'integrazione multidisciplinare e la capacità di sviluppare velocemente trade offs di configurazione riduce tempi e costi.
D'altra parte abituando e in qualche modo costringendo ad approcciare i fenomeni in modo multidisciplinare, "parallelo" e non "sequenziale", si migliorano le capacità di interazione e di ottimizzazione delle soluzioni e si migliora il prodotto.

4. Come sono cambiate le esigenze degli utilizzatori negli ultimi anni?
Il principale fattore di cambiamento sta nell'esigenza di realizzare una vera integrazione multidisciplinare e di operare spesso in real time.

5. Quali vantaggi ha rilevato nella sua esperienza professionale e come è cambiato il suo approccio alla progettazione/produzione?
Il cambiamento maggiore sta nell'aver riconosciuto che anche nelle attività di ricerca e sviluppo la forza sta nel network e nell'approccio collaborativo. La difesa e la protezio-



selling products. At the same time, a perfect knowledge of the recommended products and their abilities, as well as an understanding of the entire development and design cycles are fundamental. For this reason, EnginSoft is a valued partner because its experts have the experience to offer effective solutions for different problems. Often, the expertise of EnginSoft suits our expectations perfectly because it can be transferred and adjusted also to sectors close to ours.

7. In your opinion, what are the perspectives for computational codes in view of the future market challenges?

In my opinion, calculation codes will play an important role. I'm convinced that in the future, standardized solutions and multidisciplinary environments will be required and that in-house codes will only be necessary and applied in a handful of situations.

Given the expected development of nanotechnology in the future, its functionalities, and the narrow ties between chemical and physical requirements, I hope to have the support from a computational code which is able to follow a global design, all the way from material requirements to the final component design.

8. What are the projects that you plan to realize for which these tolls will be used?

Cost reduction, time to market and product optimization will be the primary objectives that we hope to reach with the support of CAE and VP tools. However, I also plan to increase our networking capability with the same technologies.

9. What are your expectations for technology developers and vendors who still strive for the right balance between competition and creativity?

I believe a creative person should not act as an anarchic inventor. We professionals are important parts of company processes. We have to have the capability to develop a different point of view based on our competencies and experiences, and to answer to unconventional problems, in other words: to solve problems and provide solutions!

ne del know how hanno lasciato, o stanno lasciando, il posto alla condivisione e allo sviluppo del know how. È un salto culturale enorme, e soprattutto deve essere sostenuto da strumenti efficaci ed integrati per la gestione delle informazione (Product Life Cycle Management), per l'integrazione multidisciplinare ed il Virtual Prototyping.

6. Qual è stato il contributo di EnginSoft e in che modo ha saputo valorizzare qualità, potenzialità e capacità della sua industria/impresa?

Quello che ho sempre apprezzato di EnginSoft è la capacità di fornire soluzioni, per esempio il software modeFRONTIER per l'ottimizzazione multi-discliplinare, sviluppato da ESTECO EnginSoft Tecnologie per l'Ottimizzazione, ampiamente utilizzato dalle aziende aeronautiche.

Oggi le aziende cercano partners che possano portare valore aggiunto, non fornitori che vendano prodotti.

Questo d'altro canto impone una perfetta conoscenza dei prodotti offerti ma anche dei processi di progettazione e sviluppo del Cliente, per consentire di proporsi come solutori di un problema, spesso mutuando esperienze già fatte in ambiti e settori contigui.

7. Che prospettive intravede per i codici di calcolo in relazione alle sfide poste dal futuro?

Vedo una prospettiva importante, senza dubbio, pensando anche al fatto che sempre più dovremo ricorrere a soluzioni standardizzate ed integrate in ambienti di simulazione multidisciplinare, e solo per casi "ai limiti" ricorrere a codici proprietari.

Vedo anche, con il futuro delle nanotecnologie e delle strutture funzionalizzate, un legame sempre più stretto tra la chimica e la fisica su tutta la filiera, dalla progettazione del materiale alla progettazione del componente.

8. Quali progetti, obiettivi e nuovi traguardi intende perseguire grazie all'uso di questi strumenti?

Oltre ai consueti obiettivi di riduzione dei tempi di sviluppo, dei costi e alla ottimizzazione del prodotto penso che questi strumenti aumenteranno sempre di più la capacità di networking e di collaborazione. Questo è già oggi ma lo sarà sempre più in futuro un fattore chiave di successo.

9. E cosa si auspica per il mondo della tecnologia scientifica alla continua ricerca di una dimensione tra creatività e competitività?

Le due dimensioni non solo non competono ma sono estremamente interconnesse.

Competitività vuol sempre più dire capacità di innovare e di valorizzare l'innovazione. E l'innovazione si sviluppa al meglio in ambienti creativi. Il creativo non è il genialoide anarchico, è il professionista inserito nel processo aziendale che con la sua capacità di avere un punto di vista differente, basato sulla sua competenza ed esperienza ma anche sulla sua abilità di dare risposte non convenzionali, risolve i problemi e fornisce soluzioni.

Il Progetto VERDI: Virtual Engineering for Robust Manufacturing with Design Integration

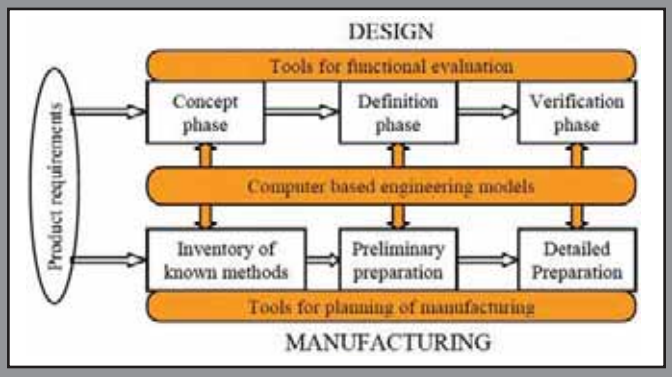


Figura 1 – Virtual – Design – Manufacturing Design Chain.

La sigla VERDI è l'acronimo di Virtual Engineering for Robust Manufacturing with Design Integration ed è il nome di uno progetto STREP co-finanziato dalla Comunità Europea che si è da poco concluso dopo 4 anni di lavoro. Il progetto è stato finalizzato alla creazione e validazione di una metodologia affidabile per la simulazione numerica della Design Chain che governa la progettazione di componenti aeronautici.

La progettazione di tali componenti ha la prerogativa di coinvolgere un elevato numero di aziende con competenze e utilizzazione di strumenti, sia software che hardware eterogenei che rendono il flusso delle attività particolarmente complesso.

Il progetto ha inoltre sviluppato protocolli per validare in modo verticale ogni fase della Design Chain, validando ogni lavorazione virtuale con risultati ricavati da test sperimentali (es. caratterizzazione dei materiali).

Dal punto di vista della simulazione numerica, particolare importanza è stata ricoperta dalla capacità di trasmettere i risultati tra software diversi, che possono utilizzare mesh anche molto dissimili, senza perdere dati significativi, sia tra una fase della Design Chain e la successiva, sia, all'interno di una stessa fase, tra simulazioni effettuate su scale fisiche diverse.

Oltre a EnginSoft, il progetto ha coinvolto sei tra i maggiori produttori europei di motori aeronautici e componentistica (Volvo Aero, Rolls-royce, MTU Aeroengines, Avio, Techspace Aero, ITP), sei Università europee (Aachen University of Technology, Karlsruhe, Lulea University of Technology, Trollhattan/Uddevalla University, Notthingam ed il Politecnico di Torino), tre centri di ricerca (CIMNE, CENEARO, AIC).

Figura 2 - Processo di lavorazione e simulazione del componente in Nickel.

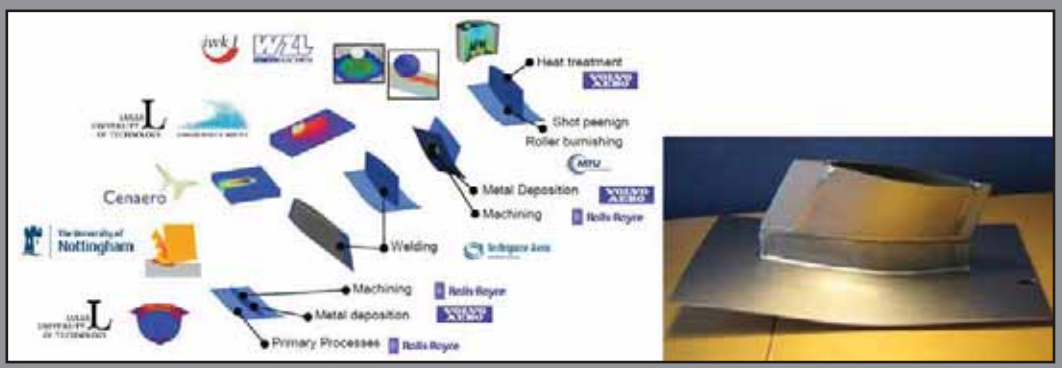


Figura 3 - Processo di lavorazione e simulazione del componente in Titanio.

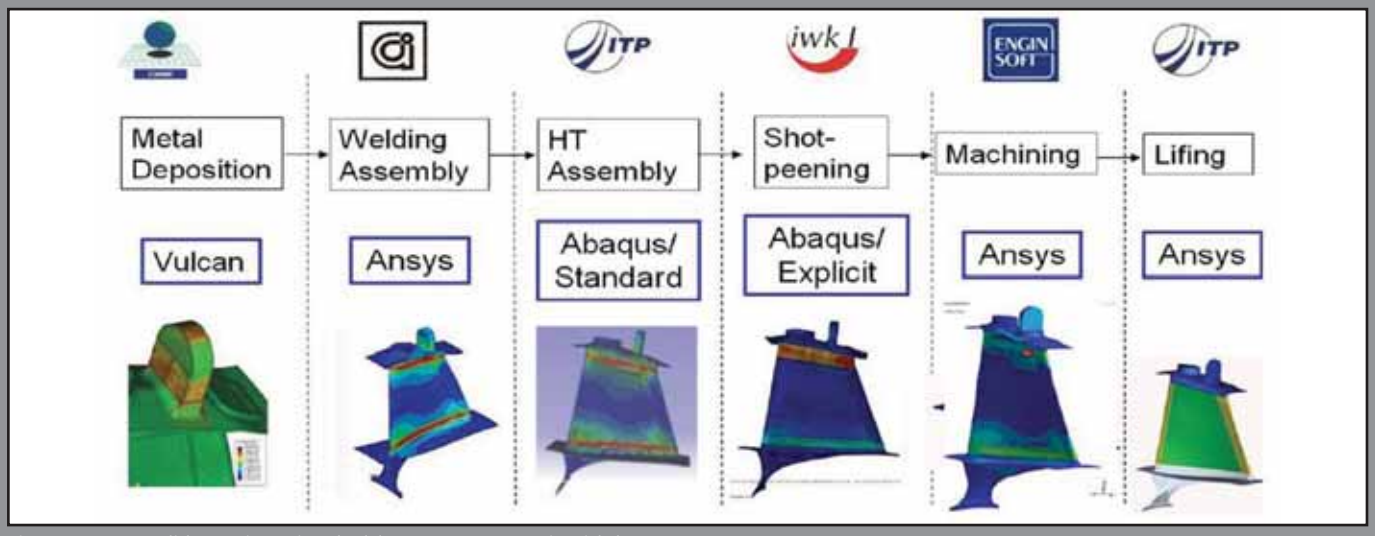


Figura 4 - Catena di lavorazione virtuale del sotto componente in Nickel.

Descrizione del lavoro svolto

I partner sono stati divisi in due gruppi che hanno sviluppato, in modo indipendente, due sotto componenti sia dal punto di vista numerico che nella produzione del prototipo reale: una struttura della parte posteriore del motore realizzata in Inconel 718 (lega di Nickel) e una della parte frontale realizzata in Ti-6V-4Al (lega di Titanio).

Ogni partner ha utilizzato, come anticipato, un differente software di simulazione, sia per descrivere le diverse fisiche coinvolte, che per descrivere la scala del problema (micro scala o macro scala). I dati tra i vari partner sono stati scambiati mediante software sviluppati all'interno del progetto da diversi partern.

Nella figura 4 è stato riportato, come esempio, la Design Chain virtuale relativa la componente in Nickel.

I principali argomenti sviluppati durante il progetto, oltre a quello relativo alla mappatura dei risultati, hanno riguardato le simulazioni dei processi di deposizione di materiale (metal deposistion), pallinatura (shot peening), trattamenti termici (heat treatment), saldatura (welding), pelo rullatura (roller burnishing) e lavorazioni per asportazione di truciolo (machining).

In particolare, ANSYS è stato utilizzato in alcune fasi cruciali della catena, quali la simulazione della saldatura, delle lavorazioni per asportazioni di truciolo e della valutazione della vita a fatica del componente, sfruttandone a pieno le caratteristiche multi fisiche legate alle analisi termo-strutturali in accoppiamento forte.

Contributo di EnginSoft

EnginSoft si è occupata della simulazione del processo macroscopico di lavorazione per asportazione di truciolo del componente in Nickel.

La simulazione ha tenuto conto di due effetti che si sviluppano su scale differenti:

1. Un effetto macroscopico legato all'asportazione di una parte di materiale che va ad alterare lo stato di sforzo auto-equilibrato derivante dalla catena di lavorazione che precede la fresatura.
2. Un effetto microscopico dovuto invece alle distorsioni derivanti dagli effetti termo-meccanici che si sviluppano in un volume molto limitato sotto la superficie esterna del pezzo durante e dopo il passaggio dell'utensile.

Il primo effetto è stato simulato in ANSYS Workbench 11.0 mediante l'utilizzo della proprietà degli elementi di ANSYS di essere attivati (Birth) e disattivati (Death) durante una simulazione.

Figura 5 – Fresatura sul pezzo reale.

Come mostrato in Figura 6, lo stato di sollecitazione auto-equilibrato mappato dalla simulazione di pallinatura, è stato alterato disattivando gli elementi che devono essere fresati. Il nuovo stato di sforzo, non auto equilibrato ha generato una nuova configurazione deformata del sotto componente nella nuova configurazione di equilibrio.

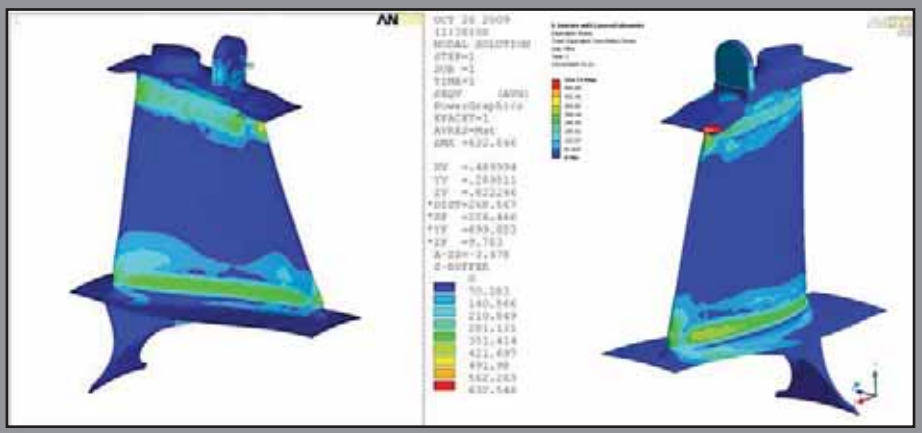


Figura 6 - Effetto della disattivazione degli elementi.

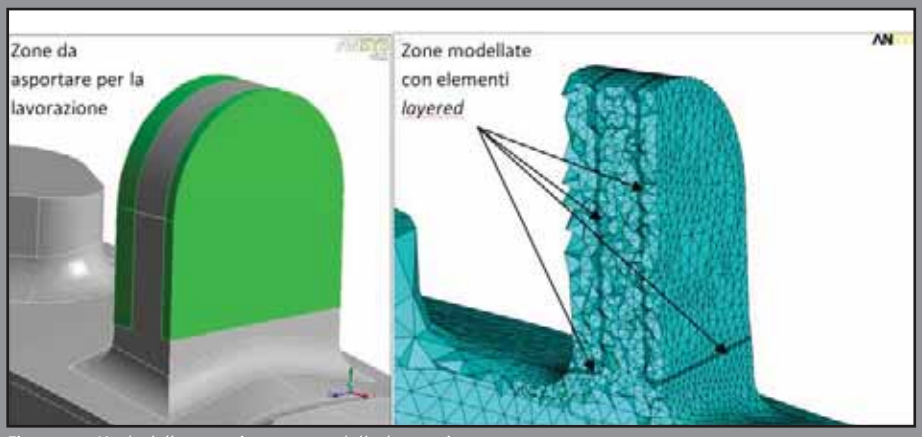


Figura 7 - Mesh della zona interessata dalla lavorazione.

Il secondo effetto è stato invece simulato sovrapponendo, allo stato di sforzo risultante dall'equilibrio dopo la fase di disattivazione degli elementi, una distribuzione di sforzi solo negli elementi di superficie, per una profondità valutata da simulazioni a livello micro scala (DEFORM) o prove sperimentali (Hole drilling, ...).
Per cogliere il gradiente di sforzo sotto pelle misurato a livello micro-scala, servirebbero molti elementi solidi in uno spessore molto piccolo con il risultato di ottenere una mesh molto fitta nella zona superficiale, con un incremento esponenziale dei tempi di calcolo e le dimensioni del modello, caratteristiche poco attraenti in una fase di progettazione in ambito industriale, dove dovranno essere sviluppate molto analisi per ottimizzare il processo di lavorazione.
Gli elementi solidi con formulazione Layered di ANSYS - normalmente utilizzati per la simulazione di materiali compositi - uniti alla generazione della mesh sottopelle mediante il metodo di Inflation - punto di forza del generatore di mesh di ANSYS Workbench - hanno permesso di generare un modello con una mesh di dimensioni accettabili, utilizzando un unico elemento nello spessore interessato dal gradiente di sforzo generato dagli effetti di microscala. La facilità di creazione della mesh e la sua piccola taglia rendono questa metodologia molto appetita nelle fasi di progettazione di un qualsiasi ciclo industriale. La Figura 7 mostra la mesh utilizzata per la simulazione dell'aletta di sollevamento (handling lug), oggetto di indagine per la lavorazione di fresatura. La Figura 8 mostra le distorsioni risultanti sull'aletta di sollevamento del sottocomponente simulato.
La distribuzione di sforzo e le distorsioni del modello sono state poi utilizzate da AICIA per la valutazione della vita a fatica del pezzo. In questa ottica la possibilità di passare informazioni di dettaglio sullo stato di sforzo sotto pelle dovuto alla fresatura, con un modello di facile gestione permette analisi a fatica in ANSYS molto dettagliate con tempi di calcolo relativamente brevi.
EnginSoft ha inoltre messo a disposizione di alcuni partner del progetto le competenze ingegneristiche sviluppate negli anni in campo CAE, in particolare per la creazione di modelli matematici (mesh) particolarmente complessi e procedure per le analisi di saldatura e fatica in ANSYS.

Conclusioni

Il progetto VERDI ha dimostrato con successo come sia possibile simulare il ciclo di lavorazione completo virtuale di un componente aeronautico, tenendo conto di ben 8 differenti processi di lavorazione e diversi materiali. Superando i problemi relativi all'utilizzo di software differenti con mesh molto dissimili tra loro, sviluppate da ingegneri con diverse competenze nei vari campi.

Il processo è stato completamente validato da misure sperimentali attuate su un prototipo reale, sviluppando tutta una serie di modalità di scambio di dati dal mondo sperimentale a quello virtuale e viceversa.
ANSYS si è dimostrato uno strumento molto versatile nell'interfacciamento con gli altri software e pronto ad affrontare qualsiasi tipo di simulazione di lavorazioni meccaniche richieste nella progettazione di componenti aeronautici.

Michele Camposaragna, Sergio Sarti
EnginSoft

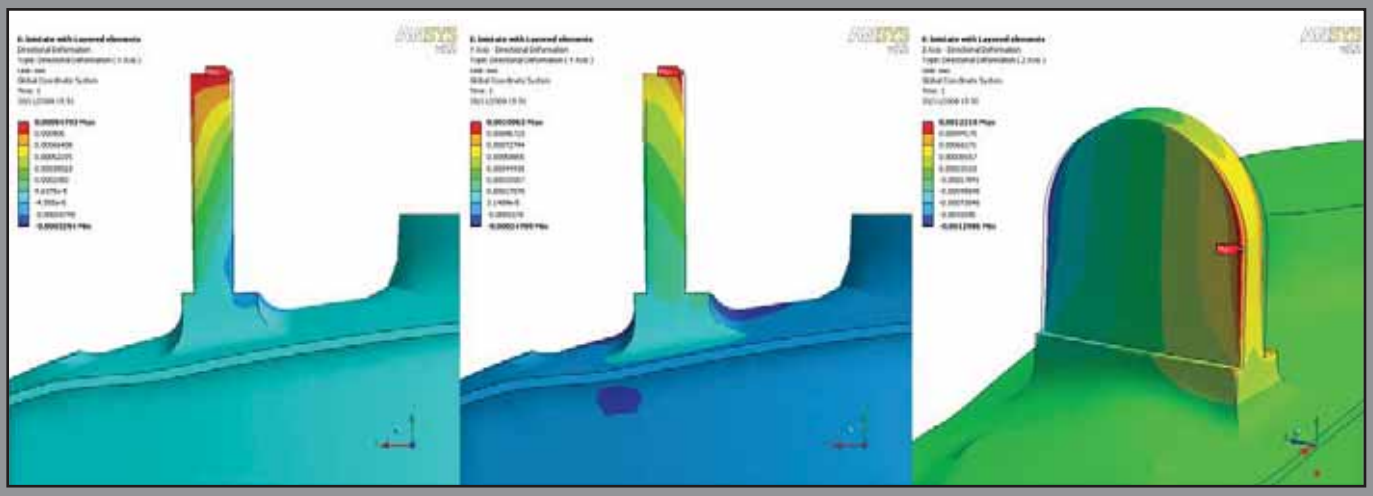


Figura 8 – Distorsione risultante sull'aletta di sollevamento (handling lug).

The Future of Engineering Analysis: Pervasive Realistic Simulation

Second Generation Simulation

Organisations such as NAFEMS and EnginSoft have been in existence for over 25 years, with FEA having been in widespread use for even longer. We are now seeing a generation of engineers that have spent their whole working lives immersed in FEA and CFD approach retirement- yet some people say that the exploitation of such methods is still very much in its infancy. Whilst many great things have been achieved thanks to simulation, and the techniques have evolved almost beyond recognition, we still expect that future generations will see "orders of magnitude" increases in the exploitation of simulation technology.

Today, simulation has the potential to be used as a "strategic weapon" by companies who have the courage to build their engineering processes around CAE, and not vice versa. The future vision is one of Pervasive Realistic Simulation. What does this mean? We say that it means all engineers having easy

Tim Morris, Chief Executive of NAFEMS

David Quinn, Head of Marketing

access to simulation results, which they can trust and have confidence in. It means not having to worry about mesh type, adequate element density, appropriate constitutive laws, convergence criteria or the like: all this will have been encapsulated in clever software and processes that have been developed, tried and tested. We are still some way from this happy state of affairs. As we travel on this long and rewarding journey, what sights and milestones can we expect to see next? Let's consider Technology, Processes and People.

Technology: a Multitude of Possibilities

As engineers, we all love new technology. I am sure that many of us have been drawn to careers in the world of simulation because of the opportunities that it offers to apply the latest in computing capability to create new products. Seeing the new technology unfold and emerge is an exciting part of that. And we can be certain that there are many, many new technological advances around the corner for FEA and CFD. These might include (but certainly won't be limited to):

Multi-scale modelling – as we move towards the year 2020, we can expect to see multi-scale modelling take off, particularly in the area of materials modelling

Widespread multiphysics modelling – the capabilities that are available have increased dramatically over the past 10 years, but the technology and its exploitation are still maturing, with "islands of excellence". Much needs to be done in terms of spreading the word about what is and isn't achievable at the moment, and which are the best methods to employ for particular applications. HPC developments are acting as an enabler in this sector to continually advance the boundaries of what is possible.

Visualisation and Post-processing – we can surely expect to see yet more in the way of 'Hollywood style' visualisation, exploiting the technologies that are being vigorously developed by the lucrative gaming industry.

Element formulations – some of us may be surprised to learn that there is still a way to go in terms of creating new elements: a notable example being the isogeometric analysis techniques being promoted by Tom Hughes and his team, offering the promise of "exact geometry" and seamless CAD interfacing.

Connections and Joints – a recent NAFEMS seminar on this topic (covering subjects such as riveted and bolted joints, spot welds, glued connections) resulted in a record turnout. Clearly even areas like this where methods have been evolving for several decades still contain significant challenges for practicing engineers.

Processes – the Key Enabler

In order to enjoy the true business benefits from the deployment of CAE techniques, senior management needs to embrace its

About Nafems

NAFEMS is an independent, not-for-profit, membership organisation that is focused on driving forwards the effective use of FEA, CFD and related methods. The organisation traces its roots back to the early 1980's, and was formed when FEA was starting to gain widespread popularity within the engineering community. Today NAFEMS has branches in countries across Europe, the USA and in India. It has a vibrant and growing membership of over 950 member organisations, which cover almost every industry sector. In this article Tim Morris, Chief Executive of NAFEMS, and David Quinn, Head of Marketing, present some views about the current trends in the use of simulation, and how things might change in the years that lie ahead. They point out that these are not the views of NAFEMS itself, but those of its members, gleaned from presentations made at recent events and material being gathered in preparation for their upcoming Virtual Conference in September, which will be setting out a "2020 Vision of Engineering Analysis and Simulation".

About Nafems - www.nafems.org

NAFEMS World Congress 2009 - Crete, Greece, June 16th-19th, 2009

capabilities and shape the business processes around what it has to offer. This, in turn, means that the simulation processes must be utterly dependable and able to play their part. Some of the things that could help to support this are:

Greater deployment of Simulation Data Management. This by itself almost enforces a degree of discipline and a capturing of the relevant processes. In time, we might anticipate that this leads to the development of knowledge databases, and that these might be interactively managed.

Selecting a strategy for software integration. There are still many different FEA, CFD and MBS packages to choose from. At the same time, the various mergers and acquisitions of vendor companies have resulted in some of the major vendors putting forward a unified system. Companies need to decide whether to opt for the potential benefits of ease of use that such a system can offer, or to pursue a policy of integrating best-in-class offerings from a variety of providers.

Reports on simulation precision/quality. As software becomes more intelligent and computing powers increase, it is to be anticipated that more will emerge in terms of automated reports to give some form of indication of the amount of confidence that we can have in a particular analysis.

Optimization, stochastics and non-deterministic approaches. Technologies in these areas are now well established, and many larger industrial companies have a track record of successful deployment.

People

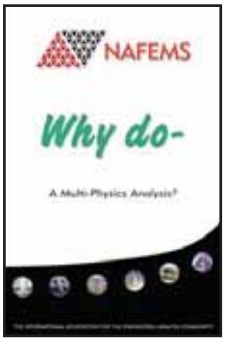
NAFEMS is aware of a large body of evidence (admittedly much of it is anecdotal) that the rate of growth in the use of simulation is being limited by the lack of availability of suitably trained and experienced people to exploit the existing technology. Education and training is the answer to this, and is a major focus for NAFEMS. We are tackling this on a number of fronts, including:

Utilising new training methods. Our e-learning programme, launched just over 12 months ago, has been hugely successful. By allowing trainees from around the globe to have live access to a world-class instructor, the reach and influence of NAFEMS has been extended immensely.

Training for new/advanced technologies. Training is required to ensure that engineers can take advantage of new technologies such as Multi-Physics and Stochastics. NAFEMS is actively developing Best Practice guidance documents for such areas.

Training design engineers. To fulfil the increasing demand for engineers who can perform simulation, and in order to move towards the vision of pervasive realistic simulation, it is essential that we educate designers and design engineers. We need to equip them with the appropriate skills to make effective and appropriate use of FEA and CFD.

Skills management. NAFEMS is working towards setting out the various skills (or "learning outcomes") that are required in order to carry out different types of analysis. This will be accompanied by pointers towards specific training courses, literature or other ways in which these skills could be acquired.



Above all, it is essential that industry is able to supply an army of suitably qualified and experienced people who are able to embrace the technology, enact the processes, and empower their management to truly deploy the strategic weapon of engineering simulation.

For more information, please contact: info@nafems.org

EnginSoft and NAFEMS – Fruitful relations over the years

EnginSoft has supported NAFEMS in Italy since the early days of the association in 1983, a time when engineering analysis and simulation were applied by a relatively small group of forward-thinking visionary users.

In collaboration with NAFEMS, EnginSoft developed, over the years, a variety of projects. The majority of these were focused on education and best practices and co-funded by the European Commission. Together with NAFEMS, EnginSoft also supported and contributed to NOEs Networks of Excellence, and other European initiatives.

Today, EnginSoft is a Global Corporate Member of NAFEMS with more than 10 EnginSoft offices and partner offices worldwide collaborating with the association.

We are proud supporters of NAFEMS as we share the association's vision to foster the effective use of engineering simulation methods in industry, research and education.

This is why we have asked Tim Morris and David Quinn to present NAFEMS and their visions for the future of CAE and VP in the EnginSoft Newsletter.

We would like to inform our readers that this introductory article will be followed by a more comprehensive one in the Fall Edition 2010. Moreover, NAFEMS is the official patron of the EnginSoft International Conference 2010. Conference visitors have the opportunity to meet NAFEMS in the exhibition and to discuss the future of computer modelling and simulation methods with the only worldwide independent association dedicated to this technology!

Stefano Odorizzi, General Manager EnginSoft

AperioTec and modeFRONTIER collaborate with METCA

AperioTec is collaborating with Epsilon Euskadi within the Master of Technical Specialization in Racing Industry (METCA) which is the result of an ongoing collaboration between EPSILON EUSKADI and Mondragon University. Epsilon Euskadi is a competition racing car team, currently competing in the World Series, Formula Renault 3.5 and Formula Renault 2.0 categories and in the LMP1, Le Mans Series endurance racing. Due to their commitment to education this pioneering Masters programme has become an international benchmark, with 32 students from around the world participating in 2010. The ambitious and unique combination of theory and practical work in METCA offers an excellent opportunity to educate future generations of engineers capable of attaining the highest level and the ability to perform at their best in the world of motor racing, and other industries where technology and innovation are the key drivers. The aim of the course, of 1700 hours duration over 11 months, is to offer a multidisciplinary education to students to broaden their knowledge in disciplines such as aerodynamics, vehicle dynamics, engine-gearbox (motor, gearbox and transmission), calculation and simulation, CAD, programming, engineering and team track management.

This postgraduate master course is unique in the world not only because of the quality and the theoretical subjects lectured, but also for the practical work that the students carry out throughout the year and the unparalleled facilities available at Epsilon.
"Complementing the theory, every weekend that we attend race meetings of the World Series in the Renault categories, we have groups of students coming with us as part of the team. When they get back to the school the students have to complete a report with everything they saw and they learnt" explains Mr. Sergio Rinland, Engineering Director at Epsilon Euskadi.

Students doing practical circuit trials.

Included in the practical training are the trials developed with the Le Mans prototype EE LMP1, at the 50% wind tunnel that Epsilon Euskadi has within their facilities. This impressive wind tunnel can be used to test 60% F1 scaled models, reproducing the same conditions of a car running at 180 kph, thanks to its rolling belt that cycles at the same speed as the wind flows.

Students doing practical trials with a racing car.

The EE LMP1 prototype is in continuous development in all the aspects: aerodynamics, engine-gearbox, suspension, etc. Based on the technical rules dictated by the ACO ("L'Automobile Club de l'Ouest"), the shape of the racing car evolves annually. "With the help and guidance of our engineers at Epsilon Euskadi, the students get to design the aerodynamic components in CAD that, after the manufacturing process, will be tested in the model. In this way we get to show the students the complete development process of a racing car, from the concept to reality."

Moreover, inside the Epsilon Euskadi workshop the students test real set-ups of a racing car, and learn what a torsion test is. Using the racks of computers that the engineers bring to the race track, the students also practice using data acquisition software, such as MOTEC i2 Pro, Pi Toolbox or

Gino Duffett, Director de AperioTec, with the Le Mans series and Le Mans 24 hours prototype car.

Magneti Marelli Wintax 3, analyzing examples of real data and real problems that they could face in the real racing world.

To support the quality of the lectures and the practical work, Epsilon Euskadi has prepared one of the best classrooms in Europe, if not from all over the world. These classrooms have implemented some of the most interesting solutions for the new educational age and have made Epsilon become the indisputable leader in Motorsport Education.

The workstation that each student has for his/her own use during the course duration is a dual quad-core DELL R5400. These workstations have 16GB RAM memory and Nvidia Quadro Pro Fx graphic cards with 1.5GB memory. Each computer has two 20 inch screens with a total desktop resolution of 3060x1050. When these machines are connected in parallel, to compute for example a complex CFD simulation case, the computation capacity is 528GB. All this computational power is completely assigned for METCA use, always with the help and the assistance of the trainers and engineers of Epsilon Euskadi.

The whole system has been designed with the know-how of Epsilon, and all computers are physically set inside the Data Center that also contains all the network and data processing equipment. To achieve a good communication between the Data Center and the terminals situated in the classrooms, Epsilon has one of the most advanced and fast systems of telecommunications in the world. Based on the VSS Technology (Virtual Switching System) and with a commutation capacity in core of 10GB, the network operates at 1GB transmission per second between the workstations and the terminals.

The engineering applications that the students address during the course require capable software and these software tools will be learnt and applied to engineering applications. The software tools used, for example, are CATIA V5 for CAD, Abaqus for Finite Element Analysis, Star-CCM+ for Computational Fluid Dynamics, SIMPACK for kinematic and dynamic simulations and modeFRONTIER (APERIO Technology) to define the simulation and optimization processes using the different simulation and calculation tools.

Another peculiarity is the opaque chamber installed on the trainer's desk allowing components to be shown to the students with great definition and clarity. This system allows the display of component details that would otherwise be complicated to assess. The projection of these images is performed by two overhead projectors with 4000 lumen capacity.

The traditional blackboard is still present even though the classroom has a whiteboard system that allows the trainer to create graphics and annotations that students can see on their own screens.

Finally, a 3D printer or rapid prototyping machine is included. This impressive machine, courtesy of our technology partner Pixel Systems, allows three-dimensional parts to be "printed" based on the CAD design. The components that are designed and manufactured by the students using this machine are later trailed in the wind tunnel undertaken with the Epsilon Euskadi Le Mans model.

Dr. Roberto Battiti, Reactive Search CTO meets with Cascade Technologies Inc, the new EnginSoft Joint Venture in the US

Palo Alto, California – April, 2010

Reactive Search and EnginSoft at Stanford University – Prof. Roberto Battiti, CTO of Reactive Search, met Prof. Parviz Moin and Prof. Gianluca Iaccarino.
Roberto Battiti spent three days in California to support the strategic partnership and joint investments of EnginSoft and Cascade Technologies Inc. in the North American market. The objective of the visit was to present and promote EnginSoft's latest initiative in the United States.

During his visit at Stanford University, Roberto Battiti met with top notch CFD experts to brainstorm about new possible initiatives. Organized by the kind and highly experienced Professor Parviz Moin, founder of Cascade Technologies Inc., and the Center for Turbulence Research at Stanford and Ames, and attended by Prof. Gianluca Iaccarino, Assistant Professor at Standford's Mechanical Engineering Dept., one of the meetings was particularly interesting and fun. It brought together a great cross section of data mining, interactive visualization, and the latest CFD technologies.

Several opportunities for collaboration could be identified. Grapheur, the novel data mining and interactive visualization tool by Reactive Search (http://grapheur.com/), could be adopted in the CFD simulation and design process cycle of complex turbulent systems carried out by the Cascade Technologies team. The ability to navigate the solution space will be an ace in the hole for Cascade defining relationships among data characterized by extreme uncertainty in turbulent flow conditions.
The experts shared their visions for the future of engineering design in industry which they see as a combination of simulation, visualization and interaction with designers in effective learning loops. This is also the leitmotif of Reactive Search, the "Learning and Intelligent Optimization" Company (http://reactive-search.com/).

Dr. Battiti shared his ideas with all the colleagues he met during his short visit. He listened to their visions for future products, aiming at building stronger links between clients and the growing worldwide network of EnginSoft.

Dr. Battiti, stated, "I am pleased to report that Reactive Search is eager to start collaborations with EnginSoft's partners here in the US, (n.d.r. Cascade Technologies Inc.). Our joint initiatives in California are moving forward and there has been considerable interest for Grapheur, our data mining and interactive visualization tool".

These connections will serve as a platform on which we will build Reactive Search's future technologies and strategies. The visit was a real pleasure and a milestone for the EnginSoft road map to develop a worldwide network of partners and customers.

Prof. Parviz Moin is the founding director of the Center for Turbulence Research at Stanford and Ames.
Established in 1987 as a research consortium between NASA and Stanford, Center of Turbulence Research is devoted to fundamental studies of turbulent flows. Center of Turbulence Research is widely recognized as the international focal point for turbulence research, attracting diverse groups of researchers from engineering, mathematics and physics. Prof. Moin pioneered the use of direct and Large Eddy Simulation techniques for the study of turbulence physics, control and modelling concepts and has written widely on the structure of turbulent shear flows.
http://www.stanford.edu/group/fpc/cgi-bin/fpcwiki/People/ParvizMoin

Prof. Gianluca Iaccarino is an Assistant Professor at the Mechanical Engineering and Institute for Computational Mathematical Engineering at Stanford University with many years of experience in fluid dynamics, physical modeling and advanced computer simulations
http://www.stanford.edu/group/fpc/cgi-bin/fpcwiki/People/GianlucaIaccarino

Prof. Roberto Battiti is best known for his seminal work on Reactive Search Optimization (RSO), a methodology for integrating machine learning and neural network techniques into stochastic local search heuristics for solving complex optimization problems. His methods have been widely used by industry to solve challenging problems like knapsack, quadratic assignment, graph problems related to clustering and partitioning, vehicle routing and dispatching, power distribution, industrial production and delivery, telecommunications, industrial and architectural design, biology. He is a Fellow of the IEEE.
http://lion.disi.unitn.it/~battiti/

Stanford University is located between San Francisco and San Jose in the heart of Silicon Valley, it is noted for multidisciplinary research within its schools and departments, as well as its independent laboratories, centers and institutes. There are more than 4,500 externally sponsored projects throughout the university, with the total budget for sponsored projects at $1.060 billion during 2008-09, including the SLAC National Linear Laboratory (SLAC)
www.stanford.edu

Cascade Technologies Inc., located in Palo Alto, California, develops, markets, and supports state of the art "Computational Fluid Dynamics" analysis tools for engineers across industries. Our flagship product, CharLES, is a multiphase, combustive and reactive Large Eddy Simulation package geared towards accurate prediction of thermal, species, and flow field in complex geometries. We also accelerate technology transfer to our clients through the development of advanced computational modules specially designed for commercial CFD packages. Hence, cutting edge developments in computational engineering are provided to the end-users in their preferred environment.
http://www.turbulentflow.com

Reactive Search realizes new software and services for problem solving and business intelligence, data mining and visualization. Our competitive edge is based on a unique integration of automated learning and optimization, aimed at facilitating the interaction between domain experts, decision makers, and well-designed "reactive" software. The founders and collaborators have more than twenty years of experience and a track of successful real-world applications in various different areas.
http://reactive-search.com/

Aprilia Racing welcomes EnginSoft to the 2010 Superbike World championship in Monza

EnginSoft was honored to be the guest of its customer Aprilia Racing at the famous Superbike World Championship at the historic circuit of Monza near Milan.

The EnginSoft engineers were invited to visit the Noale Team Pit during preparations for the tests runs and even had the opportunity to meet Max Biaggi and Leon Camier, the team riders.

The highlight and most memorable moment was the meeting with Eng. Gigi Dall'Igna (pictured below), the legendary figure of Aprilia that every fan wants to meet! Even though Gigi Dall'Igna does not need any introduction: He is today the Technical Director of Aprilia Racing.

EnginSoft would like to thank Aprilia Racing for their hospitality and the availability of their technicians – Our congratulations for the excellent results of the Aprila Team and its promising visions and goals for the future.

From left to right: Nicola Baldecchi, Gigi Dall'Igna, Francesco Franchini

L'esperienza di un leader mondiale: Sapa

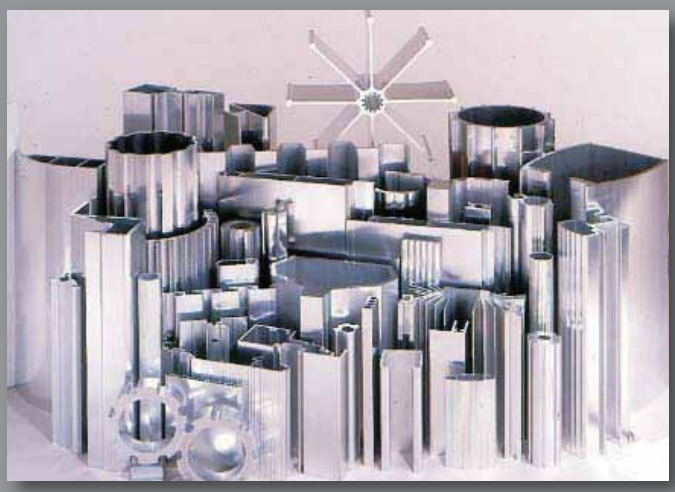
Leader mondiale tra le aziende che operano nel settore dell'alluminio, giorno dopo giorno Sapa consolida la sua presenza in Europa e nel mondo.
Tutto in Sapa presta particolare attenzione alle persone, Sapa cresce insieme alle persone che vi lavorano le quali, tutte orientate al cliente, sono sempre in grado di fornire le soluzioni a più alto valore aggiunto.
Nel settore dei sistemi per l'edilizia, Teknowindow, Teknowall e Sistema R sono i marchi di prodotti che si contraddistinguono sul mercato per l'affidabilità, la funzionalità, la qualità e la semplicità di lavorazione e montaggio.

Sapa offre un prodotto di qualità e garantito mettendo a disposizione dei propri "partners" tutte le conoscenze tecnologiche che sono il risultato di un investimento costante, in tutto il mondo, giorno dopo giorno, nella ricerca e sviluppo nel settore dell'alluminio.

Sapa, leader mondiale nell'estrusione dell'alluminio, servendo i mercati ed i clienti più disparati (IKEA, Audi, Bombardier, Solsonica, Marconi, Alenia, Beretta, Brembo...) è in grado di mutuare le diverse esperienze acquisite in un dato mercato negli altri, mettendo a disposizione dei propri clienti la tecnologia per sviluppare sempre nuove soluzioni ed applicazioni. Oltre a ciò, la gamma dei prodotti Sapa include profili commerciali standard come Flutzi, tubi e barrame,
Visitate il sito Sapa all'indirizzo:
www.sapagroup.com

L'utilizzo di ANSYS nella progettazione
L'utilizzo di ANSYS è previsto per analisi statiche su strutture realizzare con profilati in alluminio, come ad esempio serre, strutture frangisole fotovoltaiche, parcheggi, ecc.
ANSYS verrà utilizzato anche per analisi che prevedono non linearità di materiale o di contatto (pale eoliche, corpi pompa, componentistica meccanica, giunti bullonati);
Inoltre è previsto l'utilizzo di ANSYS sia per analisi meccaniche con modelli parametrici per ottimizzazione della geometria che per analisi termiche in regime stazionario su dissipatori di calore alettati.

Perché EnginSoft ed ANSYS in Sapa Group
"Da sempre la Sapa Group è favorevole e sposa le soluzioni software che ci possono fornire un valore aggiunto dal punto di vista della Ricerca e Sviluppo" - ha dichiarato l'Ing. Alberto Terenzi Sales Engineer della divisione italiana di Sapa – "e in questa ottica ANSYS ha dimostrato di avere tutte le caratteristiche necessarie per essere valutato positivamente... a valle di una serie di attente valuta-



zione tecniche abbiamo scelto ANSYS perché rappresenta a nostro avviso la migliore tecnologia attualmente presente sul mercato nel campo dei software di analisi strutturale" – ha continuato l'Ing. Terenzi – "inoltre la EnginSoft ha dato prova di essere un partner serio ed affidabile che ci ha aiutato nel migliore dei modi nella fase iniziale di utilizzo del software e nell'assistenza tecnica post-vendita".

EnginSoft partecipa al METEF 2010

La Fiera METEF, expo internazionale dedicata alla filiera produttiva dell'alluminio e dei metalli non ferrosi, è uno degli eventi di maggior rilievo e di richiamo internazionale che si occupa di tecniche e tecnologie innovative per l'industria fusoria.
La Fiera ha cadenza biennale e si è svolta al Centro Fiera di Montichiari dal 14 al 17 aprile 2010. L'edizione 2010 ha registrato 15.766 presenze (espositori esclusi).

Da alcune edizioni EnginSoft partecipa alla manifestazione con un proprio spazio espositivo e nelle ultime edizioni, inclusa quella dell'anno corrente, EnginSoft ha presenziato assieme al partner tedesco MAGMA, mostrando ai visitatori i vantaggi offerti dalle più avanzate tecniche di simulazione virtuale dei vari processi di pressocolata, nonché alcune storie di successo di alcune aziende italiane che hanno utilizzato il software MAGMAsoft.

Nell'occasione, in particolare, EnginSoft ha presentato MAGMA5, la nuova release di MAGMAsoft, che riguarda principalmente i processi di colata in SABBIA per leghe ferrose e non ferrose. MAGMA5 è basato sulle più recenti tecnologie software e permette di creare e gestire i modelli in modo più semplice, impostare la simulazione e visualizzare in maniera efficiente i risultati. Questo nuovo ambiente CAD permette l'integrazione con gli altri CAD commerciali, offrendo la possibilità di importare ed esportare file geometrici di vari formati: all'interfaccia STL si potrà affiancare il formato STEP per un periodo di prova di un anno senza costi aggiuntivi, mentre diventano disponibili come opzioni attivabili anche le interfacce CATIA V5 (solo per le piattaforme Windows) e Pro/E.

Oltre alla presenza con il proprio spazio espositivo EnginSoft è anche intervenuta in due importanti convegni organizzati il giorno venerdì 16 aprile:

- Difettologia dei pressocolati – presentazione del nuovo "Manuale di difettologia" organizzato da AIM – Associazione Italiana di Metallurgia, Centro Studi Pressocolata (con intervento di P. Parona – anche autore del manuale - dal titolo "Esempi di simulazione numerica di difetti").
- Progetto di ricerca NADIA - presentazione risultati del progetto europeo "New Automotive components Designed for a manufactured by Intelligent processing of light Alloys".

Interventi di:

- Ing. S. Odorizzi, "Il progetto NADIA: una breve panoramica".
- N. Gramegna, assieme a R. Molina (Teksid Aluminium), "Componenti motore progettati e realizzati utilizzando nuove leghe e nuovi processi".
- N. Gramegna, assieme a I. Loizaga (CIE Automotive), "La previsione del comportamento meccanico di getti presso colati in alluminio per il settore automotive".

EnginSoft riceve il Premio Innovazione Metef2010 nella categoria Prodotti, Componenti e Sistemi

Il primo giorno di apertura della fiera METEF-FOUNDEQ 2010, ossia il 14 aprile presso il Centro Fiera del Garda a Montichiari (BS), si è tenuta la cerimonia di premiazione dei vincitori della prima edizione del Premio Innovazione METEF 2010.

Il premio è stato assegnato alle aziende espositrici nelle diverse aree di interesse dell'edizione 2010 della fiera, privilegiando i progetti più in linea con le esigenze di risparmio energetico, eco-sostenibilità e salvaguardia del patrimonio ambientale. Tale riconoscimento internazionale ha premiato i migliori casi di innovazione per la produzione o lavorazione di prodotti o componenti in metallo ed è stato concepito per incentivare l'impiego di nuove applicazioni sui metalli, come per esempio nuove leghe o tecnologie che possono innovare tutta la filiera, dalle macchine ai prodotti o processi.

EnginSoft ha ricevuto il premio nella categoria Prodotti, Componenti e Sistemi, per un innovativo strumento tecnologico destinato alla progettazione avanzata dei pressocolati in leghe di alluminio. EnginSoft ha realizzato, avvalendosi anche di qualificate partnership sviluppate nel contesto di progetti di ricerca finanziati dall'Unione Europea, uno strumento software per la progettazione integrata di componenti pressocolati ad elevatissima affidabilità, destinati soprattutto al settore automotive. Il conferimento del Premio Innovazione per la categoria Prodotti, Componenti e Sistemi vuole valorizzare l'approccio pienamente ingegneristico che EnginSoft ha reso disponibile nel settore della pressocolata delle leghe di alluminio e di magnesio.

Per maggiori informazioni:
info@enginsoft.it

Manuale della difettologia nei getti pressocolati

Il "Manuale della difettologia nei getti pressocolati" è stato realizzato nell'ambito del Centro di Studio Pressocolata dell'AIM (Associazione Italiana di Metallurgia) da Elisabetta Gariboldi, Franco Bonollo e Piero Parona (EnginSoft) e presentato ufficialmente durante il METEF il 16 aprile presso il Centro Fiera del Garda a Montichiari.

Il "Manuale della difettologia" fornisce una classificazione dettagliata dei difetti che si possono verificare durante il processo di pressocolata e rappresenta uno strumento utile ed essenziale ai fini di una comprensione della genesi e delle problematiche riferite ai difetti stessi. Si ritiene che l'utilizzo integrato della classificazione e di questo strumento possa fornire un reale supporto alle fonderie nel miglioramento continuo della qualità e nella gestione dei rapporti coi clienti. Il manuale è scritto in due lingue, italiano e inglese: ciascuna pagina è infatti divisa in due parti, a sinistra il testo in italiano e a fronte la versione inglese. Ogni difetto è classificato in base ai medesimi parametri: in primo luogo viene codificato il difetto, in seguito gli aspetti morfologici più significativi, successivamente le possibilità di previsione e correzione mediante la simulazione numerica ed infine una serie di immagini macrografiche e a raggi X del difetto, e in alcuni casi, la visualizzazione del difetto ottenuta con la simulazione numerica.
Poiché la simulazione numerica è divenuta nel corso degli anni uno strumento sempre più affidabile per la messa a punto e l'ottimizzazione dei processi di fonderia, inclusa la pressocolata, è parso quindi essenziale introdurla come elemento di descrizione, visualizzazione e previsione dei difetti del processo di pressocolata. In questo manuale, tra i diversi software di simulazione di processo disponibili industrialmente, si è deciso di utilizzare il codice MAGMASOFT per l'analisi delle casistiche riportate. Coloro che utilizzano altri software di simulazione possono comunque avvalersi dei contenuti presenti in questo materiale, visti i criteri analoghi di classificazione. L'ulteriore integrazione tra il dettaglio sull'origine metallurgica dei difetti e la simulazione numerica può trovare concreta ed efficace applicazione in sede di ottimizzazione di processo.

Per ulteriori informazioni, rivolgersi alla Segreteria AIM (e-mail: info.aim@aimnet.it - tel. 02 7602 1132)

CONFERENZA NADIA
Leghe leggere per l'automotive: le sfide del Progetto NADIA

Il titolo del seminario rende merito agli obiettivi perseguiti nell'ambito del progetto NADIA e illustrati, nella loro forma più significativa, dai referenti industriali all'interno di un evento ospitato presso il centro congressi del METEF.
METEF rappresenta la cornice ideale per ospitare un tale evento in quanto si contraddistingue come punto di incontro delle eccellenze nel settore del manufacturing delle leghe non-ferrose e il loro utilizzo a livello industriale.

NADIA (New Automotive components Designed for and manufactured by Intelligent processing of light Alloys, Contract n. 026563-2) è un progetto finanziato dall'Unione Europea per un ammontare di 7.2 milioni di Euro, che ha coinvolto, nel periodo 2006-2010 27 partners industriali, centri di ricerca ed universitari, con particolare attenzione alle piccole medie imprese che costituiscono la maggioranza del tessuto produttivo europeo. NADIA è stato finalizzato alla valutazione del potenziale, nell'ambito dell'industria europea dei trasporti, delle leghe leggere per la realizzazione di componenti automotive basati sull'utilizzo di nano- e micro-tecnologie.

S. Odorizzi (ENGINSOFT), responsabile del coordinamento del progetto, ha avuto l'onore di introdurre gli aspetti chiave del progetto e la struttura, assai complessa, di un impegnativo progetto integrato grazie al supporto del coordinatore scientifico F. Bonollo (DTG).

La presentazione di L. Anberg (NTNU) ha illustrato la correlazione fra i difetti derivanti dai processi di colata e prestazioni meccaniche delle leghe leggere con particolare attenzione alla previsione della porosità da idrogeno nei getti in lega d'alluminio. In fatti, il modello di previsione della microporosità e segregazione di idrogeno costituisce uno degli aspetti innovativi del progetto spostando la scala di valutazione a livello interdendritico, in funzione della composizione della lega e dei parametri di processo, per comprendere il comportamento meccanico dell'intero componente automobilistico.

È ovviamente difficile sintetizzare in un seminario l'articolato progetto durato quattro anni, ad ogni modo, W. Rhem (DAIMLER), U. Weiss (FORD), R. Molina (TEKSID) e I. Loizaga (Fundacion CIE) hanno descritto i risultati a partire dalla ricerca di base ma sottolineando soprattutto i benefici dell'applicazione industriale delle nuove conoscenze e modelli CAE. La fase finale del progetto, come chiaramente espresso dai singoli relatori, vede la definizione di modelli avanzati per le leghe leggere che correlano il processo produttivo di fonderia alle performance del materiale e la loro implementazione nelle procedure di progettazione integrata, comunemente denominata Design Chain. Il progetto integrato si conclude con l'applicazione degli strumenti CAE (simultaneous engineering & manufacturing approach for High Tech components) e il test a livello di componenti industriali, quali una testa cilindri, un blocco motore, un componente telaio in lega di magnesio e una scatola sterzo.

Il progetto NADIA è stato insignito del "Premio Innovazione METEF 2010" per la categoria "Tecnologie di Engineering" a riprova degli ottimi risultati ottenuti, tra i quali l'innovazione per la progettazione multiscala & ingegneria simultanea che è stato esteso e reso disponibile anche ai componenti presso colati.

Come rimarcato da S. Odorizzi, un ringraziamento è rivolto al comitato organizzatore del METEF ma soprattutto a tutti i partner che hanno svolto con dedizione e professionalità le attività pianificate con pregevole collaborazione a livello europeo.

4th PhilonNet CAE Conference

The 4th PhilonNet CAE Conference was held on 17 June 2010 at the Training Center of the National Bank of Greece in Athens. Attendees enjoyed a day full of exciting speeches and presentations from an international group of experienced engineers on how Computer Aided Engineering Technologies help companies jump ahead of their competition, covering a wide range of application areas. Coffee breaks, lunch and the evening reception left room to relax and meet with people, discuss projects and ask in-depth questions. Feedback from attendees was overwhelmingly positive.

The theme of the conference "Drive Innovation with Simulation" was outlined with multiple examples of industrial

applications demonstrating the benefits of simulation technologies: Reduced product cost, faster development cycles, improved part quality, more new products per year and increased innovation. Process integration. Since today these benefits of simulation are mainly limited by its scope of use, successful companies strive to make these technologies accessible across their enterprise. This requires configurable tools which are process integrated. Strategic implementation and communication focus further collaboration and user confidence.

Dr. Stefano Odorizzi delivered the key note speech and outlined the benefits of process integration in civil engineering projects and how modeFRONTIER was used to speed up to erection the roof of the Olympic Stadium in Athens in 2004.

The value of process integration with modeFRONTIER was also impressively demonstrated by Dr. Andreas Vlahinos who conducted some recent research on whether alternative fuel vehicles make sense yet? Many completely diverse applications such as battery management, driving habits, government policies and future energy and battery prices had to be brought together into one single simulation model.

Roger Grimes, senior developer at LSTC, showed advances in process integration in LS-Dyna, which make it possible to switch back and forth between explicit and implicit solvers with just one command in the input deck, helping to solve difficult problems like spring-back in sheet-metal forming applications more efficiently and faster.

Dr. Slatko Penzar from the Fuel Supply Division of Continental Automotive GmbH in Frankfurt, Germany showed how they used simulation technologies to develop a new sensor from an initial idea to a marketable product. The feasibility of the idea was tested with a simplified virtual model. This quickly led to a deeper understanding of the involved physics. Combined with some ingenious engineering an improved model with clear signal integrity was soon derived and tested.

Prof. Sotirios Natsiavas from the University of Thessaloniki
demonstrated the unique capabilities of his FEM code Dynamis, which can be used for non-linear spectrum analysis to efficiently and rapidly get the steady state response of a periodically exited non-linear system. This is an important advancement in FEM analysis. It was demonstrated with a multi-million DOF model of a bus, that non-linear response can be significantly different from linear response and must be taken into consideration.

More contributions from industry and academics were presented. The abstracts are posted on the web pages of PhilonNet at: www.philonnet.gr/events.

Applicazioni sempre più esigenti richiedono elaborazioni sempre più veloci.

E4 Computer Engineering si propone come una realta' italiana di eccellenza nell'integrazione di soluzioni dedicate al calcolo ad alte prestazioni (HPC); l'offerta di E4 si basa su un'estesa gamma di prodotti: workstation grafiche, server, storage, SAN, fino ai sistemi cluster "chiavi in mano" di grandi dimensioni, tutti progettati in base alla esigenze del cliente e testati secondo rigorose procedure per offrire soluzioni scalabili ed affidabili nel tempo garantendo il ritorno degli investimenti sull'hardware.

E4 Computer Engineering excels at integrating solutions for the High Performance Computing (HPC); E4's range includes a broad selection of products: from computer graphics Workstations, to server, storage, SAN, up to powerful custom built cluster systems, each one of them designed following the client's requirements and tested according to strict procedures, in order to provide scalable solutions which are reliable even as time goes by and guarantee a profitable return on hardware investments.

E4 COMPUTER ENGINEERING

The Professional Solution

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International modeFRONTIER Users' Meeting 2010

ESTECO modeFRONTIER International Users' Meeting 2010 took place in the beautiful city of Trieste, Italy (27th and 28th May 2010, Starhotel Savoia Excelsior Palace)

The conference provided an opportunity to learn how modeFRONTIER is used globally by designers and managers in many industries all over the world. It supplied a platform for exchanging ideas and views across a wide range of high-tech industrial sectors engaging technologists from leading companies of the like of FIAT, Honda, Jaguar, Bombardier and many more.
The welcome speech of Prof. Carlo Poloni, President of ESTECO, introduced the leit-motiv of the meeting: "going green" or "how having better products results in better care of the environment". The use of modeFRONTIER among several industrial application areas, was highlighted as a powerful tool to help designers in reducing pollution and the environmental impact of an industrial activity.

Poloni presented a normal day of business for a person in Europe: drinking coffee, using domestic appliances and travelling by plane, train and car result in Kg of CO_2 released in the atmosphere. When modeFRONTIER is used in the design of the manufacturing process lots of CO_2 emissions are reduced. As an example Brazilian plane manufacturer Embraer obtained 1 count of additional drag reduction after introducing modeFRONTIER optimization environment in their design process loop. BMW car manufacturer showed a reduction of about 16% fuel consumption for their cars with their enhanced models optimized with modeFRONTIER and Bombardier fast train achieved a 15% traction energy reduction. Electrolux diminished 1Kg of CO_2 emissions for any washing machine produced while Illy coffee maker optimized its Iperespresso® capsule packing with 0.7 Kg CO_2 emission less for each piece. Take all this and multiply it by about 7 millions of people who transit each day by one of the smaller sized airports in Europe and you'll get immediately an idea of the advantage.
The conference saw several industry experts presenting case studies and specialized sessions focused on different areas. Aeronautical problem-solving, automotive innovation, green design process and life-science related engineering optimization were all in the spotlight during the two days of the meeting.
Several complex project involving multi-disciplinary tools were pictured as streamlined by modeFRONTIER process flow integration, granting easy problem-solving procedures. In particular, during the first Keynote Session, Embraer engineers presented how modeFRONTIER platform is shared by different departments to deliver a truly optimized solution which includes several different requirements coming from departments as the structural department, CFD, noise and so on. They are able to design a wholly optimized aircraft and prove that modeFRONTIER allows taking parametric CAE-CAD modeling automation to the next level.
Jaguar and Ford, pioneers users of modeFRONTIER, exposed an overview of the achievements reached with ESTECO software that made them internal testimonials of the benefits of MDO (Multidisciplinary Design Optimization). From crash analysis, to occupant restraint system optimization; from NVH (noise-vibration-harshness) for a safer and more comfortable product, to CFD for external aerodynamics and fuel cells, most sections of the design process were exhibited as enhanced by modeFRONTIER optimization.

On the subject of external aerodynamics, Ferrari proposed its optimised rear diffuser of a GT sport-car by parametric CFD analysis driven up by modeFRONTIER, while Fiat Research Center used parametric mesh morpher ANSA connected by

direct interface to modeFRONTIER for external aerodynamic optimization of another GT car. HONDA showed how using modeFRONTIER DOE (Design of Experiment) and RSM (Response Surface) tools it is possible to reduce the overall time needed for the CFD analysis, while CDAJ, presented the state of the art for Multi Objective Tolerance Design, i.e. design taking into account parameters uncertainties, with modeFRONTIER.

The use of modeFRONTIER, though is not limited to the transportation and manufacturing industries: ABB, leader company for electrical engines, demonstrated an application of modeFRONTIER for industrial robot design, HSG-IMIT showed how electrostatic components can be optimized in applications for energy harvesting and Sygma Motors presented a multi-disciplinary optimization of an ethanol-SI engine. University of Trieste (Prof. Manzan) presented the application of modeFRONTIER in innovative design of energy efficient buildings, minimizing the consumption of primary energy for lighting, heating and cooling in different seasons of the year.

In view of NI intervention and the topic of applying modeFRONTIER to optimize hardware control through direct interface with LabView®, the staff at ESTECO prepared a live demonstration of hardware-in-the-loop optimization with a Lego Mindstorms® toy-robot hitting a target using the same NI tools interfaced with modeFRONTIER.

This year saw also the introduction of Life Science engineering optimization as topic of interest in one of the parallel sessions. From genome assembly to tear substitute, enzyme engineering and docked ligand, a whole variety of new applications of modeFRONTIER were testified by industry specialists.

At the closing of works, ESTECO staff presented the latest version of the product, and the vision of the future: the development of multidisciplinary optimization technology for the most effective use of enterprise know how and resources. Based on SOA (Oriented Architecture) and Web Services, it will allow industrial companies departments share information and process workflows letting the establishment of a collaborative environment for speeding up optimization processes and knowledge sharing.

Chiara Viani & Alberto Clarich - ESTECO

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EnginSoft at the modeFRONTIER International Users' Meeting 2010

As firm believers in multi-disciplinary optimization since the genesis of CAE, EnginSoft, co-founders of ESTECO, distributor and front-end providers of modeFRONTIER in Europe, the Middle East and Australia, have participated in the bi-annual event in Trieste with great enthusiasm.
The rich and diverse 2010 agenda included many contributions from the EnginSoft Community thanks to presenters from ABB Robotics, CRF, Fiat Group Automobiles, Ferrari, Jaguar and others. Academic and research institutions such as: FESB Institute from Croatia, INSA Institut National des Sciences Appliquées de Rennes, University of Strasbourg, University of Stuttgart and others, contributed to the success of the event.
This year, for the first time, the organizers had the pleasure to welcome presenters from Israel where EnginSoft started operations in 2009, through a direct presence and the representative company MEL-SIVAN Technologies.
The Keynote Session on 28th May saw RAFAEL, a worldwide leader in hi-tech defense systems for air, land, sea and space applications, presenting the advantages modeFRONTIER brought to their design processes. This keynote talk focused on the microwave behavior of sensors, and the importance of a multi-disciplinary view to catch the interactions with mechanical design variables.

The EnginSoft Team met modeFRONTIER Users in the exhibition

Furthermore, the presentation by the Israeli Aerospace Industries (IAI) "From Wing Sizing to Business Plans", gained a lot of interest thanks to a powerful and quite unique combination of engineering and business topics. In fact, proprietary IAI cost models, traditional engineering models and the ease of use of the modeFRONTIER GUI complement each other perfectly and allow the simultaneous use of keywords, such as "wingspan", "range", "profit" and "breakeven", which otherwise would contradict each other.
Contributions like these revealed the importance of multi-disciplinary optimization in today's product development to managers and decision makers in Trieste.
The participants will receive all presentations and papers in electronic format.
For more information, please contact info@enginsoft.com

APMS 2010 Third Announcement and Call for Papers

The recent financial global crisis has accelerated the need for a sustainable economic growth where smarter and greener economy could create prosperity and new job from innovation and from using the natural resources better than before. In this global context, besides the role of the policy makers, companies cannot postpone anymore the implementation of strategies to deal with an increasing competition in a sustainable, green and environmental-conscious and social-oriented market: strict regulations, consumers demand for greener products, reduction of the carbon footprint, optimization of the usage of natural resources, more societal attention and many other trends are increasing the challenges to compete in a real global market. Companies are therefore called to become more efficient, increase their productivity, use less resources and non-renewable energy in an environment with high energy prices, carbon constraints and greater resource competition.

These challenges require a deep rethinking of the role of Manufacturing with the need for new approaches to Product, Service and Production Management: from a cost-cutting to a multi-disciplinary knowledge-based eco-factory model. With this goal in mind, APMS2010 calls for new, innovative and original scientific contributions which address practical and industrial-oriented solutions where the above context is addressed.

APMS 2010 at a glance

Since several decades, APMS is one of the major events and the official conference of the IFIP Working Group 5.7 on Advances in Production Management Systems.
APMS 2010 will take place in Cernobbio (Como Lake, Italy), 11-13 October 2010.

Some numbers about APMS2010:

- Doctoral Workshop (9-10 October 2010),
- Special Sessions have been published
- 4 Projects have already joined the conference
- 2 keynote speakers have already confirmed their presentation:
- Mr. Salvatore Paparelli, AV Sales & Operations Director, Sony Italy - The Sony's Way to Sustainability: Product, Process, Planet: The Impact on Manufacturing, Operations, Products and Waste
- Massimo Mattucci, COO Comau - Enviromental, Economical and Social Sustainability: Comau's Business Evolution in Production Systems and Services

Important dates

- 15 April 2010 30 April 2010 Submission of Extended Abstract (min. 2.000 words)
- 15 May 2010 Notification of acceptance
- 1 July 2010 Final paper and registration fee due
- 9-10 October 2010 Doctoral Workshop
- 11-12-13 October 2010 APMS 2010 Conference

Conference topics

APMS 2010 will be dedicated to Competitive and Sustainable Manufacturing, Products and Services. Papers will be blind peer-reviewed. Accepted papers will be included in the conference proceedings published by Springer in the series called "IFIP Advances in Information and Communication Technology" (IFIP AICT). Selected papers will be considered for development into journal papers for a special issue in Production Planning & Control.

Conference web-site: www.apms-conference.org.

For any information, please contact
info@apms-conference.org

For any comments, requests and proposals, please contact Prof. Marco Taisch, Conference Co-chair,
marco.taisch@polimi.it, Tel: +39 02 2399 4815, Fax: +39 02 2399.3978

Multi-Disciplinary Methodology for Process Integration and Design Optimization: a presentation day organized by the Automotive Intelligence Center (AIC) in Amorebieta-Bilbao

The presentation day held on 21 April was organized by the AIC for companies in the ACICAE automotive cluster of the Basque Country, Spain, and was aimed at engineers and area managers involved in product design and production process design.

The main objective was to present new methodologies to the participants to enhance their automatic product and process designs in a collaborative manner across various disciplines and departments, analyzing data, extracting information and making decisions.

The Automotive Intelligence Centre (AIC) in Amorebieta.

The day was attended by a total of 40 people from 30 companies involved in the automotive sector within the Basque Country of Spain. Of note were the presentations made by Azterlan, AperioTec and CIE Automotive and the real interest that the attendees showed for modeFRONTIER.

Carlo Poloni, general manager and technical head of modeFRONTIER, was unable to attend due to the closure of European airspace because of the ash cloud from the Iceland volcano. However his presentations, given via Webex, were a huge success due to the approach and collaborative working concepts set out.

The presentations given by Iñigo Loizaga of CIE Automotive and Zabala Argoitz of the Azterlan Metallurgical Research Centre were also well received because they dealt with real industrial applications using the functionality and concepts of the modeFRONTIER software. Gino Duffett of Aperio Technology did not have sufficient time to present the many examples of other industrial applications but presented an optimization for hot sheet stamping without including all the confidential information. There was much interest and ample time was devoted to answering questions and resolving concerns.

The main presentations were:
Iñigo Loizaga, CIE Automotive, presented an example of the optimization of a high pressure die casting (HPDC) process showing an improvement in the product quality as well as the process stability.

Argoitz Zabala, Azterlan Metallurgical Research Centre, showed excellent results and improvements in casting process design, reducing micro-shrinkage by using statistical analysis, the analysis of relationships and ordered clustering.

Carlo Poloni, Esteco (creators of modeFRONTIER), focused on concepts and methodologies for collaborative working, multi-disciplinary integration and multi-objective optimization. He showed several examples but emphasized the example of the washing machine design by ACC that included the concepts of robust design while optimizing the cost, electro-mechanical and hydraulic performance.

Gino Duffett, Aperio Tecnología en Ingeniería, presented an optimization for a hot sheet stamping process.

Iñigo Loizaga (CIE Automotive) during his presentation.

EnginSoft Event Calendar

Italy
11-13 October - APMS 2010 International Conference Cernobbio, Lake Como. Competitive and Sustainable Manufacturing, Products and Services
www.apms-conference.org

21-22 October 2010 – EnginSoft International Conference 2010 - CAE Technologies for Industry.
Fiera Montichiari, Brescia.

Believe in innovation, simulate the world!
Stay tuned for Europe's major CAE event - Register fast to take advantage of the Early-Bird rates!
www.caeconference.com

France
EnginSoft France 2010 Journées porte ouverte dans nos locaux à Paris et dans d'autres villes de France et de Belgique, en collaboration avec nos partenaires.
Prochaine événement: Journées de présentation modeFRONTIER. Pour plus d'information visitez:
www.enginsoft-fr.com

21-23 June – ASMDO 2010 3rd International Conference on Multidisciplinary Design Optimization and Applications - Co-sponsored by ISSMO, ESTP, EnginSoft, and NAFEMS
ASMDO 2010 will bring together scientists and practitioners working in different areas of engineering optimization - Several presentations will feature work performed with modeFRONTIER! Paris
www.asmdo.com

7 October- Journée Simulation Numérique «Organisation et rentabilité de la fonction calcul». Paris
http://www.af-micado.com/

12-13 October – Congrès Nafems «Simulation numérique: moteur de performance». Paris
http://www.nafems.org/events/nafems/2010/francecongres/

18 November – French Flowmaster and modeFRONTIER Users Group Meeting. Hotel Saint James et Albany, Paris
www.enginsoft-fr.com

Germany
Please stay tuned to www.enginsoft-de.com, contact Stephanie Koch at S.Koch@enginsoft.com for more information.

22–24 Juni - Vehicles Dynamics Expo. Besuchen Sie EnginSoft am Stand 5215 und diskutieren Sie mit uns unseren Vortrag: "Optimization and robust design - Fiat Group Automobiles applications overview in chassis and vehicle dynamics". Messe Stuttgart. www.vehicledynamics-expo.com

modeFRONTIER Seminars 2010.
EnginSoft GmbH, Frankfurt am Main
- 15 June
- 13 July
- 7 September
- 26 October
- 30 November

Seminars Process Product Integration. EnginSoft GmbH, Frankfurt Office. How to innovate and improve your production processes! Seminars hosted by EnginSoft Germany and EnginSoft Italy. Please stay tuned to:
www.enginsoft-de.com

UK
Please stay tuned to www.enginsoft-uk.com,
contact Bipin Pastel at: b.patel@enginsoft.com for more information.

modeFRONTIER Workshops at Warwick Digital Lab
- 21 June
- 20 July
- 12 August
- 7 September
- 18 October
- 10 November
- 7 December

Please register for free on www.enginsoft-uk.com

modeFRONTIER Workshops with InfoWorks CS at Warwick Digital Lab
- July
- October

September 2010 - InfoWorks User Meeting
EnginSoft UK will be attending and submitting an abstract
November 2010 - WaPuG. Blackpool. EnginSoft UK will be attending – www.ciwem.org/groups/wapug

Sweden
Training Courses:
- 7-8 September: Introduction to modeFRONTIER
- 9 September Advanced Topics in modeFRONTIER
- 7-8 October Introduction to modeFRONTIER

- 3-4 November Introduction to modeFRONTIER
- 5 November Robust Design with modeFRONTIER
- 1-2 December Introduction to modeFRONTIER

For more information and registration, please visit
http://nordic.enginsoft.com/training/
Contact Adam Thorp, adam.thorp@esteconordic.se

Spain

28 - 29 September - Introductory Course on the use of modeFRONTIER. The 2-day course provides a practical introduction to design optimization using modeFRONTIER. The course combines lectures but most of the time is dedicated to hands-on sessions so that the attendees complete the course with the basic skills in using many of the modeFRONTIER functions. More information can be found on http://www.aperiotec.es/agenda.php

Programa de cursos de modeFRONTIER and other local events
Please contact our partner, APERIO Tecnología: g.duffett@aperiotec.es and stay tuned to: www.aperiotec.es

USA

Courses on: Design Optimization with modeFRONTIER
Ozen Engineering, Sunnyvale – Silicon Valley, CA
Learn about Optimization coupled with ANSYS. OZEN can easily help you out automating the search for the optimal design. The primary audience for this course includes ANSYS Classic and Workbench users as well as new modeFRONTIER users who want to have a complete overview to all software capabilities. Stay tuned to our US partner's website for the next events in the USA:
www.ozeninc.com - info@ozeninc.com

Europe, various locations

modeFRONTIER Academic Training
Please note: These Courses are for Academic users only. The Courses provide Academic Specialists with the fastest route to being fully proficient and productive in the use of modeFRONTIER for their research activities. The courses combine modeFRONTIER Fundamentals and Advanced Optimization Techniques. For more information, please contact Rita Podzuna, r.podzuna@enginsoft.it

EnginSoft UK Seminar Review

On the 25th February, 2010, EnginSoft UK held their first Technical Seminar on Manufacturing Process Simulation in association with Cranfield University. Held at the Cranfield Management Research Institute, the attendance comprised of industry experts such as Jaguar LandRover Engineers and Mahindra Satyam, the Manufacturing Advisory Service and some of the top academics in Optimisation and manufacturing.

The seminar offered engineers the opportunity to learn about the most modern CAE tools available today for manufacturing process simulation, including TWS AdvantEdge and modeFRONTIER software. Presentations from Key Note speaker Rob Lloyd at Scottish Enterprise, Bipin Patel, Managing Director at EnginSoft UK and Nicola Gramegna, an International Expert in Manufacturing Processes from EnginSoft Italy, were warmly welcomed and received positive feedback from all that attended.
Throughout the day, participants were able to question the presenters with their challenges on Manufacturing Processes and see real life examples of the large role that CAE software can have to help improve companies? time to production and reduce wear and tear of tooling. Noticeably, one of the most impressive features of the Technical Seminar was the TWS AdvantEdge demonstration, which was able to illustrate the ability of the software to simulate the formation of a chip when a manufacturing tool is being used to shape some material. By linking this together with the Multi-objective capabilities of modeFRONTIER, this really is a big step forward for manufacturing engineers.
The day concluded with a discussion session that offered a more informal approach to showing some solutions to industry specific challenges. The presenters were able to show individuals, specific case-studies that related to their sector such as Casting simulation and Metal Forming.
Overall the response was hugely positive, with most engineers saying that the lessons they had learnt not only met their primary objectives for the day, but that it would alter the way they work and research in the future too.

For further information, please contact
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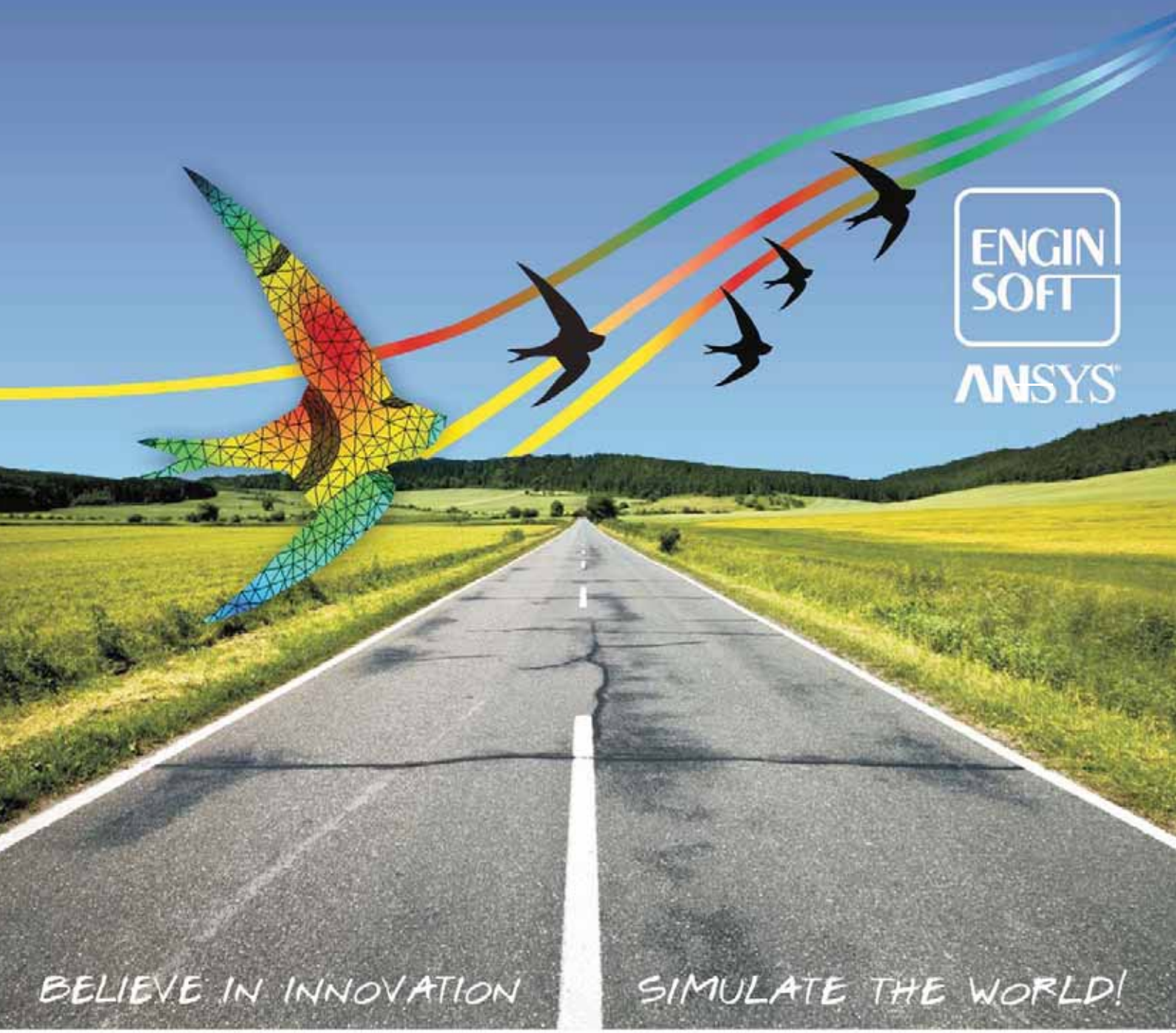

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