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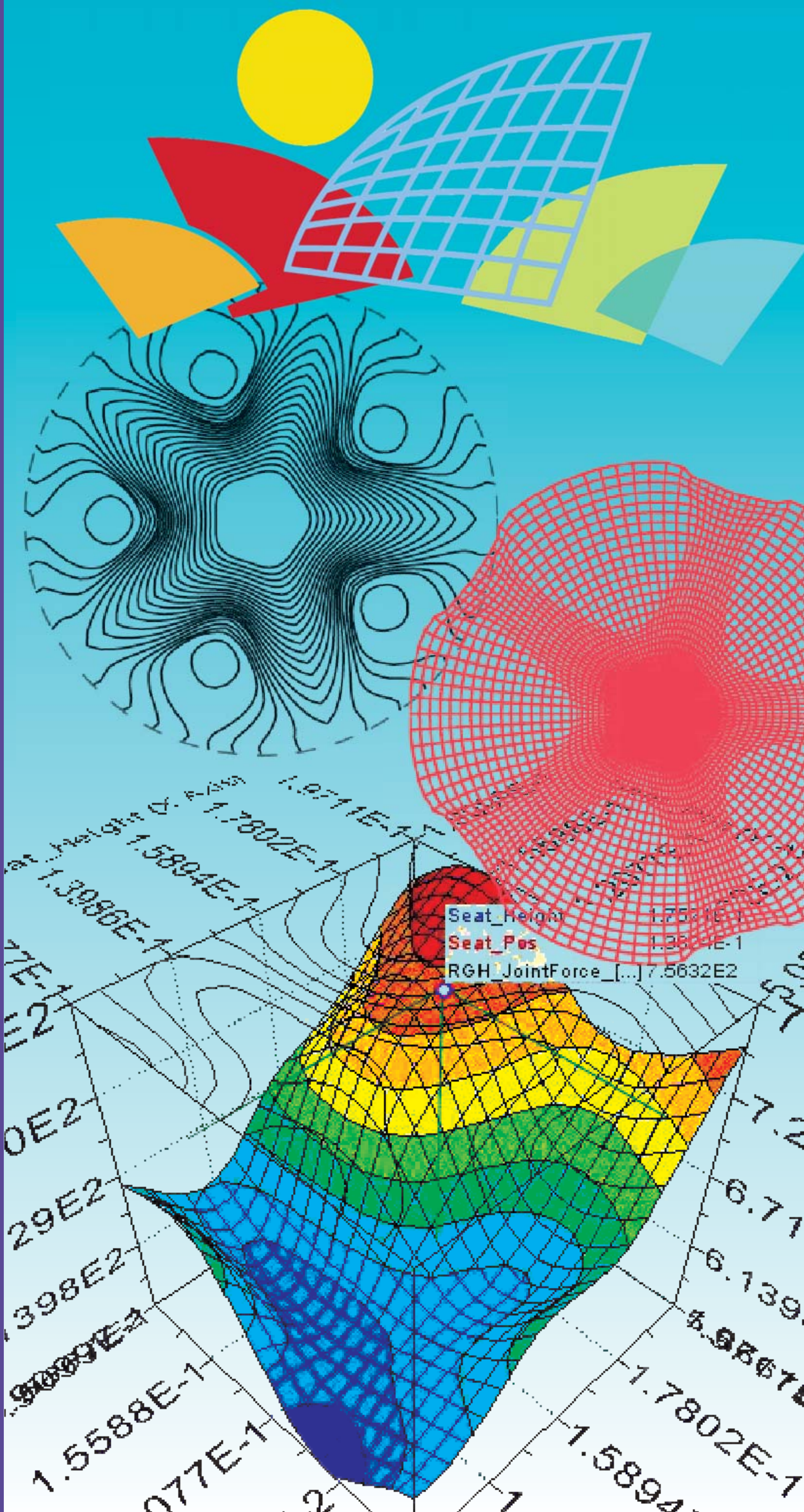
expressions



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contents

editorial

I write these lines just before closing this edition of IACM Expressions under the shock of the news of the death of Prof. Olgierd (Olek) C. Zienkiewicz in Swansea on January 2nd 2009.

Olek was a giant in the field of computational mechanics, a fine engineer and one of the founders of the IACM. He was also a mentor and a personal friend of many of us. His scientific legacy and the memory of his many personal contributions to the IACM community will remain vivid in our minds for ever.

Very little more can I express under the influence of Olek's death. I visited him in Swansea last November and he was very happy to hear about the increasing growth of IACM worldwide. He was particularly proud of the approval of the new Constitution for the IACM and the success of the 8th World Congress on Computational Mechanics held in Venice last July.

We will have the opportunity in future editions of Expressions to pay an adequate homage to Prof. Zienkiewicz.

May these lines however serve to express our sorrow and sympathy to Olek's wife Helen, his children, grandchildren and the rest of his family.

It is a sad coincidence that other two distinguished scientists in our field have recently passed away. These are: Prof. Hirohisa Noguchi in Japan and Prof. David M Young in the USA. We express our sincere condolences to their families and friends.

May all of these colleagues and great men rest in peace. Their memory will surely give us the strength to keep on working for a better world in the spirit of scientific cooperation and friendship that they impregnated to the IACM.

Eugenio Oñate
President of IACM

Computational Mechanics for Stimulus Responsive Hydrogels

by
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USA

Stimulus-responsive hydrogels (SRHs) constitute an example of an emerging class of soft, active materials, whose unique characteristics present a rich set of challenges to the computational mechanics community. Salient issues include the advance of modern models for coupled field phenomena and phase transitions, the development of element technology for sharp interface problems, and the use of stabilized methods to enforce constraints.

SRHs are crosslinked macromolecular polymer networks immersed in a solvent, synthesized to exhibit large volume changes in response to small changes in environmental stimuli.

This volume change is typically effected through an abrupt transition from a swolen, hydrophilic phase to a collapsed, hydrophobic phase. SRHs have been designed, for example, to swell and collapse in response to temperature, pH, ionic strength, solvent composition, and light.

The transition is entirely reversible, and stimulus-responsive hydrogels have been cycled thousands of times without failure. As such, SRHs constitute an example of an emerging class of soft, active materials, with unique properties that make them appealing for a whole host of practical applications.

Recently, attention has focused on the use of SRHs as the backbone of actuation and sensing devices at the nano- and microscales. The swelling process tends to be controlled by diffusion, so that swelling times scale with the square of the characteristic linear dimension of a specimen. This translates into fast actuation times at small scales, and SRHs have already been incorporated into molecular recognition sensor surfaces, optical switches, drug carriers, and microfluidic devices. A stimulus-responsive hydrogel provides the main functionality of a newly developed sensor

The sensor combines the swelling properties of SRHs with embedded holography, such that jet fuel can quickly be tested for trace levels of water.

Importantly, such a sensor does not require an external power source to function. The vast majority of these applications have resulted from costly trial-and-error experiments.

A lack of understanding of the relationship between gel composition and response kinetics (i.e. swelling times) has hindered the design of new systems and delayed the transfer of new applications from the laboratory to the marketplace.

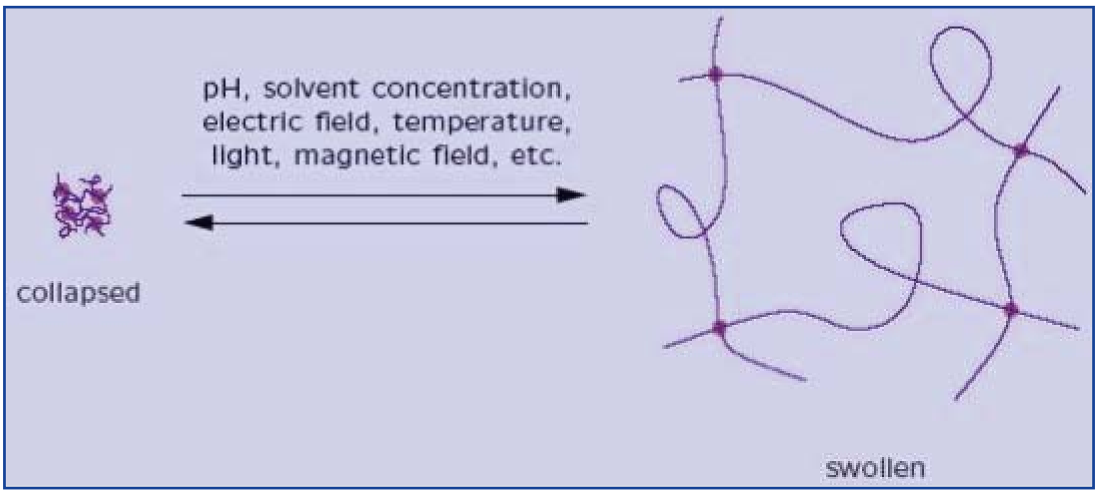


Figure 1: *Abrupt transition from a swolen, hydrophilic phase to a collapsed, hydrophobic phase.*

The rational design of SRHs and the optimization of hydrogel-based systems require a better understanding of the chemo-mechanics of gels.

It is here that the computational mechanics community has a great deal to offer, both in developing models that capture the salient features of these materials and numerical methods that can be used for predicting their response.

To a large extent, much more work has focused on the development of models for SRH behaviour than on the accompanying numerical methods. These models are typically driven by a number of important observations. First and foremost, hydrogel swelling is accompanied by large, finite volume changes.

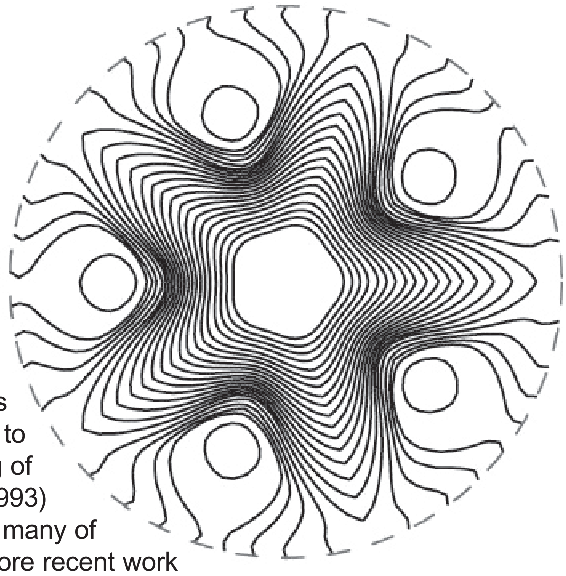
Any framework that does not allow for the representation of finite strains will therefore be lacking.

For particular gel compositions and and external environmental triggers, a phase interface also develops between the swelled and collapsed states. The motion of this interface corresponds to the swelling response of the gel.

In the late seventies, Toyoichi Tanaka at MIT was one of the first researchers to observe this phase transition and develop models for the kinetics of SRHs (Tanaka, 1978). He is widely recognized as the researcher who discovered these “smart gels.”

Recent attention has also focused on “ripple” patterns observed on the surface of gels during large swelling or collapse. Tanaka also studied this phenomena in the late eighties (Tanaka et al., 1987). The surface instability is initiated at the microscale, and the size of the cusps on the surface can eventually reach the characteristic size of the entire specimen.

Such elastic instabilities in gels have been used to advantage of late, in particular as a means to effect the nanoscale assembly of complex structures (Zhang et al., 2008). These phenomena suggest the need for models that account for curvature effects during the phase transition as well as the possibility of cusp formation.



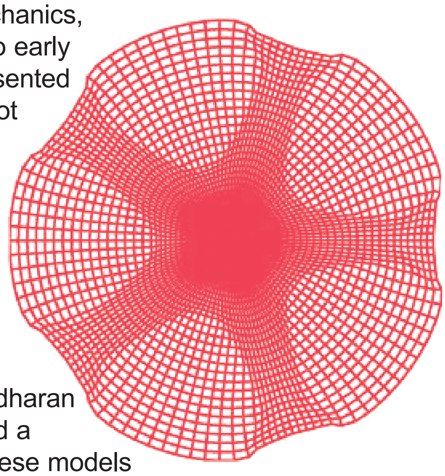


Figure 2:
For detecting contaminants in jet fuel, developed by the company Smart Hologram.

A wide range of phenomenological and empirical models has been developed to describe the swelling of hydrogels. Onuki (1993) provided a review of many of the early models. More recent work has leveraged the power of modern continuum mechanics, with acknowledgment to early pioneering work as presented by Gibbs (1878) and Biot (1941) for the inhomogeneous deformation in a swelling solid.

This includes the work of Dolbow et al. (2004, 2005) and Hong et al. (2008). Hui and Muralidharan (2005) recently provided a comparison between these models and the early work of Tanaka for describing gel mechanics.

In a series of papers, we have developed models for the chemically-induced and thermally-induced swelling of SRHs. Our models specifically account for finite strain and the role of a sharp interface separating swelled and collapsed phaes.

As primary fields, the chemo-mechanical model works with the deformation of the polymer network and the chemical potential.

A key component of the theory is an interfacial equation, expressing configurational force balance, which generalizes the Gibbs-Thomson relation arising in descriptions of alloy solidification and supplements the conventional equations expressing force and mass balance.

Work at Duke University has focused on the development of embedded interface finite element methods for phase transition problems such as those presented by SRHs. These are essentially fixed-grid methods that allow the phase interface to be arbitrarily located inside an element. This enables the simulation of phase changes without remeshing, for example, and facilitates the representatin of topology changes.

A number of computational issues have to be resolved in the context of embedded interface methods for phase transition problems. The first concerns properly capturing the sharp interface and accounting for the discontinuities in material properties. For example, with the chemo-mechanical model one can expect jumps in the solvent flux across the interface. The second concerns properly imposing interfacial constraints, such as interfacial force balance or the configurational force balance. Finally, as most of these models evolve the interface based on its local velocity, some means of robustly evaluating the interfacial velocity is required. As sharp interface problems with curvature effects tend to be stiff, all of these issues must be resolved with an eye toward maintaining good convergence.

"... the techniques have enabled a full investigation of fairly complex models for hydrogel kinetics.."

Our current approach to capturing jump conditions and enforcing interfacial constraints at the phase interface is described in Dolbow and Harari (2008). We enhance the standard finite element approximation for those elements intersected by the interface geometry. The approach may be viewed as the use of two separate meshes that happen to overlap in the vicinity of the interface. This gives rise to a basis that is identical to that obtained with the eXtended Finite Element Method (X-FEM) using Heaviside enrichment (Merle and Dolbow, 2004).

Enforcing constraints on embedded interfaces with such enhanced methods has presented a unique challenge. Consider the "simple" problem of enforcing a Dirichlet constraint on a surface whose geometry does not match the finite element mesh.

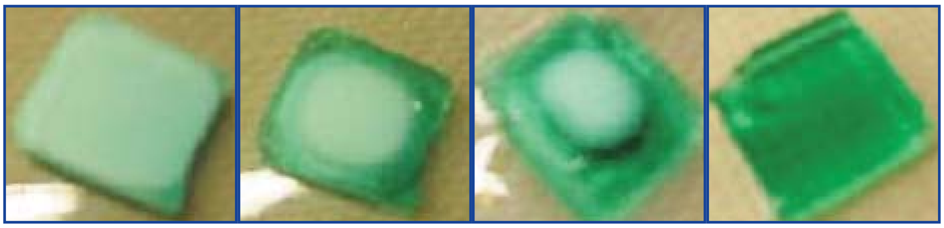
If we wish to avoid remeshing, then weak enforcement is the only option. The standard approach is to use a Lagrange multiplier to enforce the constraint, but in the discrete case the most convenient choice of multiplier is unstable. Methods that work perfectly well when the interface matches the mesh often fail to be sufficiently robust for the embedded case.
Our approach has been to employ a variation on Nitsche's method for the weak imposition of constraints. Nitsche's method is often referred to as a variationally consistent penalty method, though the use of the word "penalty" is misleading. With penalty methods the penalty parameter is typically chosen to be as large as possible. The analogous term with Nitsche's method is better viewed as a stability parameter, and should be chosen as small as possible. Through numerical analysis, we obtain simple algebraic expressions for the stability parameter that can be evaluated on an element-by element basis (Dolbow and Harari, 2008).

The stability parameter is chosen to be just large enough to ensure that the discrete bilinear form is coercive. This is much more efficient approach than some of our earlier efforts employing residual-free bubbles (Dolbow and Franca, 2008), for example.

Other researchers have approached the problem by developing a stable Lagrange multiplier (Moes et al., 2006). The advantage of this approach is that the Lagrange multiplier has a physical interpretation of a flux (or traction) on the interface, which is often a quantity of interest. If a stable Lagrange multiplier can be constructed, it yields accurate interfacial fluxes. To date, such efforts have resulted in Lagrange multipliers that are non-local and rely on the use of heuristics for construction.

Our approach to accurate flux recovery with embedded interface methods has been to adapt a version of the domain integral (Ji and Dolbow, 2004; Dolbow and Hrari, 2008). This can be viewed as a simple post-processing step, involving a local L2 projection near the interface. It can also be viewed as a generalization of the Carey superconvergent flux operator (Carey et al., 1985).

Figure 3: *Sequence of images showing a collapsed to swelled transition in a hydrogel specimen.*



The post-processing involves matrix-vector products, using pieces of the fully-assembled stiffness matrix. The resulting fluxes are smoother and generally more accurate than a direct evaluation of the numerical flux on the interface.

All of the above techniques have enabled a full investigation of fairly complex models for hydrogel kinetics. These studies have suggested several synthetic pathways that might be examined to decrease swelling times in SRHs. They include, for example, increasing the mobility of the polymer chains in the swelled phase, increasing the equilibrium dilatation of the swelled phase, and adjusting the solvent such that the jump in polymer concentration between the swelled and collapsed phases is maximized.

Nonetheless, many challenges remain for the computational mechanics community when it comes to modeling SRHs. For example, our recent research into hydrogel tribology (Chang et al. 2007) indicates the surprising (but important) role that can be played by friction with these materials. By the same token, it seems clear that strictly mechanical models for tribological response are not capable of capturing the richness of the experimental observations (Stanciulescu and Dolbow, 2008).

Accounting for coupled chemo-mechanical effects on the surface poses a difficult task for the community.

SRHs are also an example of a material where processes on the molecular scale, i.e. interactions between the polymer network and solvent molecules, translate into abrupt, observable changes at the macro scale.

Open questions concern how such interactions might be tailored to build SRHs that are sensitive to other stimuli, for example.

Finally, these materials share several common features with biological materials, while also being considerably simpler. As such, SRHs are an excellent candidate material for multiscale modeling and to demonstrate the power of modern computational mechanics. ●

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The Tasks & Aims of a History of Theory of Structures

By
Karl-Eugen Kurrer
Ernst & Sohn
Berlin, Germany

Today, theory of structures is, on the one hand, more than ever before committed to formal operations with symbols, and is less apparent to many users of structural design programs. On the other hand, some attempts to introduce formal teaching into theory of structures fail because the knowledge about its historical development is not adequate to define the concrete object of theory of structures. Theory of structures is therefore a necessary but unpopular project.

Notwithstanding, a history of theory of structures has been gradually coming together from various directions since the early 1990s, the first highlight of which was the conference "Historical perspectives on structural analysis" – the world's first conference on the history of theory of structures – organised by Santiago Huerta and held in Madrid in December 2005. The book published on the occasion of the conference (*Fig. 1*) demonstrates that the history of theory of structures already possesses a number of the features important to an engineering science discipline and can be said to be experiencing its constitutional phase.

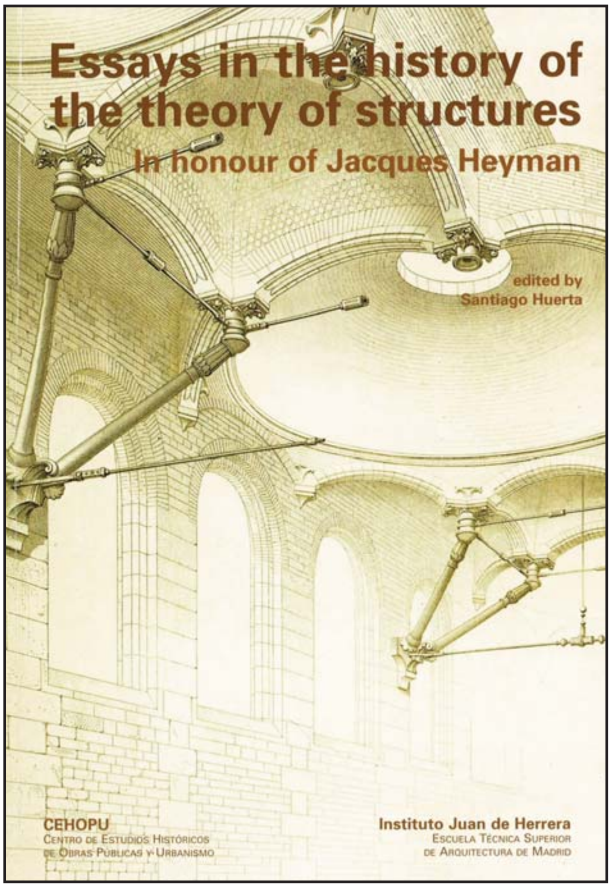


Figure 1:
Cover of the book published to mark the first conference on the history of theory of structures [1]

Internal scientific tasks

Like every scientific cognition process, the engineering science cognition process in theory of structures also embraces history insofar as the idealised reproduction of the scientific development supplanted by the status of knowledge of an object forms a necessary basis for new types of scientific ideas: science is truly historical. In their monumental work on the history of strength of materials, Todhunter and Pearson had good reasons for focusing on elastic theory (see [2], [3]), which immediately became the foundation for materials theory in applied mechanics as well as theory of structures in its discipline-formation period (1825-1900), and was able to sustain its position as a fundamental theory in these two engineering science disciplines during the consolidation period (1900-50). The mathematical elastic theory first appeared in 1820 with Navier's "Mémoire sur la flexion des plans élastiques". It inspired Cauchy and others to contribute significantly to the establishment of the scientific structure of elastic theory and induced a paradigm change in the constitution phase of structural theory (1825-50), which was essentially completed by the middle of the establishment phase of structural theory (1850-75). One important outcome of the discipline-formation period of structural theory (1825-1900) was the constitution of the discipline's own conception of its epistemology – and elastic theory contributed substantially to this. Theory of structures thus created for itself the prerequisite to help define consciously the development of construction on the disciplinary scale. And looked at from the construction engineering side, Gustav Lang approached the subject in his evolutionary portrayal of the interaction between loadbearing construction and theory of structures in the 19th century [4] – the first monograph on the history of theory of structures.

Whereas Pierre Duhem pursued the thinking of natural philosophy from the theory of structures of the Middle Ages to the end of the 17th century in his two-volume work "Les origines de la Statique" [5], the comprehensive contributions of Mehrtens [6], [7], Hertwig [8], [9], Westergaard [10], Ramme [11] and Hamilton [12] to the origins of the discipline of theory of structures provide reasons for the history of theory of structures in a narrower sense. The famous book by Timoshenko on the history of strength materials (*Fig. 2*) contains sections on the history of structural theory [13].

In the former USSR, Rabinovich [14]-[16] and Bernshtein [17], [18] contributed to the history of strength of materials and theory of structures in particular and structural mechanics in general. But of all those monographs, only one has appeared in English [15], made available by George Herrmann in the wake of the Sputnik shock. In that book, Rabinovich describes the future task of a type of universal history of structural mechanics as follows: "[Up] to the present time [early 1957 – the author] no history of structural mechanics exists. Isolated excerpts and sketches which are the elements do not fill the place of one. There is [a] need for a history covering all divisions of the science with reasonable thoroughness and containing an analysis of ideas and methods, their mutual influences, economics, and the characteristics of different countries, their connection with the development of other sciences and, finally, their influence upon design and construction" [15, p. 79]. Unfortunately, apart from this one exception, the Soviet contributions to the history of structural mechanics were not taken up in non-Communist countries – a fate also suffered by Rabinovich's monograph on the history of structural mechanics in the USSR from 1917 to 1967 (*Fig. 3*).

In his dissertation, (Prinston University) Harold I. Dorn deals with the relationship between theory and practice in Great Britain during the preparatory period of structural theory (1575-1825) [19]. Charlton concentrates on the discipline-formation period of structural theory in his book [20]. He concludes the internal scientific view of the development of theory of structures as the history of structural theory enters its initial phase. And as early as 1972, Jacques Heyman's monograph "Coulomb's memoir on statics: An essay in the history of civil engineering" [21] was not only lending a new emphasis to the treatment and interpretation of historical sources, but was also showing how practical engineering can profit from historical knowledge. This was followed nine years later by Edoardo Benvenuto's universal work "La scienza delle costruzioni e il suo sviluppo storico" [22], the English edition of which – in a much abridged form – did not appear until 10 years later [23]. Heyman's later monographs [24]-[26] in particular demonstrate that the history of theory of structures is able to advance the scientific development of structural analysis. Many of Heyman's books have been published in Spanish in the "Textos sobre teoría e historia de las construcciones" series founded and edited by Santiago Huerta (see, for example, *Fig. 4*).

In 1993 Benvenuto initiated the series of international conferences under the title of "Between Mechanics and Architecture" together with the Belgian science historian Patricia Radelet-de Grave. The conferences gradually became the programme for a school and after Benvenuto's early death were continued by the Edoardo Benvenuto Association headed by its honorary president Jacques Heyman. Only one result of this programme will be mentioned here: The volume of essays on the history of mechanics edited by Becchi, Corradi, Foce and Pedemonte (*Fig. 5*).

Erhard Scholz has investigated the development of graphical statics in his habilitation thesis [29] from the viewpoint of the mathematics historian. Dieter Herbert's dissertation [30] analyses the origins of tensor calculus from the beginnings of elastic theory with Cauchy (1827) to its use in shell theory by Green and Zerna at the end of the consolidation period of structural theory (1900-50).

In the past two decades, we have seen a

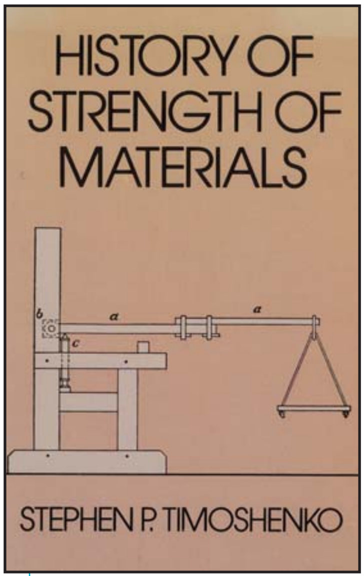


Figure 2:
Cover of Timoshenko's "History of strength of materials" [13]

Figure 3:
Dust cover of the monograph entitled "Structural Mechanics in the USSR 1917-67" [16]

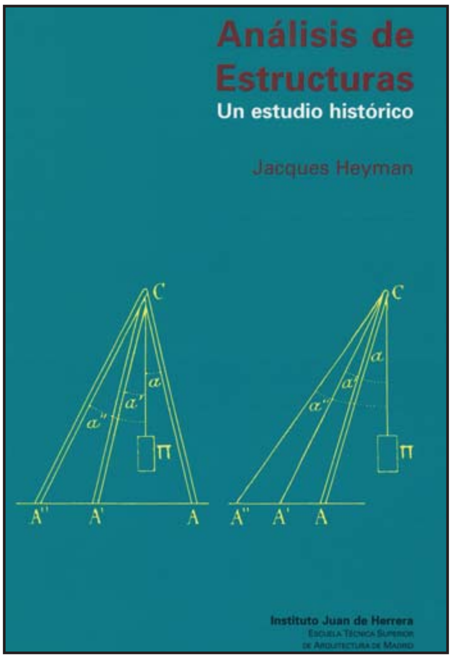


Figure 4:
Dust cover of the Spanish edition of Heyman's "Structural analysis. A historical approach" [27]

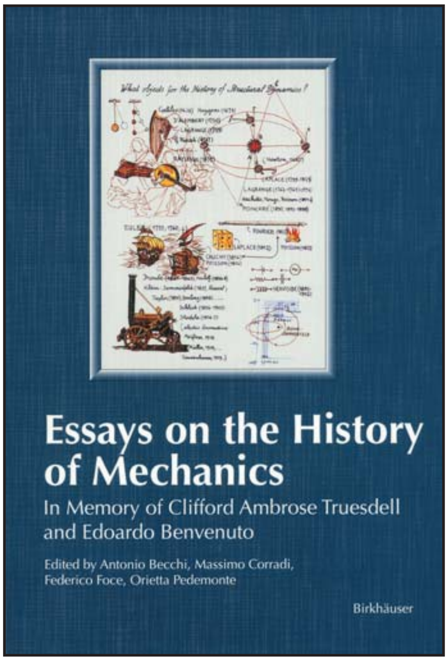


Figure 5:
Cover of the volume of essays on the history of mechanics [28]

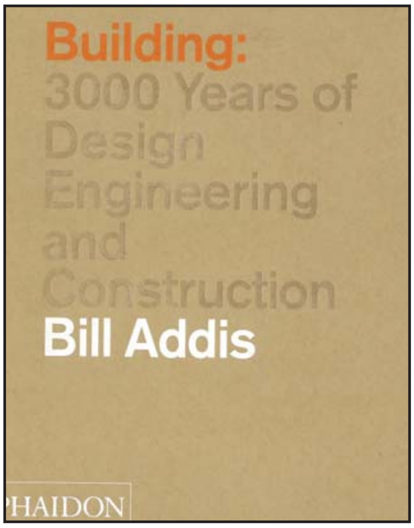


Figure 6:
Cover of the new book by Bill Addis [41]

slowly accelerating upswing in working through the backlog in the history of modern structural mechanics by specialists. The development of modern numerical engineering methods was the subject of a conference held in Princeton by the Association for Computing Machinery (ACM) in May 1987 [31]. Ekkehard Ramm provides a fine insight into the second half of the consolidation period (1900-50) and the subsequent integration period of structural theory (1950 to date) [32]. As a professor at the Institute of Theory of Structures at the University of Stuttgart, Ramm supervised Bertram Maurer's dissertation "Karl Culmann und die graphische Statik" (Karl Culmann and graphical statics) [33]. And Malinin's book "Kto jest' kto v soprotivlenii materialov" (who's who in strength of materials) [34] continued the biographical tradition popular in the Soviet history of mechanics.

Publications by Samuelsson and Zienkiewicz [35] plus Kurrer [36] have appeared on the history of the displacement method. Carlos A. Felippa deals with the development of matrix methods in structural mechanics [37] and the theory of the shear-flexible beam [38]. On the other hand, the pioneers of the finite element method (FEM) Zienkiewicz [39] and Clough [40] concentrate on describing the history of FEM. It seems that a comprehensive presentation of the evolution of modern structural mechanics is necessary. Only then could the history of theory of structures make a contribution to a historical engineering science in general and a historical theory of structures in particular, both of which are still awaiting development.

Practical engineering tasks

Every structure moves in space and time. The question regarding the causes of this movement is the question regarding the history of the structure, its genesis, utilisation and nature. Whereas the first dimension of the historicity of structures consists of the planning and building process, the second dimension extends over the life of the structure and its interaction with the environment. The historicity of the knowledge about structures and their theories plus its influence on the history of the structure form the third dimension of the historicity of structures. In truth, the history of the genesis, usage and nature of the structure form a whole. Nevertheless, the historicity of structures is always broken down into its three dimensions. Whereas historicity in the first dimension is typically reduced to the timetable parameters of the participants in the case of new structures, understanding the second dimension is an object of history of building, preservation of monuments and construction research plus the evolving history of construction engineering and structural design. One vital task of the history of theory of structures would be to help develop the third dimension, e.g. through preparing, adapting and re-interpreting historical masonry arch theories. Its task in practical engineering is not limited to the province of the expanding volume of work among the historical building stock. The knowledge gleaned from the history of theory of structures could become a functional element in the modern construction process because the unity of the three-dimensionality in the historicity of structures is an intrinsic anticipation in this; for the engineering science theory formation and the research trials, the conception, the calculation and the design as well as the fabrication, erection and usage can no longer be separated from the conversion, preservation and upkeep of the building stock. The task of the history of theory of structures lies not only in feeding the planning process with ideas from its historical knowledge database, but also in introducing its experiences from work on historical structures into the modern construction process. In this sense, the history of theory of structures could be further developed into a productive energy in engineering.

When engineers conceive a building, they have to be sure, even before the design process begins, that it will function exactly as envisaged and planned. That applies today and it also applied just the same to engineers in Roman times, in the Middle Ages, in the Renaissance and in the 19th century. All that has changed is the methods with which engineers achieve this peace of mind. Bill Addis has written a history of design engineering and construction which focuses on the development of design methods for buildings (*Fig. 6*).

Bill Addis looks into the development of graphical and numerical methods plus the use of models for analysing physical phenomena, but also shows which methods engineers employ to convey their designs. To illustrate this, he uses examples from structural engineering, building services, acoustics and lighting engineering drawn from 3,000 years of construction engineering history. Consequently, the knowledge gleaned from the history of theory of structures serves as one of the cornerstones in his evolution of the design methods used by structural engineers.

Roberto Gargiani pursues an artefact-based approach in his collection of essays on columns (*Fig. 7*), which are presented from the history of building, history of art, history of construction engineering, history of science and history of structural theory perspectives. The discipline-oriented straightforwardness of the history of theory of structures is especially evident here.

Didactic tasks

The work of the American Society for Engineering Education (ASEE), founded in 1893, brought professionalism to issues of engineers' education in the USA and led to the formation of engineering pedagogy as a subdiscipline of the pedagogic sciences. In the quarterly "Journal of Engineering Education", the publication of the ASEE, scientists and practitioners have always reported on progress and discussions in the field of engineering teaching. For example, the journal reprinted the famous "Grinter Report" [43], [44, pp. 74-94], which can be classed as a classic of engineering pedagogy and which calls for the next generation of engineers to devote 20 % of their study time on social sciences and the humanities, e.g. history [44, 1994, p. 82]. Prior to L. E. Grinter, another prominent civil engineering professor who contributed to the debate about the education of engineers was G. F. Swain. In his book "The Young Man and Civil Engineering" (*Fig. 8*), Swain links the training of engineers with the history of civil engineering in the USA [45].

Nevertheless, students of the engineering sciences still experience the division of their courses of study into foundation studies, basic specialist studies and further studies as a separation between the basic subjects and the specific engineering science disciplines, and the latter are often presented only in the form of the applications of subjects such as mathematics and mechanics. Even the applied mechanics obligatory for many engineering science disciplines at the fundamental stage are understood by many students as general collections of unshakeable principles – illustrated by working through idealised technical artefacts. Closely related to this is the partition of the engineering sciences in in-depth studies; they are not studied as a scientific system comprised of specific internal relationships, for example, but rather as an amorphous assemblage of unconnected explicit disciplines whose object is only a narrow range of technical artefacts. The integrative character of the engineering sciences thus appears in the form of the additive assembly of the most diverse individual scientific facts, with the result that the fundamental engineering science disciplines are learned by the students essentially in the nature of formulas. The task of a history of theory of structures is to help eliminate the students' formula-like acquisition of theory

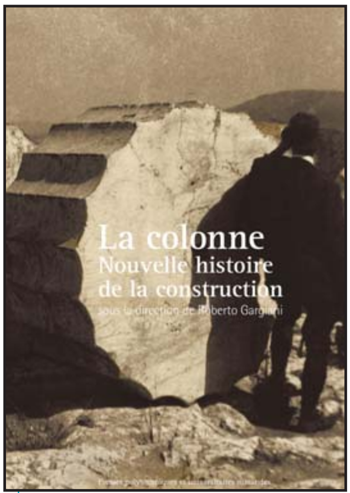


Figure 7:
Cover to the collection of essays on columns [42]

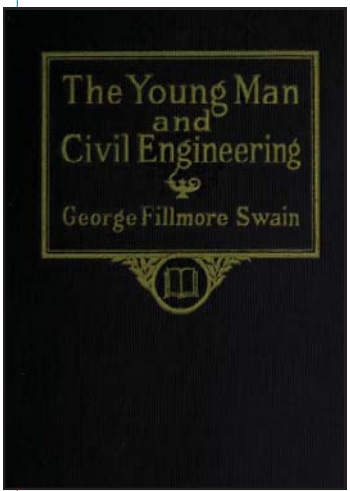


Figure 8:
Cover of Swain's "The Young Man and Civil Engineering" [45]

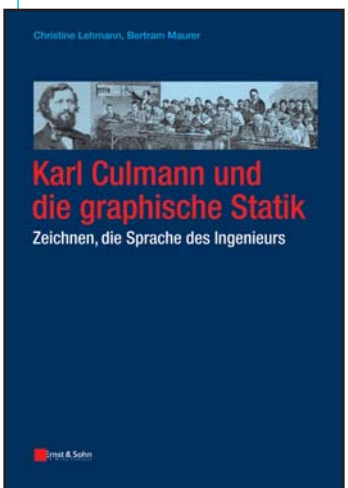
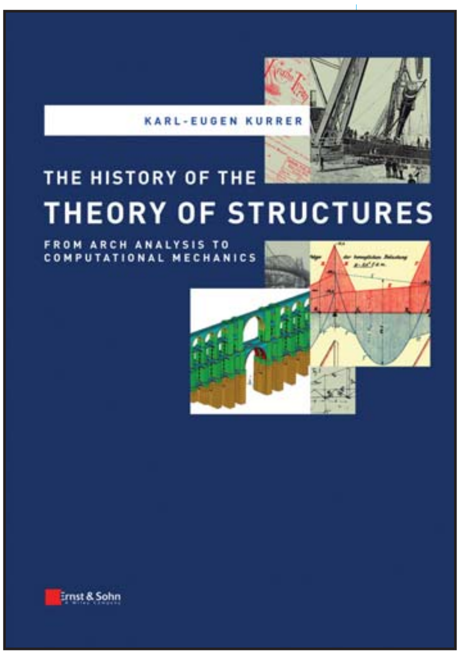


Figure 9:
Cover of the biography of Karl Culmann [47]



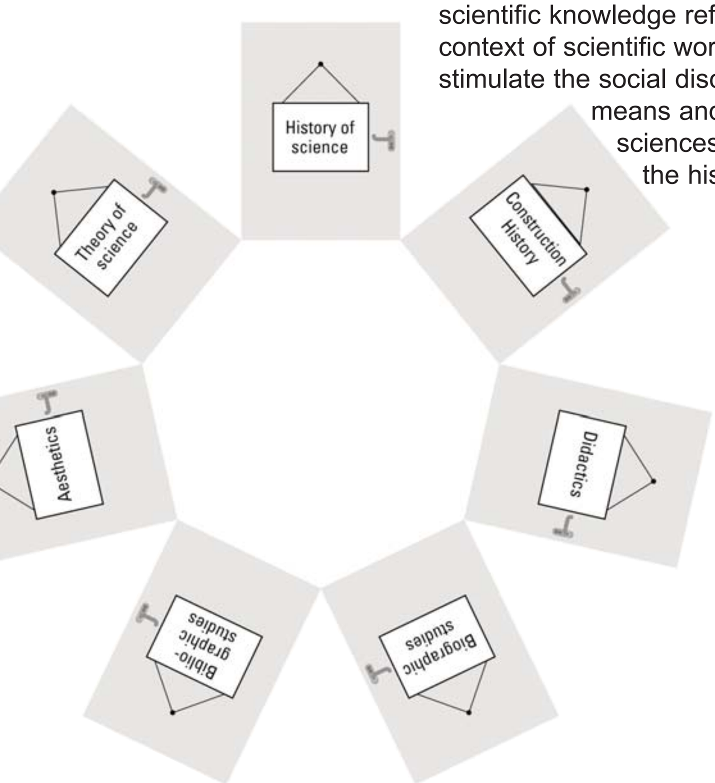
of structures. In doing so, the separation of the teaching of theory of structures into structural analysis for civil and structural engineers and structural engineering studies for architects presents a challenge. Proposals for a historicised didactic approach to structural engineering studies have been made by Rolf Gerhardt [46]. Introducing the historical context into the teaching material of theory of structures in the project studies in the form of a historic-genetic teaching of structural theory could help the methods of structural engineering to be understood, experienced and illustrated as a historico-logical development product, and hence made more popular. The history of theory of structures would thus expand significantly the knowledge database for a future historic-genetic method of teaching for all those involved in the building industry.

Figure 10: *Cover of the author's book [50]*

Cultural tasks

There is an elementary form of the scientist's social responsibility: the democratising of scientific knowledge through popularising; that is the scientist's account of his work – and without it society as a whole would be impossible. Popular science presentations are not just there to provide readers outside the disciplinary boundaries with the results of scientific knowledge reflected in the social context of scientific work, but rather to stimulate the social discussion about the means and the aims of the sciences. Consequently, the history of theory of structures, too, possesses an inherent cultural value. The author Christine Lehmann, together with her partner the mathematics teacher Bertram Maurer, has written a biography of Karl Culmann (*Fig. 9*) based on Maurer's dissertation [33] in which the results of research into the history of theory of structures are presented to the layman in an understandable, narrative fashion within an appealing literary framework.

Figure 11: *Seven gates to the knowledge of the history of theory of structures*



The individual sciences physics, biology and even chemistry transcend again and again the boundaries of their scientific communities. This may be due to their role as constituents of worldly conceptions and the close bond with philosophy and history. But the same does not apply to the engineering sciences; even fundamental engineering science disciplines find it difficult to explain their disciplinary intent in the social context. The fragmentation of the engineering sciences complicates the recognition of their objective coherence, their position and function within the ensemble of the scientific system and hence their relationship as a whole to the society that gave birth to them and which surrounds them. This is certainly the reason why the presentations, papers and newspaper articles of the emeritus professor of structural analysis Heinz Duddeck plead for a paradigm change in the engineering sciences, which in essence would result in a fusion between the engineering sciences and the humanities [48]. As the history of theory of structures forms a disciplinary union between structural analysis and applied mechanics with input from the humanities (philosophy, general history, sociology, histories of science, technology, industry and engineering), it is an element of that fusion. It can therefore also assist in overcoming the "speechlessness of the engineer" [49].

Aims

The aim of a history of theory of structures therefore consists of solving the aforementioned scientific, practical engineering, didactic and cultural tasks. The book "The History of the Theory of Structures. From Arch Analysis to Computational Mechanics" (*Fig. 10*), written from the didactic, scientific theory, construction history, aesthetic, biographical and bibliographical perspectives (*Fig. 11*), aims to provide assistance. With this in mind, I would like to invite you to join me in a journey through the history of theory of structures. Experience the moment, make it your own and give it as a gift.

●

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The Problem of Verification with reference to the Girkmann Problem

by
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I. Babuska [2] &
B. Szabo [3]

In the January, 2008 issue of IACM Expression we presented a problem, called the Girkmann problem [1], and invited readers to solve that problem, report the data of interest and *verify that the reported data are within 5 percent of their exact counterparts.* The data of interest were:

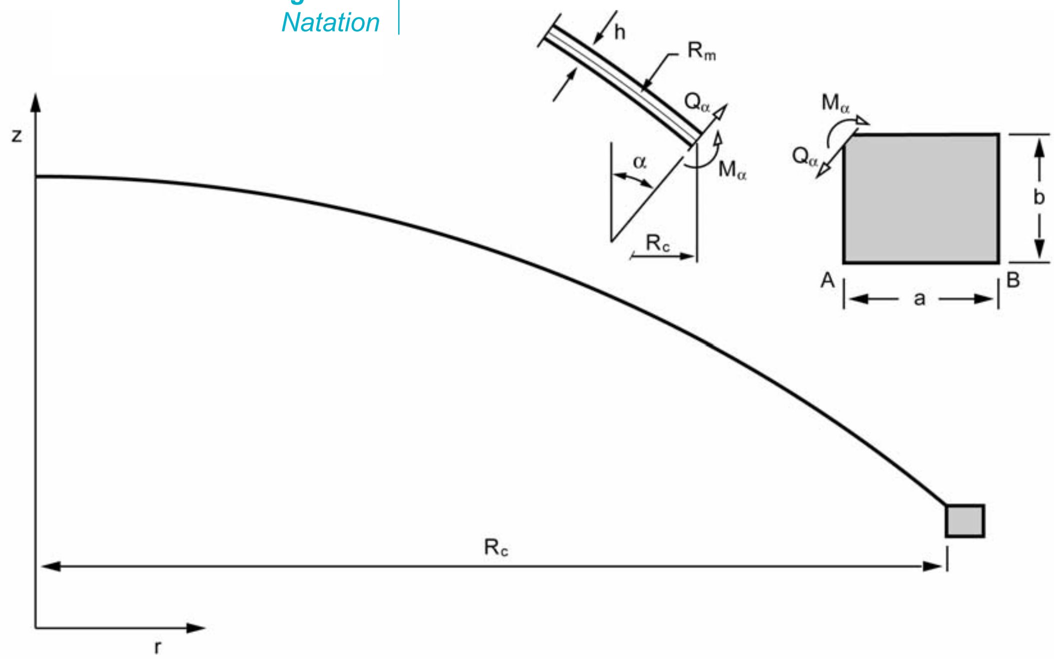
(a) the bending moment at the junction of the shell and the ring
(b) the shear force at the junction of the shell and the ring,
(c) the maximum bending moment in the shell and
(d) its location characterized by the meridional angle.

The primary purpose of this exercise was to assess how analysts, working with commercially available finite element software tools, would meet the requirement of verification, given this problem.

By the term verification we understand a process by which it is verified that the approximate solution differs from the exact solution of the mathematical problem by not more than an acceptable tolerance. In our case the mathematical problem is to determine the data of interest based on the three-dimensional linear elasticity formulation, assuming that the material properties and the loads are as specified in the problem statement. It is possible to prove that the exact solution exists and is unique. This implies that the data of interest are finite.

Since the exact solution of this problem is not known, the error in the numerical solution has to be estimated. It is not easy to obtain guaranteed upper and lower bounds of the error in the data of interest. In practice the best way is to compute a sequence of finite element solutions corresponding to a converging sequence of discretizations. Since the exact solution is independent of the discretization, a necessary condition for the errors in the data of interest to be small is that the data of interest are substantially independent of the discretization. To make a stronger statement, namely that the errors in the data of interest are within a given tolerance, involves extrapolation and judgment that the extrapolated values are sufficiently close to their exact counterparts to justify making that statement. Although this approach will not give guaranteed error bounds, it is very reliable. We emphasize that this method of error estimation is based on the assumption that convergence of the sequence of discretization has been proven. If the sequence of the discretized solutions does not converge then the numerical treatment is not correct even if in some cases it produces credible results.

Figure 1: *Natation*



In a forthcoming paper we will present a detailed description of the verification procedure used to arrive at the following results which, in our professional opinion, are within 2 percent of their exact values:

- Bending moment at the shell-ring interface: -36.81 Nm/m
- Shear force at the shell-ring interface: 0.9436 kN/m
- Maximum bending moment: 255.1 Nm/m
- Meridional angle of the location of the maximum bending moment: 38.15 degrees

These results are based on the assumption that the shell is loaded, as described in the problem statement, but the footring is weightless. In order to underline our confidence in the statement that these data are within 2 percent of their exact counterparts, we hereby offer 1000 USD to the first person who presents evidence that the error in any one of the given stress resultants is greater than 2 percent.

We received 15 solutions.
Respondents used various models: axisymmetric solids, axisymmetric shell-solid combinations, three-dimensional solids and three-dimensional shell-solid combinations. The data of interest were computed by direct integration, from nodal forces and by extraction procedures. Not all respondents included estimates of the location and magnitude of the maximum bending moment and not all respondents presented details on how verification was performed. Of the 15 solutions received, 4 utilized the p-version of the finite element method for verification, 11 utilized the h-version.

The results based on the p-version were well within the 5 percent tolerance specified in the problem statement and respondents provided demonstration of convergence of the data of interest. On the other hand, the results based on the h-version had a very large dispersion. The reported data were within the allowed tolerance of 5 percent in only two of the eleven cases. These two solutions were generated by means of the same commercial finite element analysis software product and the same analyst who used:

(a) an axisymmetric shell-solid model &
(b) a three-dimensional solid model.

This analyst did not present evidence of h-convergence, however stated that the prior information published in [2] was used for the stopping criterion.

One respondent attempted to demonstrate h-convergence for a three-dimensional shell-solid model on one quarter of the spherical shell using six successive mesh refinements. In the sixth refinement 120 million degrees of freedom were used. The sequence of moments corresponding to the six refinements still had not converged but appeared to tend to approximately -225 Nm/m and the shear force appeared to have converged to approximately 11.3 kN/m.

Another respondent wrote: *"Regarding verification tasks for structural analysis software that has adequate quality for use in our safety critical profession of structural engineering, the solution of problems such as the Girkmann problem represents a minuscule fraction of what is necessary to assure quality."* We agree with this statement. That is why we find it very surprising that the answers received had such a large dispersion. For example, the reported values of the moment at the shell-ring interface ranged between -205 and 17977 Nm/m. Solution of the Girkmann problem should be a very short exercise to persons having expertise in FEA, yet many of the answers were wildly off.

The results indicate that the requirements of verification pose challenges that users and vendors of commercial finite element analysis software products should address. ●

"... the requirements of verification pose challenges that users and vendors of commercial finite element analysis software products should address."

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Optimization for Human Well-Being

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APERIO Tecnología en Ingeniería
and
S. Carbes & A. Kiis
AnyBody Technology

Human well-being and system performance is a multi-faceted field that often requires optimisation within the field of ergonomics. Simulation software such as the AnyBody Modelling System provides a unique tool for analysing the muscular-skeletal system of humans (and animals) that for given movements allows the computation of muscle forces, joint reactions, metabolism, mechanical work and efficiency. The use of this analysis tool permits the quantitative analysis of movement patterns, working positions and anthropometric data, enabling automatic optimization to be carried out.

An integrated simulation process has been set up within the optimization software modeFRONTIER, using AnyBody to calculate the muscular-skeletal forces for general movements using a full muscular-skeletal human model to optimise general aspects in common life. The optimisations included here are: a) determining the stiffness and position required for an accelerator pedal, and b) determining the seat position of a wheel chair to minimize the force required to move it.

Introduction

Nowadays Multidisciplinary Design Optimization (MDO) is becoming more and more commonly used in several engineering fields, the aeronautical and automotive industry and as well in some fields of structural design. The application of optimization algorithms, such as gradient based or genetic algorithms and Pareto Frontier methods to optimize the trade-off, are gaining more recognition due to their efficiency and success to satisfy the intended requirements of complex engineering designs.

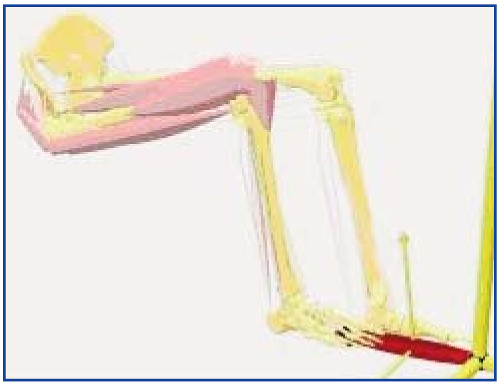


Figure 1: Model of legs and pedal

However, little, or no use at all, has been done in applying these techniques in the study of biomechanics or muscular-skeletal dynamics. For instance in the case of the aeronautical industry, the physical modelling may be mathematical or experimental but the simulation of "human interaction" effects, in the use of flight simulators for example, has not been included to date.

Analysing the response of the human body to improve the comfort and performance when interacting within the environment and under several physical conditions requires a multi-disciplinary analysis since several assignments must be accomplished to achieve such an objective.

A muscular-skeletal biomechanical analysis by itself is a complex task since it involves the interaction between several body parts. The AnyBody Modelling System enables the analysis of the muscular-skeletal system by computing muscle forces, joint reactions, metabolism, mechanical work and efficiency for several types of movements. Based on this framework, it is therefore possible to quantitatively analyze movement patterns, working positions and anthropometric data which in turn enables automatic optimization to be carried out.

Now if an optimization of the interaction between the human body and any object is desired, it will have to be performed within a Multidisciplinary Design Optimization (MDO) framework in order to take into account all the factors in this complex task. To achieve this type of analysis use is made of the multi-objective and multi-disciplinary design optimization software modeFRONTIER providing a design environment that allows easy coupling to almost any computer-aided-engineering (CAE) tool.

modeFRONTIER multi-objective Solutions

Optimization refers as the act, process, or methodology of making a design, system, or decision, as fully perfect, functional, or effective as possible.

modeFRONTIER can be used as an integrated platform or a design environment for multi-objective (where the objectives are kept separate throughout the optimization process, rather than being collapsed into a single, weighted objective function from the beginning), and multi-disciplinary design optimisation allowing easy coupling to almost any computer-aided-engineering (CAE) tool that uses a variety of state-of-the-art optimization techniques, ranging from gradient-based methods to the increasingly popular genetic algorithms, where users can optimize their process or product by specifying objectives and defining variables that affect factors such as geometric shape and operating conditions.

The optimization process starts from an initial population of designs generated by means of the most efficient DOE (Design of Experiments) techniques and then the design space exploration is conducted to determine the trade-off curve (Pareto Frontier) in the objective space. A trade-off curve result is typical for problems involving an optimization containing more than one, and often, conflicting objectives, where there is no fixed optimal solution, but rather a set of optimal solutions. The whole process, from the DOE generation to the Pareto Frontier identification is carried out in an efficient and automated way by modeFRONTIER [1].

The AnyBody muscular-skeletal modelling system

The AnyBody Modelling System is designed for constructing complex models of the human body and for determining the environment's influence on the body. Its computational efficiency is obtained by using an inverse dynamics algorithm and the analysis proceeds through a sequence of time steps identifying each segment's position, velocity and acceleration at each time step.

However, kinematics is the initial stage that plays a very important role in the process of muscular-skeletal analysis. While kinematics for mechanical analysis is a well-developed field, the modelling of the human body still requires additional and quite special facilities to be considered. The AnyBody Modelling System uses the Cartesian formulation of the kinematic problem, in which each segment has six independent degrees of freedom, and constraints corresponding to joints are imposed on the full system of equations. All segments of the mechanical system are modelled as rigid bodies, neglecting effects such as the wobbly masses of soft tissues.

The generality of the Cartesian method facilitates the implementation of useful features in the kinematic system. This is a major advantage in muscular-skeletal modelling, where the complications of the human body kinematics and interfaces to the experimental techniques used in the field call for special considerations in the software architecture, see AnyBody Modelling System [2] and Rasmussen et al [3].

Pedal design for the automotive sector

According to the automotive industry a good pedal design should provide an effortless but precise operation. This example examines how the pedal stiffness and the distance between the seat and the pedal influence the muscular effort in operating the pedal.

Consider a pedal hinged at one end and equipped with a torsion spring that stretches when the pedal is depressed. The dilemma is the following: if the spring is too weak, then the pedal will not provide much support for the leg, and the operator has to extend and hold the leg up against gravity, this will become very tiring. On the other hand, if the spring is too rigid, then the muscular

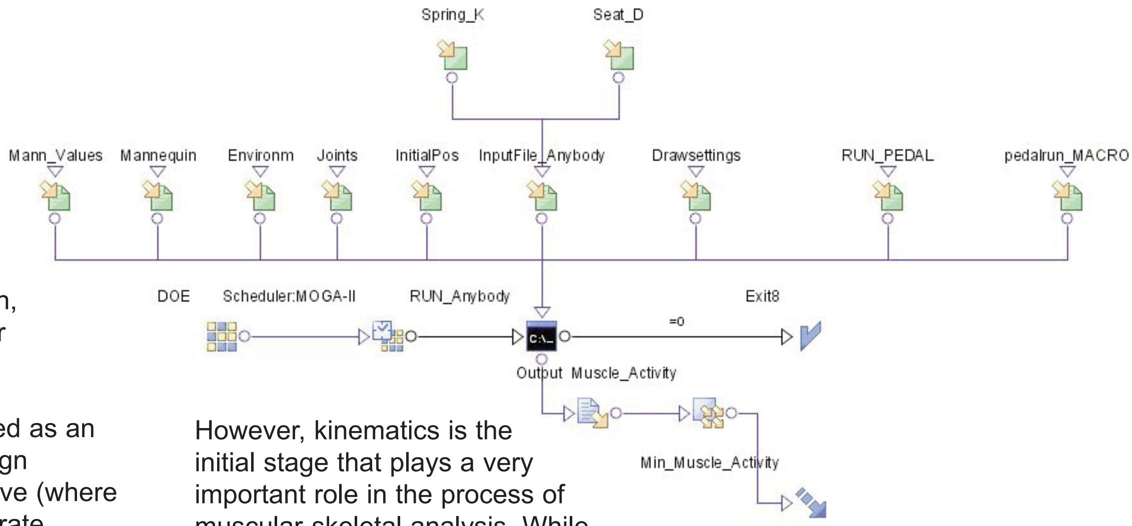


Figure 2: *Integrated process within modeFRONTIER*

“ The use of this analysis tool permits the quantitative analysis of movement patterns, working positions and anthropometric data, enabling automatic optimization to be carried out.”

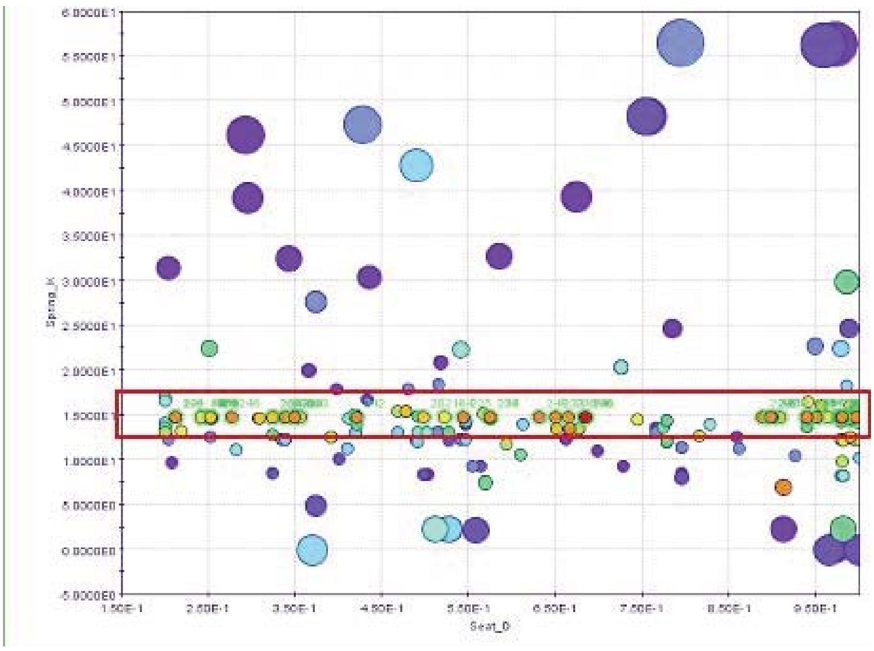


Figure 3:
The design chart showing the optimal designs marked in red square

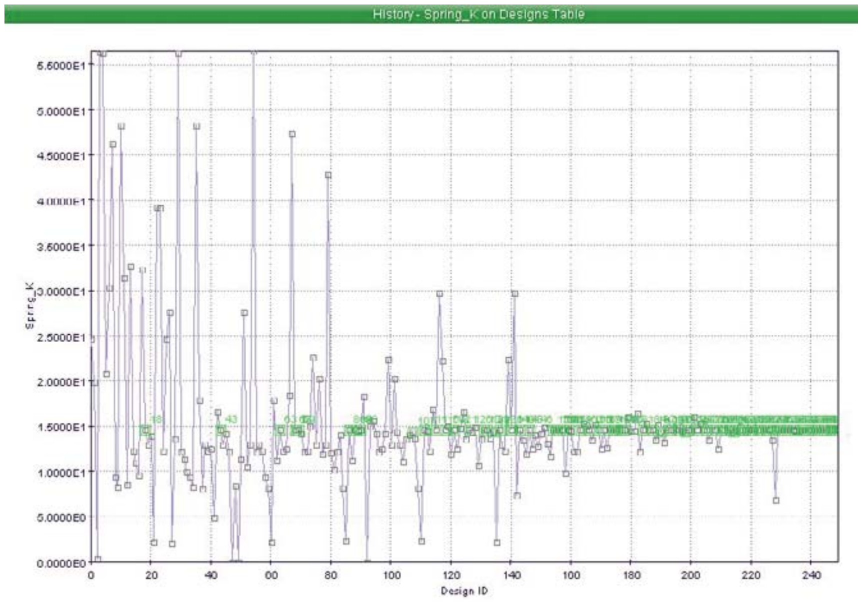


Figure 4:
Scatter matrix of statistical results for the pedal design optimisation

effort of depressing it will become too large and repetitive operation of the pedal or static maintenance of a particular pedal position will cause fatigue. Similarly, different seat positions influence the muscular effort.

Even a simple model problem like this is too complicated to be thoroughly investigated by experimental methods. By coupling the muscular-skeletal modelling software inside the optimisation software it is possible to perform a systematic optimization to find the best solution of the spring stiffness and the seat position.

An initial DOE of 9 designs was generated using the SOBOL algorithm within modeFRONTIER to attempt to cover the design parameter space as much as possible. Then the MOGA algorithm was used to find the Pareto frontier, submitting a total of 250 simulations.

In Figure 3, the optimised results represented by the Pareto designs are shown in the red square. In Figure 4 the correlation value and the Probability Density Function between the muscle activity, the seat distance and the spring stiffness are shown.

Figure 4 indicates that the vital parameter is the pedal spring stiffness, almost irrespective of the distance of the seat from the pedal, since the correlation factor between muscle activity and the spring stiffness is 0.66, meanwhile for the case of the pedal distance this is only 0.1. Fig. 3 reveals that a spring stiffness of around 15 Nm/rad will result in a comfortable pedal operation with little influence from the seat position. The results presented here can be considered as an initial study that provides valuable information for designers.

Wheel chair improvement for medical rehabilitation

A very large proportion of wheelchair users experience load-induced shoulder pain. This happens after several years of use, and it can be a very serious condition for an individual relying entirely on the arms for ambulation.

The wheelchair parameters such as wheel diameter, push-rim position, axle position, and camber influence the shoulder forces during use. But precisely how?

Figure 5:
Model of upper body moving the wheelchair

This is a field where the consequences of a design change do not appear until after several years of use. This alone makes experimentation impossible but it is also ethically unacceptable to fit wheelchairs to humans in any other way than following best practice. In other words, computer simulation is the only way to gain knowledge about the influence of the wheelchair design on body loads. The model in Figure 5 was used to investigate the gleno-humeral joint forces as a function of the axle position through a forward push on the push-rim. This is done via the model parameters: seat height (relative to the axel) and seat position (the forward distance between the pelvis and wheel axes). The initial given design had a seat height of 196mm and a seat position of 191mm producing a gleno-humeral joint force of 759.5N; these two parameters were optimised in order to reduce the shoulder forces as much as possible.

The problem was integrated into modeFRONTIER and an initial DOE of 5 designs was generated using the RANDOM algorithm to cover the parameter space. Then the MOGA algorithm was used to find the optimum, submitting a total of 40 simulations, of which 12 produced incorrect models that were not run (this is detected and indicated by the software).

Figure 6 shows all the feasible designs in a 4D bubble chart in which the original and optimal designs are indicated showing the difference in the variables between the two designs. The parallel chart presented in Figure 7 is useful to filter unwanted or un-useful designs. Figure 8 presents similar information to that in Figure 4 for seat position, seat height and the gleno-humeral force. Figure 9 presents a RSM surface, which can be used in future design optimisations combining real and virtual simulations.

The optimised results presented in Figures 6 and 7 indicate that even a slight movement of the seat can be important to reduce the shoulder forces. The optimal design indicates that with a seat height of 132mm and seat position of 98.6mm the gleno-humeral force is reduced to 589.6N. Comparing this with the original design, seat height 196mm and seat position 191mm where the gleno-humeral force was equal to 759.5N, we have obtained a reduction of 22.4 % in the shoulder force by lowering the seat height by 64mm and moving the seat position backwards by 92.4mm.

From Figure 8 we can observe that the imperative parameter in the wheelchair design is the seat height with the effect of the seat position being almost negligible. It may even be thought that a reduction of the force could be obtained by just adjusting the seat height. However, it is observed that there is a correlation factor between the seat height and the seat position of 0.125 that may affect the results if the effect of the seat position is disregarded completely.

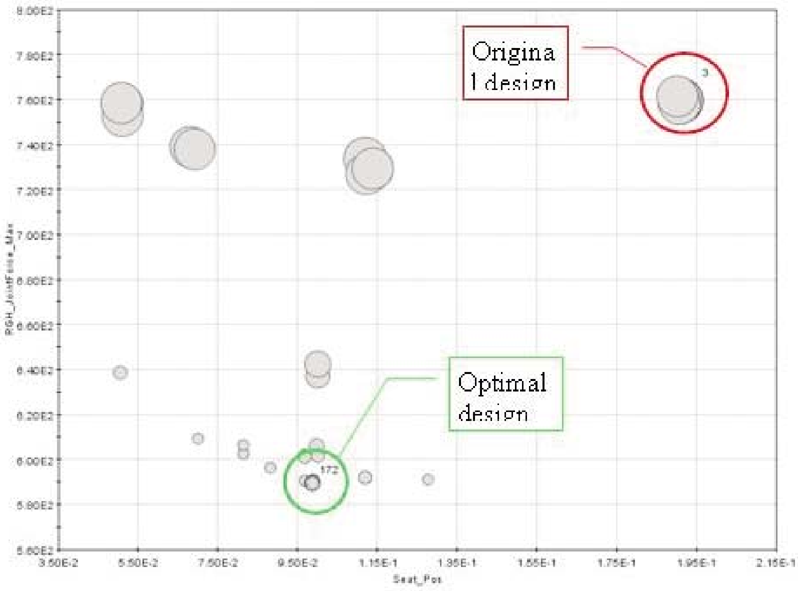
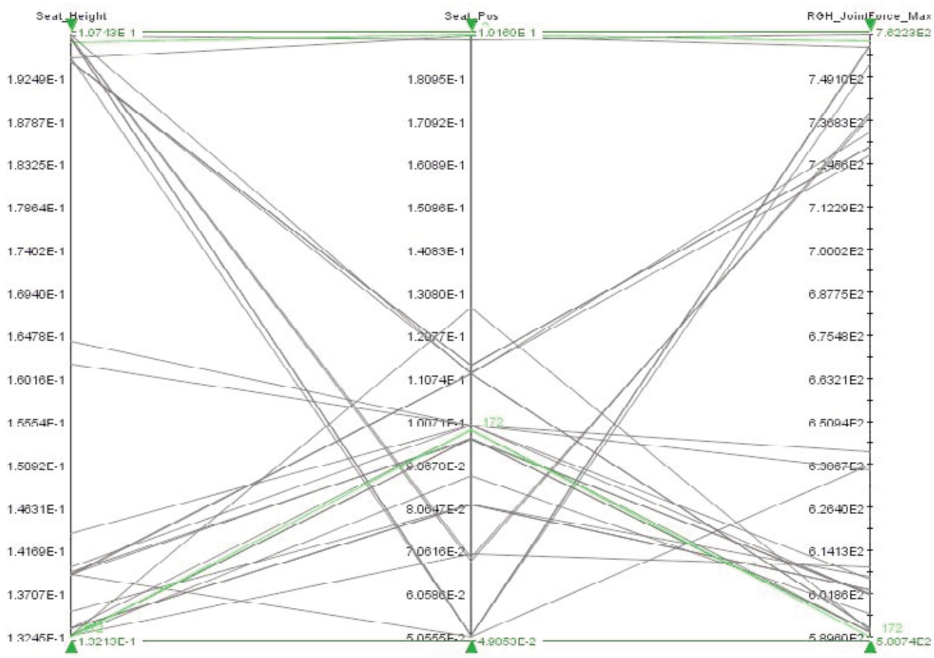


Figure 6:
Bubble chart showing the original and the optimal designs

Figure 7:
Parallel chart including all feasible designs



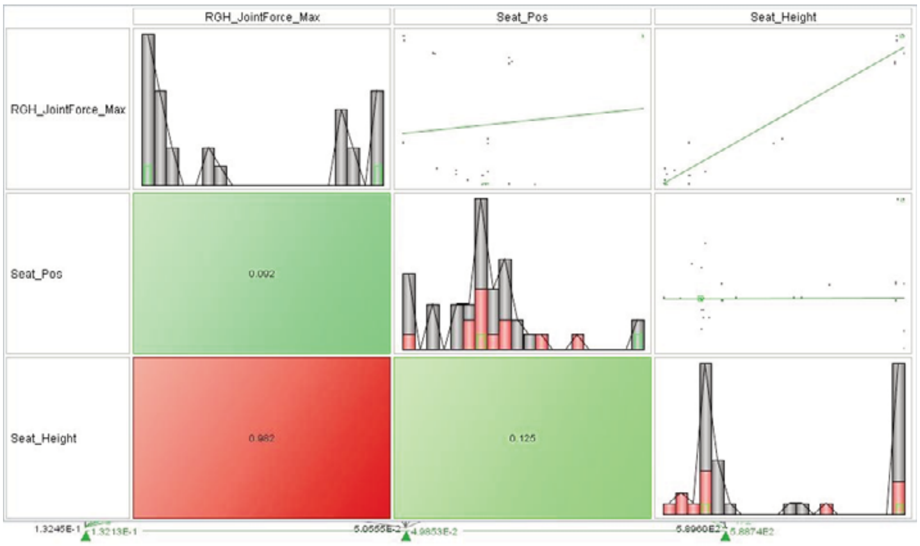


Figure 8: Scatter matrix of statistical results for the wheelchair design optimisation

If the seat position factor is neglected and only the seat height parameter is modified (seat height 132mm and seat position 191mm) the reduction factor is reduced to 13.3 % (force equal to 658N), therefore this correlation may not be ignored.

This AnyBody simulation requires significant computer time and so it is possible to create a Response Surface Methodology to speed up the optimization process. The RSM presented in Figure 9 is obtained implementing the Cartesian Anisotropic Kriging regression method using a Gaussian variogram. The RSM chart may also be useful in exploring solutions in areas where real analytical results have not been obtained or when a combination of experimental and analytical data is needed.

Conclusions

It has been shown that the integration of the AnyBody software into the optimization environment of modeFRONTIER results in a very helpful tool to calculate and optimise the muscular-skeletal forces for general movements of the human body to optimise ergonomic situations.

It is shown that it is convenient to create a Response Surface Methodology to speed up the optimisation process as in the case of time consuming or computationally exhaustive processes, such as the one presented here for the wheelchair optimisation. ●

References

[1] **modeFRONTIER** v4.0 User manual. ESTECO Srl, Trieste, Italy, 2008.

[2] **AnyBody Modelling System** v3.0 *User Manual. AnyBody Technology* A/S, Aalborg, Denmark, 2008.

[3] *Rasmussen, J., Damsgaard, M., Christensen, S.T., Surma, E. Design* optimization with respect to ergonomic properties. **Structural and Multidisciplinary Optimization**, 2002, v24, pp89-97.

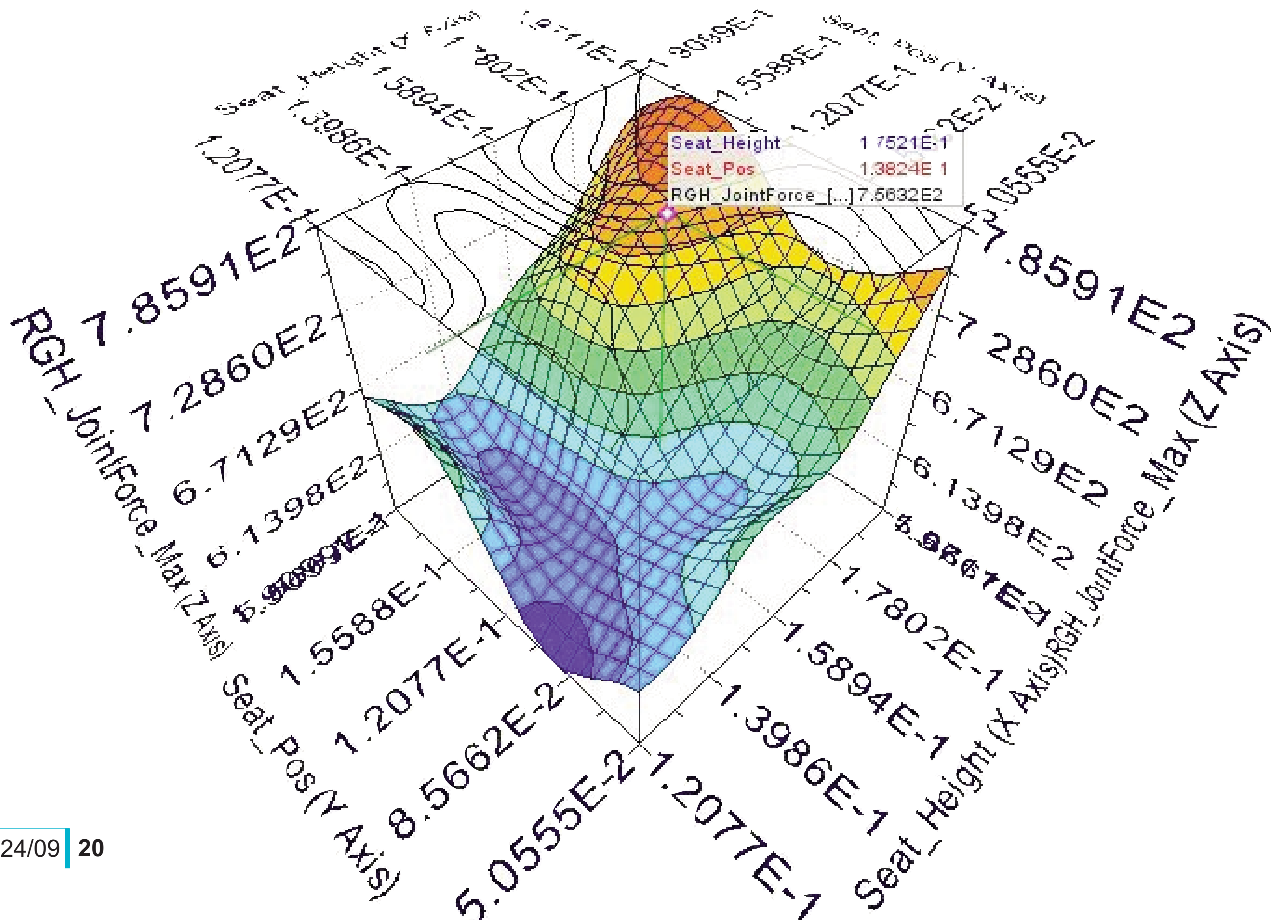


Figure 9: RSM surface

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19- 23 JULY SYDNEY AUSTRALIA

Joint

IX World Congress on Computational Mechanics

and

IV Asian Pacific Congress on Computational Mechanics

The Joint 9th World Congress on Computational Mechanics and 4tht Asian Pacific Congress on Computational Mechanics will be held in Sydney, Australia during July 19-23, 2010 under the auspices of Australian Association for Computational Mechanics (AACM), Asian Pacific Association for Computational Mechanics (APACM) and International Association for Computational Mechanics (IACM).

Sydney is one of the most beautiful cities in the world. It has a reputation for friendly people, a cosmopolitan lifestyle, wonderful shopping and world class entertainment. Sydney's magnificent harbour, renowned Opera House and sunny beaches combined together make this city a unique destination.

"Early planning for the congress is well underway and we have put together a magnificent program for our guests. Sydney is colourful, sophisticated, vibrant and progressive, with everything needed to make the congress an outstanding success", says Professor Khalili, Chairman of WCCM/APCOM 2010. The congress and exhibition will be held at the Sydney Convention and Exhibition Centre at Darling Harbour, which is adjacent to the heart of the city. The centre offers first class facilities to delegates, presenters and exhibitors alike and is the focal point of Darling Harbour which itself is alive with shops, restaurants and visitor attractions. Hotel accommodation of all standards is within walking distance from the Convention Centre.

The format of the congress will be based on the previous congresses in the sense that a number of Mini-Symposia will be organized by leading academics and researchers on latest developments in computational mechanics applied to various fields of engineering, science and applied mathematics. Plenary and Semi-Plenary lectures on important, recent developments in computational mechanics will be delivered by leading authorities in these fields.

For further information, please contact Conference Secretariat or register your interest online at **www.wccm2010.com**

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IACMM Israel Association

For all inclusions under Israel Association for Computational Methods in Mechanics (IACMM)

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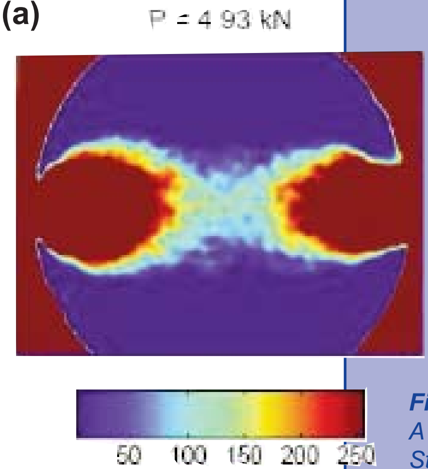
The Israel Association for Computational Methods in Mechanics (IACMM) has held two IACMM Symposia since our last report (see IACM Expressions No. 22). In this issue we shall report on them.

The **23rd IACMM** Symposium was held in October 2007 at the Weizmann Institute of Science (WIS), for the first time in the IACMM history. This first experience at WIS was a big success. The local organizers were Rami Ben-Zvi and Einat Aharonov from the Department of Environmental Sciences and Energy Research. A fascinating Opening Lecture was given by Prof. Spencer Sherwin, from Imperial College, London, and was entitled *"Arteries and Algorithms: Multi-scale Modeling of Flow in the Cardiovascular System."* See *Figs. 5 and 2*. *Figure 3* is a photo taken after the end of the Symposium.

We were also honored to host during this Symposium Prof. Jiri Plesek, from the Institute of Thermomechanics, Academy of Science of the Czech Republic, and two of his colleagues. Prof. Plesek gave an interesting talk on computation of elastic wave propagation in pre-stressed solids. See *Figures 1(a) and (b)*, and *Figure 6*.

(a)



(b)

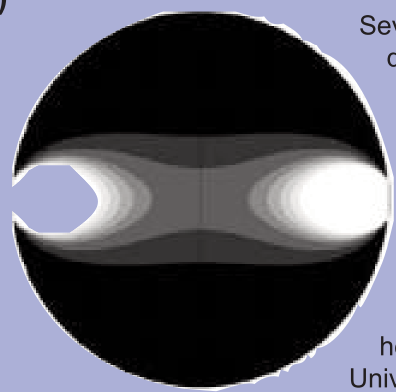


Figure 1:
A figure from Jiri Plesek's talk. Stress field in a thin disc: (a) measured and (b) computed.

Seven additional lectures were given during the Symposium, including a Keynote Lecture by Joseph Falcovitz, who presented his work with Matania Ben-Artzi from the Hebrew University in Jerusalem, on GRP conservation laws scheme.

The **24th IACMM** Symposium was held in April 2008 at Tel-Aviv University. The local organizers were Slava Krylov and Alex Gelfgat. The Opening Lecture was given by

Figure 2:
Computed blood flow: a figure from the Opening Lecture of Spencer Sherwin.

Figure 3:
IACMM council members, local organizers of the 23rd IACMM Symposium and the Guest Speaker. From left to right: Rami Ben-Zvi, Michael Engelman, Einat Aharonov, Dan Givoli, Spencer Sherwin, Emanuel Ore and Amiel Herszage

Prof. Jacob Fish, an international leader in multiscale computation, from Rensselaer Polytechnic Institute (RPI). *See Figure 4*. The lecture was a tour de force of the use of multiscale technology in computational solid mechanics. *Figure 7* is a photo taken during a special dinner in honor of Prof. Fish.

Eight additional talks followed the Opening Lecture, including a Keynote Lecture given by Alex Yakhot from Ben-Gurion University on application of CFD for cardiovascular flows. The Symposium ended with an eye-opening 90 minute Tutorial Lecture given by Zohar Yosibash, also from Ben-Gurion University, on Computational Biomechanics.

An additional major CM event that took place in Israel recently was the 18th International Conference on Domain Decomposition Methods (DD-18).

It was held at the campus of the Hebrew University in Jerusalem during 12-17 January, 2008.

The conference was a great success owing to the superb talks which were all plenary and to the endless efforts of the local organizer, Michel Bercovier. ●

Figure 4:
Jacob Fish giving an Opening Lecture at the 24th IACMM Symposium.

Figure 5:
Specner Sherwin giving an Opening Lecture at the 23rd IACMM Symposium.

Figure 6:
Jiri Plesek giving a talk in the 23rd IACMM Symposium.

Figure 7:
Hosts with the Guest Speaker of the 24th IACMM Symposium. From left to right: Zohar Yosibash, Dan Givoli, Jacob Fish, Slava Krylov and Moshe Eisenberger.

The Japan Society for Computational Engineering and Science

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The Japan Society for Computational Engineering and Science (JSCES) hosted the thirteenth Conference on Computational Engineering and Science, which was held on May 19-21, 2008, at the Sendai Civic Hall (Sakuragaoka, Aoba-ku, Sendai). About 400 delegates attended the conference and about 300 papers were presented. The conference had 5 tracks and 33 sessions, each of which was organized by prominent researchers in each field of computational engineering and science, and lasted three days with full lectures, many of which were given by Japanese researchers as well as graduate students and young practitioners. Also, the conference invited Prof. Thomas J.R. Hughes (The University of Texas at Austin,) as a plenary lecturer who gave a talk entitled "Isogeometric Analysis: Progress and Challenges" (Figure 1). Moreover, we had a panel discussion, "Future Society Lead by Simulations" and organized a special session that collected papers on specific activities by ten CAE vendors and distributors in Japan. On the day before the conference, the JSCES organizes a special lecture class for meshfree methods and generalized/extended FEM.

Prior to the banquet held on the first day of the conference, we held the award ceremony, where the JSCES awarded various kinds of JSCES prizes to senior and young researchers and practitioners; this year's recipients are M. Siratori, Y. Tago, G. Yagawa (The JSCES Award), K. Kashiyama (Kawai Medal), H. Miyachi (Shoji Medal), S. Nishiwaki and Y. Yoshimura (Outstanding Paper Award), A. Sawada and T. Harada (Young Researcher Award). The JSCES established "The JSCES Grand Prize" and this year's recipient was Prof. T.J.R. Hughes for his longstanding and outstanding impacts in the field of computational engineering and sciences. Figure 2 shows T.J.R. Hughes and some of the recipients together with the founding president T. Kawai as well as past presidents M. Shoji and K. Fujii.

All the events in this conference were quite successful, which we welcomed lots of enthusiastic participants as well as high-standard presentations. The significance of JSCES's annual meeting has been determined as an established setting for the exchange of ideas in the field of computational engineering and science, and for the enlightenment of state of the art in this field. The effort will continue to have another conference in Tokyo, May 2009.

At present, the JSCES (the current president Prof. N. Takeuchi) has about 900 members, all of who are registered as international members of the IACM. The JSCES periodically publishes both quarterly magazines

Figure 1:
Plenary lecture by Prof. Thomas J.R. Hughes

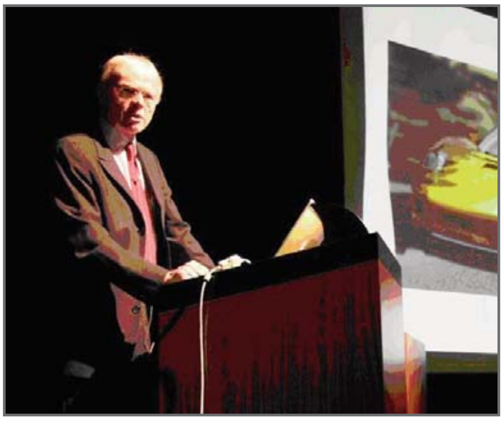

Figure 2:
Group shot of recipients of The JSCES Grand Prize, The JSCES Award, Kawai Medal, Shoji Medal, Outstanding Paper Award and Young Researcher Award.

Professor Hirohisa Noguchi (1959-2008)

On 22 August, 2008, Professor Hirohisa Noguchi passed away, after a yearlong battle with cancer. He was 48 years old and we mourn his premature death. We have lost an invaluable researcher, not only for Japanese community but also for the international computational mechanics community.

Prof. Hirohisa Noguchi, called Hiro by close friends, was appointed to prestigious and important posts in several Japanese academic societies, such as the Japan Society of Mechanical Engineers (JSME) and the Japan Society of Computational Engineering and Sciences (JSCES). In particular, he was a member of the Executive Committee at JSCES for 4years from 2004 and served as chairman of the organizing committee for the 10th and 11th JSCES Computational Engineering Conferences in 2004 and 2005, bringing them to highly successful conclusions. He also helped many overseas researchers by serving as a chairman, vice-chair or organizing committee member for several international conferences held in Japan. . In recognition of his manifold contributions during all of these activities, he became the first recipient of the Kawai Medal, bestowed by the JSCES in 2007.

Many readers of IACM Expressions may not be aware that Prof. Noguchi was interested in, and devoted a lifetime of effort to, adult education, especially in the field of computational mechanics, but also the mechanics of materials. In fact, he played a central role in the Certification Program for Computational Mechanics Engineers offered by the JSME, and was in charge of countless lecture classes and training sessions for industrial engineers engaged in computer-aided-engineering (CAE) in Japan. In this context, he also stressed the importance of Non Profit Organizations (NPO) for adult education, and served as a permanent representative for the Study Meetings of the Japan Association of Nonlinear CAE (JANCAE) for industrial CAE engineers. Everyone involved in these events was touched by Prof. Noguchi's expertise and kindness.

Those who knew Hiro as a friend and participant in major computational mechanics conferences such as IACM cannot forget their vivid impression of him, as he wore casual clothes, jeans and sweatshirt, a personal style that was eloquent evidence of his frank personality and honesty. In fact, he loved talking with anyone, without prejudice, and therefore was adored by students and colleagues alike, across generations. Those who were privileged to know him treasured his charm and genuineness, not only in academic research-oriented associations, but also in private and everyday communications.

Hiro will be missed by all of us and even more by his family. He leaves his wife, Ms. Kanako Noguchi, who often accompanied him at international conferences, and a son and daughter. We believe that if the many people around the world who were touched and stimulated by Prof. Hirohisa Noguchi can strive to follow in his footsteps, this will preserve and extend his important legacy.

Kenjiro Terada &Yuichi Tadano

The computational mechanics community lost our most precious treasure, when Professor Hirohisa Noguchi, Keio University, Japan, died on August 22nd, 2008. He was 48 years old. He is survived by his wife, Kanako, son, Yuta, and daughter, Anna.

Hiro was born in Osaka, Japan, September 1959. He started his professional career at Mitsubishi Research Institute, Inc. in 1982 after his graduation from Department of Aeronautics, the University of Tokyo. In 1989, he moved to academia and joined the Research Center for Advanced Science and Technology (RCAST), the University of Tokyo. In 1993, he received his Doctoral Degree of Engineering from the University of Tokyo. He joined Keio University in 1994, and was promoted as a Professor of Department of System Design Engineering, Keio University in 2002. He was also the Chair of the Center for Space and Environment Design Engineering, School of Science for Open and Environmental Systems, Graduate School of Science and Technology, Keio University.

His areas of interests include the formulation of nonlinear finite element method and mesh free method in solid and structural mechanics and their applications to industrial problems. Especially, he made great contributions in nonlinear mechanics, such as the Scaled Corrector Method for bifurcation buckling of large-scale structures, and the meshfree methods. Definitely, he has been one of the most advanced leaders of the community of nonlinear mechanics and meshfree method. Hiro's research interest was not only limited to the computational mechanics, but also was being extended to parallel computing, and computer sciences.

He has published more than 70-refereed scientific papers on the major journals. He was awarded K. Washizu Medal at the ICCES 2002 (International Conference on Computational & Experimental Engineering and Sciences). In 2006, He was awarded the first Kawai Medal from JSCES (Japan Society for Computational Engineering and Science). He also organized many international and domestic conferences.

Hiro was also an outstanding educator, and supervised many excellent students. Since he was very young, he has been eager in teaching and encouraging younger people. He had a very special ability to make appropriate advice, and to force people to extract their full potential. His open and frank personality attracted everybody from all generations. I am recalling days in recent one year, since his stomach cancer was found in October 2007. Although we had to encourage him to recover, we have been inversely inspired by his positive attitude. I remember he always mentioned "I shall return" after October 2007.

What we can do for his repose of his soul is to inherit his spirits and to pass them on to next generations, as Hiro has been always moving forward.

Dr. Kengo Nakajima

ENIEF 2009

XVII Congress on Numerical Methods and their Applications

Tandil, Argentina, November 3-6, 2009

For all inclusions under AMCA please contact:

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This congress is being organized by the PLADEMA Institute at the National University of the Center of Buenos Aires (UNCPBA), Argentina. The first ENIEF Congress took place in 1983. Since then seventeen ENIEF and eight MECOM (Argentine Congress on Computational Mechanics) have been organized by AMCA.

Conference Topics: Application of numerical methods in engineering problems, including the following topics: Fluid mechanics, Heat and mass transfer, Solid mechanics, Structural analysis, Multiphysics problems, Multiscale modeling, Biomechanics, Algorithms and software development, Computational mathematics, Computational geometry, Mesh generation and error estimation, High performance computing, Innovative computational methods, Inverse problems , Control and optimization, Industrial applications.

ENIEF 2008

XVII Congress on Numerical Methods and their Applications

10 - 13 November 2008, San Luis, Argentina

A new edition of the ***Congress on Numerical Methods and their Applications*** of the ***Argentine Association of Computational Mechanics (AMCA)*** was held from November 10th to November 13th, 2008 in San Luis, Argentina. *ENIEF 2008* has been the seventeenth edition of the congress, which was this time organized jointly by the Mathematics Department, Faculty of Physics, Mathematics and Natural Sciences of the National University of San Luis (UNSL) and the International Center for Computational Methods in Engineering (CIMEC-INTEC) from National University of Littoral (UNL) and the National Council for Scientific and Technological Research (Conicet). The congress was attended by more than 250 delegates, mainly from Argentina, but also from Brazil, Bolivia, Chile, Colombia, Mexico, Paraguay, Spain, United States, Uruguay, and Venezuela.

Full length papers were submitted to a review process prior to publication. From them, 228 papers have been accepted and included in the XXVII Volume of the AMCA Series "Mecánica Computacional". The editors of this volume were Alberto Cardona, Mario Storti and Carlos Zuppa. The papers

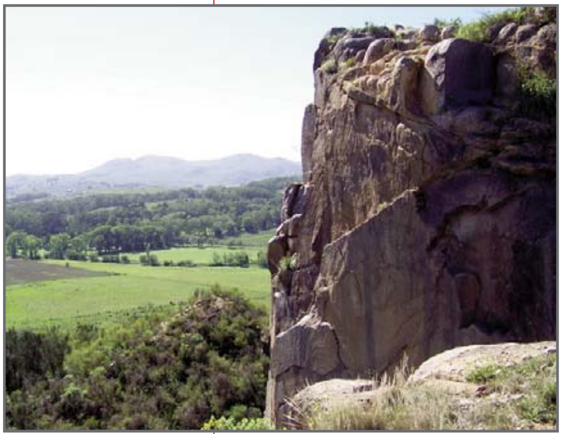
Figure 1: *Opening ceremony. Carlos Zuppa, congress organizer; Victorio Sonzogni, president of AMCA; Jorge Pellegrini, vice-governor of San Luis; José L. Riccardo, rector of UNSL; Félix Nieto, dean of the Faculty; and Alberto Cardona, congress organizer.*

Figure 2: *Participants at ENIEF 2008*

Important Dates:

Deadline for presenting a one-page abstract: May 8, 2009
Acceptance of the one-page abstract: May 22, 2009
Deadline for submitting the full length paper: July 10, 2009
Acceptance of the full length paper: August 10, 2009
Deadline for early payment: August 28, 2009

Organizing Committee - Presided by: Pablo A. Lotito, Marcelo J. Vénere



Tandil is a hilly nice city located at the center of the Buenos Aires State (350km from Buenos Aires City and 150km from Mar del Plata) at the time of the conference the spring weather is warm and the landscape is characterized by large crop fields on the valleys.

Further Information: **www.pladema.net/enief2009**
E-Mail: **enief2009@gmail.com**

of "Mecánica Computacional" are publicly available at the website: **http://www.cimec.org.ar/ojs/inex.php/mc/issue/archive** .

The event lasted four days and took place at the Main Building of the National University of San Luis. The technical program included five plenary lectures given by Professors Francisco Armero, Carlos Felippa, Raynald Löhner, Alan Needleman, and Xavier Oliver. A total of twenty one sessions, covering Fluid Mechanics; Turbulent Flow Simulation; Water Resources and Environmental Engineering; Acoustics; Multiphysics; Solid Mechanics; Structural Analysis and Design; Material Constitutive Modeling; Stability and Nonlinear Structures Behavior; Fracture, Fatigue and Failure Material Modeling; Heat Transfer; Structural Dynamics; Mathematical Fundamentals of Finite Elements and Meshless Methods; Interdisciplinary Mathematical Models; Inverse Problems and Applications; Optimization; High Performance Computing in Computational Mechanics; Computational Geometry; Aerospace Technology; Numerical Methods for Simulation and Analysis en Bioengineering; and Industrial Applications were run in parallel in four rooms.

Figure 3:
Some of the lecturers: S. Idelsohn, A. Needleman, R.Löhner and his wife and C. Felippa.

Eleven undergraduate students received scholarships covering living expenses at San Luis to assist to the congress. An undergraduate student posters competition was also carried out. The best papers received special prizes consisting in books kindly donated by Springer publisher editorial.

A cocktail reception was organized on Monday, with the very beautiful environment of Potrero de los Funes hotel. The ordinary annual assembly of AMCA was held on Tuesday. The Congress Banquet took place on Wednesday at the Quintana hotel, during which the 2008 AMCA prizes and best undergraduate papers were awarded.

Figure 4:
Relax time at a typical resto. Carlos Zuppa and Gloria Simonetti, from the local organizing comittee.

The congress received support from National Council for Scientific and Technological Research (CONICET), National Agency of Scientific and Technological Promotion (ANPCyT), San Luis province government, National University of San Luis, Faculty of Physics, Mathematics and Natural Sciences (UNSL), Department of Mathematics (UNSL), Springer publishers, Intel Argentina Software Development Center (Intel ASDC), KB Engineering S.R.L. and ESSS - Engineering Simulation and Scientific Software Ltda.

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CILAMCE2008

The XXIX Iberian Latin American Congress on Computational Methods in Engineering

The **29th Iberian Latin American Congress on Computational Methods in Engineering** (CILAMCE'08) was successfully held in Maceió, Alagoas, from **November 4 to 7, 2008.**

CILAMCE'08 was organized by the Federal University of Alagoas (UFAL) and The Brazilian Association of Computational Methods in Enginnering (ABMEC), with financial backing from PETROBRAS, CAPES, and CNPq. CILAMCE has consistently been the largest event on Computational Methods in Engineering in Latin America for the last 30 years. Having been held in Argentina, Spain, Italy, Portugal, and cities throughout Brazil, it is greatly important to the dissemination of scientific information about Computational Methods and solutions to theoretical and practical problems in engineering.

[This year, the 29th edition of CILAMCE was held for the first time in the beautiful city of Maceió. Attendance reached nearly 500 people, including undergraduates, researchers, and professionals. The Congress offered 26 mini-symposia covering a wide range of multidisciplinary subjects on computational methods in engineering and applied sciences. A total of 492 papers were presented, in addition to 50 poster presentations by undergraduate students. A roundtable was organized to discuss High Performance Computing and 6 plenary lectures were given by some of the most distinguished researchers from around the world. The lecturers were: Álvaro Maia da Costa - Petróleo Brasileiro S/A (PETROBRAS), Brazil; Estevam Barbosa de Las Casas - Federal University of Minas Gerais (UFMG), Brazil; Eugenio Oñate - Universitat Politècnica de Catalunya (UPC), Spain; Gláucio Hermógenes Paulino - University of Illinois at Urbana-Champaign, USA; Graham F. Carey - The University of Texas, Austin, USA; Luiz Fernando Ramos Martha - Pontifícia Universidade Católica (PUC/Rio), Brazil; and Marek-Jerzy Pindera - The University of Virginia, USA.

One cannot overstate the importance of this congress to the strengthening of ties between the scientific communities of the Iberian Peninsula and Latin America, to the active exchanging of ideas and information about computational methods and systems, as well as to the development of the high computational technology employed in the solution of engineering problems.

Figure 1:
Opening Ceremony

XXIX CILAMCE 2008 MACEIÓ-AL

During the Conference Banquet, awards were given to the 5 most outstanding papers delivered by undergraduates from a number of Brazilian Universities. The winners were: *1st place* - Rafael Cabral de Moura, from the Federal University of Pernambuco (UFPE), tutored by Professors Paulo Roberto Maciel Lyra and Ramiro Brito Willmersdorf; *runner-up* – Reberth Douglas Bandeira Cavalcante, from the Laboratory of Scientific Computation and Visualization at the Federal University of Alagoas (LCCV-UFAL), tutored by Professors Adeildo Soares Ramos Júnior and Severino Pereira Cavalcanti Marques; *3rd place* - Victor da Mata Bandeira, from the Federal University of Rio de Janeiro (UFRJ), tutored by Professors Armando Carlos de Pina Filho and Flávio de Marco Filho; *4th place* – Catarina Nogueira de Araújo and Ricardo Albuquerque Fernandes, from LCCV-UFAL, tutored by Professors Eduardo Nobre Lages and William Wagner Matos Lira; and *5th place* – Ana Gabriela Román Reina, from the Department of Structural Engineering and Construction at the Federal University of Ceará (UFCE), tutored by Professor Tereza Denyse de Araújo.

Next year, the **30th CILAMCE,** will be held in Búzios, **Rio de Janeiro**, Brazil, in November 2009. ●

Figure 2:
From left to right, Profs. José Alves (President of ABMEC), Eugenio Oñate (President of IACM), Eduardo Setton (Chair of XXIX CILAMCE) and Agustin Ferrante (Honorary President of ABMEC)

Figure 3: *(above)*
At the dinner party, from left to right, seated by the table, Profs. Estevam de las Casas, , Eugenio Oñate, Paulo Pimenta and Bill Barth, standing in the back, Profs. Alvaro Coutinho and Agustin Ferrante.

Figure 4: *(left)*
Profs. Graham Carey, Alvaro Coutinho and Roberto Beuclair

news

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New Executive Council for GACM

The German Association of Computational Mechanics has elected a new executive council. After eight successful years as president of GACM, Ekkehard Ramm leaves the board. The new president is Peter Wriggers from Hannover, former vice president of GACM.

The general assembly was held on July 1, 2008 during the IACM/ECCOMAS Congress in Venice, Italy. One of the major topics on the agenda was election of a new executive council. After eight years as president of GACM, Prof. Ekkehard Ramm, former head of the Institute of Structural Mechanics in Stuttgart, handed over the responsibility for one of the largest national branches of IACM, with over 200 members, to Peter Wriggers from the Institute of Continuum Mechanics, Leibniz Universität Hannover.

At the same time, Manfred Bischoff, Ramm's follower as professor for structural mechanics in Stuttgart, quit service as secretary of GACM. The new secretary will be Stefan Löhnert from Hannover. New vice president is Wolfgang Wall from the Chair of Computational Mechanics, Technische Universität München, who had been elected into the executive council four years ago.

Together with Ekkehard Ramm, Michael Schäfer from Darmstadt left the executive council. Accordingly, two new members entered: Günther Meschke from Bochum and Manfred Bischoff from Stuttgart.

On behalf of all GACM members, the general assembly expressed its gratitude to the services of the outgoing members, above all Ekkehard Ramm, whose commitment and dedication had a sustainable effect on the positive development and growth of GACM in the recent past. Coincidental, his achievements as a scientist and scholar were recognized at IACM/ECCOMAS 2008 by the Gauss-Newton Medal, the highest award assigned by IACM (see page 34 of this issue). The IACM award for Young Investigators went to Manfred Bischoff, his follower in Stuttgart and new member of the GACM executive council. ●

Prof. Peter Wriggers,
President of GACM as of 1 September 2008

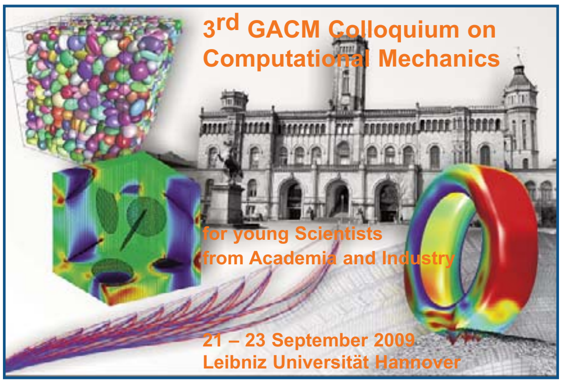
New Members of GACM Team: Günter Meschke & Stefan Löhnert

Prof. Günther Meschke is well-known to the computational mechanics community since quite some time. He is native from Austria and got his PhD in 1989 from Vienna University of Technology, his academic teacher being Professor Herbert Mang.
He is currently full Professor at Ruhr-Universität Bochum and head of the Chair of Structural Mechanics (Statik und Dynamik) in the Department of Civil and Environmental Engineering. Professor Meschke is active in many areas of computational mechanics with emphases on material models for metals and concrete, multi-field and coupled problems, like hygro-chemo-mechanical coupling, as well as life cycle assessment of structures.

Dr. Stefan Löhnert will henceforth be in charge as GACM secretary. He studied mechanical engineering (Maschinenbau) and mechanics at TU Darmstadt, from where he graduated in 1999. He obtained is doctoral degree from the University of Hannover in 2004 and is currently working at the Institute of Continuum Mechanics at Leibniz Universität Hannover, chaired by the new GACM president Prof. Peter Wriggers.
Stefan Löhnert's scientific activities include numerical methods for homogenization of micro-heterogeneous materials at finite deformations, as well as multi-scale methods for two-dimensional and three-dimensional analysis of fracture using the extended finite element method (XFEM). ●

GACM Colloquia for Young Scientists on Computational Mechanics

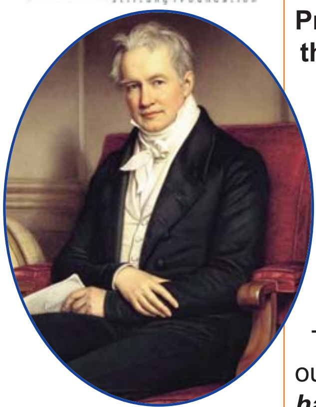
In 2005 the GACM Colloquia for Young Scientists on Computational Mechanics were introduced. The main objectives of these colloquia are to provide a forum for young researchers in the field of Computational Mechanics to present their latest research results and to exchange ideas and network among each others. The Colloquium is organized mainly by young scientists and it is intended mainly for young scientists to participate, which is expressed by the motto "from young people, for young people".



The first two Colloquia took place in Bochum (2005) and in Munich (2007). Both Colloquia were a full success as the strongly increasing number of participants shows. The third Colloquium for Young Scientists on Computational Mechanics will take place at the **Leibniz Universität Hannover** on **21 – 23 September 2009.** Young researchers who wish to participate will find further information at http://www.ikm.uni-hannover.de/gacm09.html ●

Humboldt Prize for Tom Hughes

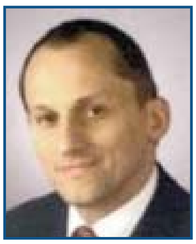
Professor Thomas J.R. Hughes receives the prestigious Humboldt Prize, awarded by the German Alexander-von-Humboldt-Stiftung. Host institution will be the Institute of Structural Mechanics at Universität Stuttgart.



Alexander von Humboldt
1769 - 1859, German naturalist and explorer, pioneer in geography as empirical science.

Thomas J.R. Hughes is Professor of Aerospace Engineering and Engineering Mechanics at University of Texas at Austin and he is probably one of the most well-known and respected personalities in the computational mechanics community. In November 2008, the German Alexander von Humboldt foundation added a quite prestigious prize to the many awards and honors Prof. Hughes has already received.

The Humboldt Research Award is a tribute to the lifework of exceptional scientists from outside Germany, ***"whose fundamental discoveries, new theories, or insights have had a significant impact on their own discipline and who are expected to continue producing cutting-edge achievements in future"*** (*http://www.humboldt-foundation.de*). The award is equipped with a substantial funding and associated with the invitation to spend up to one year at a research institution in Germany to cooperate with experts in the same field. ●



Prof. Dr.-Ing. Günther Meschke, Bochum

Dr.-Ing. Stefan Löhnert, Hannover

The New GACM Board on a Glance

President: **Prof. Peter Wriggers**
Institut für Kontinuumsmechanik, Leibniz Universität Hannover
Vice President: **Prof. Wolfgang A. Wall**
Lehrstuhl für Numerische Mechanik, Technische Universität München
Treasurer: **Prof. Werner Wagner**
Institut für Baustatik, Universität Karlsruhe (TH)
Honorary Presidents:
Prof. John Argyris† (Stuttgart), **Prof. Erwin Stein** (Hannover), **Prof. Walter Wunderlich** (Munich)
Further members of the Executive Council:
Prof. Manfred Bischoff - Institut für Baustatik und Baudynamik, Universität Stuttgart
Prof. Günther Meschke - Lehrstuhl für Statik und Dynamik, Ruhr-Universität Bochum
Dr. Günter Müller - CADFEM GmbH, Grafing b. München
Secretary:
Dr. Stefan Löhnert - Institut für Kontinuumsmechanik, Leibniz Universität Hannover ●

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CHILEAN SOCIETY FOR COMPUTATIONAL MECHANICS

National and international professionals and faculty members attended the **VII Workshop on Computational Mechanics** (**JCM 2008**, acronym in Spanish) hosted by the Pontificia Universidad Católica de Chile (PUC) at Santiago de Chile. This annual meeting of the Chilean Society for Computational Mechanics (CSCM) was chaired by Prof. Diego Celentano of the Mechanical and Metallurgical Engineering Department. The Workshop was officially opened by Prof. Hernán de Solminihac, Dean of the Engineering School of PUC.

This Workshop encompassed different activities such as two Plenary Lectures, three Technical Parallel Sessions and the Annual CSCM Members Meeting.

Prof. Alvaro Coutinho, from the Universidade Federal de Rio de Janeiro (Brasil), presented a relevant talk as Plenary Lecture titled "Recent advances in finite element simulation of coupled fluid flow and transport". The Plenary Lecture "Algorithms and problems during triangle mesh generation via finite element methods" by Prof. María Cecilia Rivara from the Universidad de Chile was devoted to novelty aspects for remeshing techniques. The CSCM warmly thanks the participation of both speakers.

Participants from different countries (Argentina, Brasil, Canada, México, Sweden and, of course, Chile represented in turn by six Universities and two engineering consulting companies) presented 38 works from several areas of computational mechanics. Moreover, a collection of 12 full written papers were reported in the journal of the CSCM "Cuadernos de Mecánica Computacional, Vol. 6". The CSCM specially acknowledged the active participation of under and post graduate students. Finally, the CSCM cordially invites to participate in the next version of the Workshop (JMC 2009) to be held in Temuco at the Universidad de la Frontera during September 4th 2009. Contact Prof. Juan Möller (jmoller@ufro.cl) for further information on this next meeting or visit the the web page of the CSCM: www.scmc.cl.

Figure 1. *Participants of the VII Workshop on Computational Mechanics together with invited Plenary Lecturers Profs. María Cecilia Rivara and Alvaro Coutinho.*

Figure 2. *Prof. Alvaro Coutinho*

Figure 3. *Prof. María Cecilia Rivara*

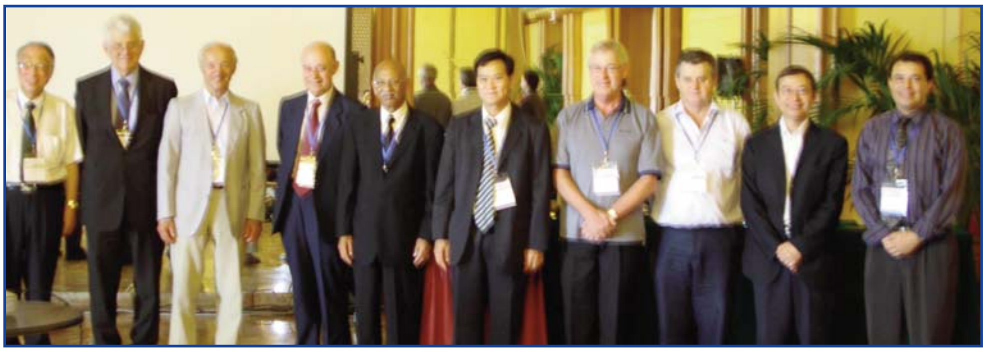
Russian Academy of Sciences

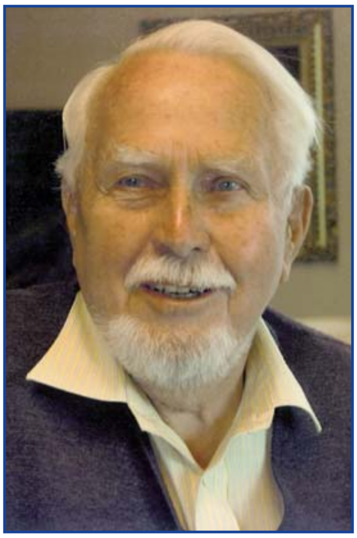
The Russian Academy of Sciences has awarded to Bernard Schrefler the academic degree of Doctor Honoris Causa

Award delivered by Academician Dr. Irina Goryacheva at the ICTAM 2008-10-30 (International Congress of Theoretical and Applied Mechanics) in Adelaide (Australia) on August 25-29, 2008

Special Symposium for the 75th Birthday of Professor Valliappan

A Special Symposium in honour of Professor Valliappan's 75th Birthday was organized by Professor Nasser Khalili (Vice President ,AACM and Chairman of WCCM/APCOM 2010) and Professor Scott Sloan(President, AACM) during the WCCM/ECCOMAS in Venice. The participants included H.Mang (Vice President, IACM and President, ECCOMAS),B.Schrefler (Chairman, WCCM/ECCOMAS), G.Yagawa (Secretary General , APACM), E.A.Oliveira (EC Member, IACM), W.Wunderlich(EC Member, IACM), G.Steven (Director, AACM), Q.Li (Secretary, AACM), W.Kanok-Nukulchai (President, TSCM), M.W.Yuan(President, CACM), A.Leung(President, HKACM), andY.B.Yang(President, ACMT).





Prof. Olgierd C. Zienkiewicz

It is with great sadness that we report the death of Prof. Olgierd C. Zienkiewicz in Swansea (UK) on January 2nd 2009. We express our deep and sincere condolences to his beloved wife Helen, his children Andy, David and Krystyna and his grandchildren.

An homage to Prof. Zienkiewicz and his many contributions to computational mechanics and the IACM will be presented in the next edition of IACM Expressions.

Photo Gallery of the Joint WCCM8/ECCOMAS 2008 Congress

Figure 1:
Opening Ceremony

Figure 2:
Congress staff before the opening

Figure 3:
Internet Café

Figure 4:
Opening Session

The Joint **WCCM8/ECCOMAS 2008** Congress was held in the **Lido Island of Venice** from J**une 30 to July 4**, under the chiarmanship of prof. Bernhard Schrefler, University of Padua, and prof. Umberto Perego, Politecnico di Milano. The Congress was hosted in the complex formed by the Palazzo del Cinema and the former Venice Casino.

This has been the first time that IACM and ECCOMAS have joint their efforts to set up a common conference, and the initiative has been enthusiastically received by the Computational Mechanics community. With 2916 registered participants from 61 countries, the event scored the highest attendance ever achieved in the history of this type of events.

Such a high participation required an exceptional effort from the Scientific and Organizing Committees: 3457 abstracts were submitted to the Congress Scientific Committee and individually reviewed. After review, 2583 abstracts were accepted for presentation in one of the 439 Sessions which were held during the 5 full days of the Congress (for a total of 957 hours of technical presentations). 138 Minisymposia and 15 Special Technology Sessions were held during the Congress, thanks to the contributions of about 400 colleagues that promoted and contributed to organize them.

The student participation has also been remarkable, with 684 student registrations. This high student particpation has been obtained also thanks to the 194 scholarships awarded with the contribution of several sponsoring organizzations: ECCOMAS (32 scholarships), USACM (50 scholarships), AVA (Venetian Hotel Association, 10 scholarships), in addition to the 95 scholarships supported on the Congress budget.

Figure 5:
Congress Banquet at the Venice Cruise Terminal

Despite the very intense technical programme, the delegates also found the time to attend the social programme, featuring a Welcome Cocktail and Concert around the beautiful swimming pool of the Excelsior Hotel, a visit to the San Marco Basilica with an exceptional night view of the ceiling frescos and a banquet at the Venice Cruise Terminal, reached after a night navigation along the scenic Giudecca Channel. The celebrated Venetian Prosecco sparkling wine was very much appreciated during the banquet, but fortunately nobody was reported falling down into the water channel on the way back from the banquet.

Both supporting Organizations, IACM and ECCOMAS, presented their prizes druring the Opening Ceremony. A total of 15 prizes were awarded, including the most prestigious IACM Gauss-Newton Medal, awarded to Prof. Ekkehard Ramm, and the ECCOMAS Ritz-Galerkin Medal, awarded to Prof. Giulio Maier. ●

Figure 6:
Ladies of the Congress staff are presented with flowers at the banquet

Figure 7:
The Ritz-Galerkin Medal recipient, Prof. Giulio Maier at the Congress Banquet

Figure 8:
Quartetto concert during the Congress Reception

Figure 9:
A view of the Excelsior Hotel hosting many of the Congress sessions

awards 2008

IACM Awards 2008

awarded at the
8th World Congress
on Computational Mechanics/ECCOMAS Congress

Lido Island, Venezia, Italy
June 20 – July 2, 2008

Gauss-Newton Medal (Congress Medal)
Ekkehard Ramm

Ekkehard Ramm studied Civil Engineering at Darmstadt and Stuttgart Institutes of Technology, graduating as "Diplomingenieur" with distinction in 1966. He obtained his PhD at the University of Stuttgart in 1972. He was a post-doc at the University of California, Berkeley and the University of Stuttgart. After his habilitation, he became an Associate Professor of structural mechanics at the University of Stuttgart in 1976. He was promoted to full professor (Chair of Structural Mechanics) in 1983 and was Head of the Institute until 2006. He has served in many positions, among those as Dean of the Department, as elected member of the Council of the University and the Grants Committee for Collaborative Research Centers of DFG.

He is most well known for his seminal work on updated and total Lagrangian formulations and his work on the applications of finite elements to structures, particularly shells. He has developed shell elements of exceptional versatility, robustness and accuracy that were tailored by his deep insight into structural behaviour. His research interests cover many other areas of structural mechanics, including dynamic non-linear analyses of thin-walled structures, structural optimisation, materials modelling, multi-scale problems, contact mechanics and fluid-structure interaction. He has published over 325 papers and was awarded Honorary Doctorates from the University of Calgary, Canada, and the Technical University of Munich, Germany. He is a member of several Academies of Engineering and Sciences, and was recently elected to the U.S. National Academy of Engineering as a Foreign Associate.

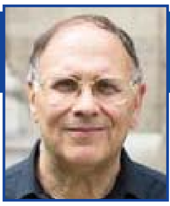
In the computational mechanics community he is also known for his kindness and generosity. He is always willing to lend a hand, and his hospitality is unsurpassed. We also know him for his hobby, the study of bridges, which was recently featured in his article on the Golden Gate Bridge which appeared in *Expressions*.

IACM Award
Genki Yagawa

Dr. Yagawa received his Doctorate in 1970 from University of Tokyo where he was Professor (1984-2004) at the School of Engineering and is currently Emeritus Professor (2004-present).

He is Director and Professor of the Center for Computational Mechanics Research at Tokyo University, Executive Member of the Science Council of Japan, member of the Engineering Academy of Japan, Honorary Member of the Executive Council of International Association for Computational Mechanics and Founding Member and Secretary General of the Asian-Pacific Association for Computational Mechanics. He was Chairman of the 3rd Congress on Computational Mechanics that was held in Tokyo in 1994.

He is the recipient of the Prime Minister Award (2007), the APACM Zienkiewicz Medal (2007) and the IACM Computational Mechanics Award (2004) among others. He has published more than 380 journal papers and authored or edited 64 textbooks and special issues of journals in the areas of super-computing, mesh-free methods, application of neural networks and applications of simulation to nuclear reactor safety.



IACM Computational Mechanics Award
Roger Ohayon

Professor Roger Ohayon received his PhD from University Pierre et Marie Curie (Paris 6) in 1971 in Theoretical and Applied Mechanics. From 1970 to 1992, he was at ONERA, the National French Aerospace Lab, Chatillon, France, Since 1992, he is Professor, Chair of Mechanics and Director of the Structural Mechanics and Coupled Systems Laboratory of Conservatoire National des Arts et Metiers (CNAM), Paris, France, that he created in 1997, remaining as a consultant at ONERA. His major achievements are in computational methods for fluid-structure interaction, including new symmetric formulations and in smart materials. He is the co-author of more than 130 publications and co-author of three books.

He is a Fellow of IACM, ASME, and AAAF; a member of National Academy of Engineering of Brazil and a member of France Academy of Aeronautics and Space (ANAE). He has received the French Academy of Science Prize (1989), the IACM Award and the ASME Adaptive Structures and Materials Systems Award.

IACM Computational Mechanics Award
Xavier Oliver

Professor Xavier Oliver obtained the degree of Civil Engineer at the Civil Engineering School of Valencia (Spain) in 1976. After a short career in the construction management field, he moved to the Technical University of Catalonia in Barcelona to obtain the Ph.D. degree in 1982. Since then, he has remained at the Civil Engineering School of Barcelona (ETSECCPB) as Associate Professor (1982) and Professor (1989). His research has been mainly related with computational solid mechanics, more specifically in the fields of computational material failure and numerical modeling of forming processes.

He has made major contributions in embedded finite elements for the computational modeling of fracture and in the modeling of strain softening behavior. He is fellow of the IACM (2002) and member of the Catalan Royal Academy of Doctors (2006).

Young Investigators in Computational Mechanics Award
Manfred Bischoff

Manfred Bischoff studied civil engineering at Universität Stuttgart from 1988 to 1993 and received his doctoral degree under the supervision of Ekkehard Ramm in 1999 from the same university. With a grant of the German Research Foundation (DFG) he spent one year at UC Berkeley, where he cooperated with Francisco Armero and Robert L. Taylor. Returning to Germany he spent five years at Technische Universität München and finished his habilitation in March 2005 under the supervision of Professor Kai-Uwe Bletzinger.

Since April 2006 he is Professor for Structural Mechanics in Stuttgart and, as successor of Ekkehard Ramm, head of the "Institut für Baustatik und Baudynamik".

Young Investigators in Computational Mechanics Award
John Dolbow

John Dolbow received his BS in Mechanical Engineering from the University of New Hampshire in 1995, and his Ph.D. in Theoretical and Applied Mechanics from Northwestern University. He has been a faculty member in the Department of Civil and Environmental Engineering at Duke University since 1999, and his research concerns the development of the extended finite element methods for evolving interface problems.

He has authored more than thirty peer-reviewed publications, and has received the Young Investigator award of the USACM. He will be a visiting professor at Harvard University in 2008, while on sabbatical from Duke.

IACM Fellow Award
Rainald Lohner

Rainald Lohner, PhD, DSc is the head of the CFD center at the Department of Computational and Data Sciences of George Mason University in Fairfax, VA, in the outskirts of Washington, D.C. He received an MSc in Mechanical Engineering from the Technische Universität Braunschweig, Germany, as well as a PhD and DSc in Civil Engineering from the University College of Swansea, Wales, where he studied under Profs. Ken Morgan and Olgierd Zienkiewicz. His areas of interest include numerical methods, solvers, grid generation, parallel computing, visualization, pre-processing and fluid-structure interaction. He is the author of more than 500 articles covering the fields enumerated above, as well as a textbook on Applied CFD Techniques.

IACM Fellow Award
Wolfgang Wall

Wolfgang A. Wall, born in Salzburg (Austria), received his PhD from the University of Stuttgart in 1999. Since 2003 he has been Professor and Head of the Institute for Computational Mechanics at Technische Universität München. His research interests encompass a broad range of areas in computational mechanics, including both computational solid and fluid mechanics. His recent focus is on various coupled and multiscale problems as well as on computational biomechanics. He has received several awards and has recently been elected Vice-President of the German Association of Computational Mechanics. Among others he is Associate Editor of REMN and member of the Editorial Boards of IJNMF and CNME, the General Council of IACM and the scientific council of CISM.

IACM Fellow Award
Alain Combescure

Alain Combescure is a Professor at INSA Lyon where he is Head of the LaMCoS Laboratory. Prior to that, he was head of a software development team at CEA, the French Atomic Energy Center, (1975-1995) and Professor at ENS Normale Superioeure de Cachan (1995-2001). He has made significant contributions to methods for the buckling computations of shells, gluing of time-space for integrators, volumetric 3D shell elements, X-FEM methods for dynamic and fatigue crack propagation and SPH methods for fluid-structure interaction. He has won the Thomas Jaeger Prize for his work on shell buckling, an ASME PVP Best Paper Award, the Association Francaise de Mecanique Prize and the Henri de Parville Quarterly Prize of the French Academy of Sciences.

IACM Fellow Award
Tarek I. Zohdi

Tarek I. Zohdi received his Ph.D. in 1997 in Computational and Applied Mathematics from the University of Texas at Austin under Prof. J. Tinsley Oden. After a Postdoctoral fellowship at the Technical University of Darmstadt, he joined the faculty of Mechanical Engineering at the University of California, Berkeley in 2001. He received his Habilitation in Mechanics from the Gottfried Wilhelm Leibniz Universitaet Hannover under Prof. Peter Wriggers, in 2002. He made significant contributions to the hierarchical modelling of heterogeneous systems including other areas on inverse problems involving optimization and design of new materials of strongly coupled multified processes in multiphase systems, granular flows and the dynamics of high-strength fabrics. He has authored several monographs on homogenization.

IACM Fellow Award
Jean-Loup Chenot

Jean-Loup Chenot is Head of the Center of Materials Forming Laboratory, Ecole des Mines des Paris. He is also associated with Transvalor, a company which markets materials forming worldwide, including the widely known FORGE2/3 software. He has written four books and 230 research papers and is internationally known as one of the leaders in simulation of materials forming. He was the first chairman of ESAFORM (European Scientific Organization for Material Forming). He obtained his undergraduate degree from Ecole Polytechnique and his Ph.D. from the French Petroleum Institute.

IACM Fellow Award
Dan Givoli

Dan Givoli completed his PhD degree at Stanford University in 1988. He is a full professor at the Technion – Israel Institute of Technology, and has had visiting positions at other places. He holds the Lawrence and Marie Feldman Chair in Engineering. During 2004-05 he was the Chairman of the Dept. of Aerospace Engineering. Dan Givoli is one of the founders of the Israel Association for Computational Methods in Mechanics (IACMM), and is currently its President. Among Dan Givoli's many contributions are advanced computational methods for wave problems. Dan Givoli is a member of the Editorial Board of six journals, and acts as an Associate Editor of two of them.

IACM Fellow Award
Nicolas Moes

Nicolas MOËS is full professor at the Ecole Centrale de Nantes (France) and member of the "Institut Universitaire de France." Over the past ten years, his research was dedicated to the development of the eXtended Finite Element Method (X-FEM) mainly for fracture mechanics. In 2006, he received the Young Investigator Award from the IACM (International Association for computational Mechanics). In 2003, he received the Jean Mandel Prize. He is the author of about thirty papers in international journals totalling more than 1300 citations.

IACM Fellow Award
Umberto Perego

Umberto Perego is a full professor of Structural Mechanics at the Politecnico di Milano where he is currently the Coordinator of the CCOSMM (Centre for Computational Structural and Material Mechanics). In the period 2000-2004 he has been the Chairman of the Italian Group of Computational Mechanics (GIMC) and he is now member of the General Council of the International Association of Computational Mechanics (IACM). In 2002 he was awarded the "Bruno Finzi" Prize for rational mechanics by the Istituto Lombardo Accademia di Scienze e Lettere. He was Chairman, together with Prof. B. Schrefler, of the Joint World Congress on Computational Mechanic/ECCOMAS Congress held in 2008. He is author or co-author of more than 80 papers in the field of the computational mechanics of materials and structures.

IACM Fellow Award
Daya Reddy

Daya Reddy holds the South African Research Chair in Computational Mechanics at the University of Cape Town, and is Director of the Centre for Research in Computational and Applied Mechanics. His research is concerned with the well-posedness of problems arising in solid and fluid mechanics, and the analysis and implementation of numerical approximations and associated algorithms. Plasticity has been a particular and enduring interest. His publications include over a hundred articles, a number of edited volumes, as well as a text on functional analysis with applications to the finite element method and a monograph, written with Weimin Han, on mathematical and numerical aspects of plasticity. ●

edited by
Ted Belytschko

Above: *Ekkehard Ramm being presented the Gauss-Newton Congress Medal*
From left to right: Sergion Idelsohn, Ted Belytschko, Ekkehard Ramm and Eugenio Oñate

Review of Four Years of Presidency of ECCOMAS

by
Herbert A. Mang
President of ECCOMAS
Vienna University of Technology, Austria

My period as president of ECCOMAS will end on March 31st, 2009. Therefore, it is appropriate to briefly look back at four years of presidency of ECCOMAS.

In spite of the remarkably high geographical density of organization of ECCOMAS, there are still national associations seeking membership in ECCOMAS. One of them is the Serbian Association for Computational Mechanics which, two years ago, became a member of ECCOMAS.

My predecessor in the office of President of ECCOMAS, Prof. Eugenio Oñate, was very successful in establishing the so-called Thematic Conferences, focused on specific state of the art topics in computational science and engineering. During this year, 23 Thematic Conferences, covering a wide spectrum within this field, will be held.

The ECCOMAS Managing Board (MB) has chosen Paris (Palais de Congres, porte Maillot) as the site of the Fourth European Conference on Computational Mechanics (Solids, Structures and Coupled Problems in Engineering) (ECCM 2010) and Lisbon (Laboratório Nacional de Engenharia Civil) as the one of the Fifth European Conference on Computational Fluid Dynamics (CFD 2010). The 6th European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2012) will take place in Vienna.

We are confronted with problems in engineering and in the applied sciences with levels of complexity never encountered before in the history of mankind. The solution of problems characterized e.g. by the interaction of fluids and structures, not to forget materials, is of paramount importance in a technical world of rapidly increasing sophistication. Such problems were discussed at the ECCOMAS Multidisciplinary Jubilee Symposium on New Computational Challenges in Materials, Structures, and Fluids which took place in Vienna, from February 18-20, 2008. The Symposium accentuated the political intention of and the strong desire within the European Community to support research in the field of Computational Methods in Applied Sciences and to disseminate research results in this field in and outside of Europe.

Figure 1: *ECCOMAS Multidisciplinary Jubilee Symposium on New Computational Challenges in Materials, Structures and Fluids, Vienna, February 18-20, 2008*

In need of strengthening the ECCOMAS CFD Committee, a meeting took place in Barcelona, in April 2008, where Prof. Deconinck, Von Karman Institute for Fluid Dynamics, Brussels, was elected to chairman of this committee. Plans for future activities of this committee were discussed.

In order to acknowledge outstanding scientific achievements, the ECCOMAS MB decided to create three awards: the Ritz-Galerkin Medal, the Euler Medal, and the Prandtl Medal. A Voting Committee consisting of a representative of each one of the ECCOMAS Affiliated Organizations was formed. Prof.Eugenio Oñate was appointed to Chairman of this committee. The awardees were selected by electronic voting. The winner of the Ritz-Galerkin Medal was Prof. Giulio Maier, Politecnico di Milano

The two ex-aequo winners of the Prandtl Medal were Prof. Antonio Huerta, Universitat Politècnica de Catalunya, Barcelona, and Prof. Ken Morgan, University of Swansea. The Euler Medal was awarded to Prof. Peter Wriggers, Leibniz Universität Hannover.

The two established ECCOMAS Awards for young scientists are the Lions Awards and the Zienkiewicz Awards. The recipient of the Jacques L. Lions Award was Prof. Manuel J. Castro Diez, Universidad de Malàga, and the recipient of the Olgierd C. Zienkiewicz Award was Prof. Christian Hellmich, Technische Universität Wien.

Great efforts were made to intensify the contacts with representatives of the European Commission as well as of other European Associations, relevant to the tasks of ECCOMAS. Prof. Jacques Periaux, former President of ECCOMAS, deserves credit for organizing four meetings with these representatives in Brussels. The first two of these meetings as well as a meeting in Vienna after the aforementioned ECCOMAS Multidisciplinary Jubilee Symposium served the purpose of preparing a proposal entitled *"Supporting the harmonised dissemination of European scientific knowledge from ad-hoc organisations in the field of aeronautics and air transport"* submitted to the FP7 Coordination and Support Action. I am pleased to announce that this proposal was successful.

At the beginning of this year it was my sad duty to inform the colleagues from ECCOMAS that Prof. Zienkiewicz passed away on January 2, 2009. In ECCOMAS the memory of Olek as a great scientist in the area of computational mechanics and far beyond this area, and as a true friend of many colleagues will be held in highest esteem

The last period of my chairmanship has been devoted to revising the By-laws of ECCOMAS. For that purpose an Ad-hoc Committee, chaired by Prof. Manolis Papadrakakis, was established. The purpose of this revision is to create a legal framework that will allow an efficient management of ECCOMAS based on rules with the proper degree of flexibility.

Figure 2:
Prof. Giulio Maier receiving the Ritz-Galerkin Medal

In the Editorial of the 15 Years Jubilee Issue of the ECCOMAS Newsletter I have paid tribute to the three former presidents of ECCOMAS, Profs. Jacques Periaux, Oskar Mahrenholtz, and Eugenio Oñate. They have contributed significantly to realize the vision of a European organization in the area of Computational Methods in Applied Sciences as a spearhead of modern technology-driven research. I consider it a privilege having been elected to follow them in office for the period that has started on January 1st, 2005. Let me not forget to thank Prof. Pedro Diez, General Secretary of ECCOMAS, all other members of the MB, and Ms. Martina Pöll at the "homefront" for their loyal support.

My successor will take office in April 2009. I wish him a lot of success for the benefit of ECCOMAS and thus for the wide field represented by this organization. ●

iacm

Const it ution

The IACM has a new Constitution

Last year, the IACM started last year a in-depth update of its Constitution. For this purpose, a Special Committee was created and a draft version of a new Constitution was then presented to the Executive Council. After several iterations, the new text was approved and sent to the General Council for discussion. This Council introduced several improvements to the document and then the new Constitution was put up for a vote among all the General Council members. The final text was then approved on 15th December 2008. The new IACM Constitution can be found in **www.iacm.info**.

The IACM started its activities in 1986. The first IACM Constitution was particularly adapted for an organization formed by a relatively small community. Nowadays, with over 50 affiliated organizations and more than 4000 members, clearly the Constitution needed an update introducing more precise rules.

One of the most important changes in the new constitutional text is the implicit recognition of the IACM as a Confederation of National Associations. In the new Constitution, the National Associations are recognized as the basis of the IACM, describing their obligations and rights.

The three levels of organic government bodies remain unchanged. These are the General Council, the Executive Council and the Executive Council Officers: the President, the two Vice Presidents and the Secretary General. However, the way to elect each of the Council members and the way to ensure the renewal of persons in these bodies has been described more precisely.

Briefly, the idea is the following:

1. Each Affiliated Association will elect their own General Council members.
2. The General Council members will elect the Executive Council members.
3. The Executive Council Members will elect the President, the two Vice Presidents and the Secretary General.

The permanence period in each Council has been also fixed, with partial renevals of General and Executive Council members in order to preserve the continuity of the previous activities.

The status of Corresponding Members of the Executive Council has been suppressed. The status of Honorary members of the IACM have been defined. The initial list of Honorary members will be formed by the current Honorary Members of the General and Executive Councils.

I believe that we have now a modern IACM Constitution where the democratic premises of the previous text has been preserved and even enlarged. We hope that the new IACM Constitution will serve to increase the participation, communication and friendly ambiance that we currently have between the IACM members.

by
Sergio R. Idelsohn
Argentina
December 2008

conference diary planner

01 - 03 April 2009	**Composites 2009 - Conference on the Mechanical Response of Composites** *Venue:* London, UK *Contact*: www.imperial.ac.uk/aeronautics/composites2009
08 - 13 April 2009	**ICCES 09 - Meshless & Other Novel Methods** *Venue:* Phuket, Thailand *Contact*: http://submission.techscience.com/icces09
27 - 29 April 2009	**ESAFORM 2009 - Conference on Material Forming** *Venue:* Enschede, Netherlands *Contact*: http://www.esaform2009.org
18 - 21 May 2008	**CMM 2009 - 18th International Conference on Computer Methods in Mechanics** *Venue:* Zielona Góra, Poland *Contact*: http://www.cmm.uz.zgora.pl/
25 - 27 May 2009	**ADMOS 2009 - International Conference on Adaptive Modelling & Simulation** *Venue:* Brussels, Belgium *Contact*: http://congress.cimne.upc.es/admos09
25 - 27 May 2009	**Fluid Structure Interaction 2009** *Venue:* Create, Greece *Contact*: http://www.wessex.ac.uk/conferences/2009/fsi09/
01 - 05 June 2009	**CHAOS 2009 - 2nd Chaotic Modelling and Simulation International Conference** *Venue:* Create, Greece *Contact*: http://www.chaos2009.net/
01 - 05 June 2009	**WCSMO-8 - World Congress on Structural and Multidisciplinary Optimization** *Venue:* Lisbon, Portugal *Contact*: http://www.wcsmo8.org/
08 - 10 June 2009	**OPTI 2009 - Optimum Design of Structures and Materials in Engineering** *Venue:* Algarve, Portugal *Contact*: www2.wessex.ac.uk/09-conferences/opti-2009.html
8 - 11 June 2009	**Computational Methods for Coupled Problems in Science & Engineering** *Venue:* Ischia Island, Italy *Contact*: coupledproblems@cimne.upc.edu
09 - 12 June 2009	**ECMS 2009 - European Conference on Modelling and Simulation** *Venue:* Madrid, Spain *Contact:* www.scs-europe.net/conf/ecms2009/index.html:
15 - 17 June 2009	**III ECCOMAS Int. Conference on Computational Methods in Marine Engineering** *Venue:* Trodheim, Norway *Contact:* http://congress.cimne.upc.es/marine09/
15 - 17 June 2009	**EUROGEN 2009 - Int. Conf. on Evolutionary & Deterministic Methods for Design, Optimization & Control with Applications to Industrial & Societal Problems -** *Venue:* Cracow, Poland *Contact*: www.eccomas.org
17 - 19 June 2009	**5th MIT Conference on Computational Fluid and Solid Mechanics** *Venue:* Cambridge, ,MA, USA *Contact:* http://www.fifthmitconference.org/
17 - 19 June 2009	**COMPDYN 2009 - Int.Conf. on CM in Structural Dynamics & Earthquake Engineering -** *Venue:* Rhodes, Greece *Contact*: http://www.compdyn2009.org
22 - 24 June 2009	**CSE - 09 - Int. Symp. Computational Structural Engineering** *Venue:* Shanghai, China *Contact*: http://www.cse-shanghai.org/
22 - 24 June 2009	**SEECCM 2009 - South-East European Conference on Computational Mechanics** *Venue:* Rhodes, Greece *Contact*: http://www.seeccm2009.org
16 - 19 July 2009	**USNCCM X - 10th U.S: National Congress on Computational Mechanics** *Venue:* Columbus, Ohio USA *Contact:* http://usnccm-10.eng-ohio-state.edu
20 - 22 July 2009	**SMART 2009 - International Conference on Smart Structures and Materials** *Venue:* Porto, Portugal *Contact:* www.eccomas.org
02 - 04 September 2009	**COMPLAS 2009 - X International Conference on Computational Plasticity** *Venue:* Barcelona, Spain *Contact:* http://congress.cimne.upc.es/complas09/
04 September 2009	**JMC 2009 - VIII Workshop on Computational Mechanics** *Venue:* Temuco, Chile *Contact:* www.scmc.cl
21 - 23 September 2009	**JMC 2009 - VIII Workshop on Computational Mechanics** *Venue:* Hannover, Germany *Contact:* http://www.ikm.uni-hannover.de/gacm09.html
5 - 7 October 2009	**MEMBRANES 2009 - International Conference on Textile Composites & Inflatable Structures** *Venue:* Stuttgart, Germany *Contact:* http://congress.cimne.upc.es/membranes09
03 - 06 November 2009	**ENIEF 2009 - XVII Congress on Numerical Methods & their Applications** *Venue:* Buenos Aires, Argentina *Contact:* http://amcaonline.org.ar
16 - 21 May 2010	**ECCM 2010,4th European Conference on Computational Mechanics** *Venue:* Paris, France *Contact:* www.eccm2010.org
14 - 17 June 2010	**CFD 2010, Fifth European Conference on Computational Fluid Dynamics,** *Venue:* Lisbon, Portugal *Contact:* http://www-ext.lnec.pt/APMTAC
19 - 23 July 2010	**IX World Congress on Computational Mechanics** **IV Asian Pacific Congress on Computational Mechanics** *Venue:* Sydney, Australia *Contact*: http://www.wccm2010.com

WCCM / APCOM

9th World Congress on Computational Mechanics
and
4th Asian Pacific Congress on Computational Mechanics

19-23 July 2010, Sydney, Australia

www.wccm2010.com/