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Bulletin for The International Association for Computational Mechanics

Nº 14
October 2003

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IACM Expressions

Published by
The International Association for Computational Mechanics (IACM)

Editorial Address
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contents

editorial

The strive for the unification of the laws of nature has been a goal for physicists in all ages. A single theory holding for the very small and the very large scales of the physical world is still a dream pursued by hundreds of scientists in different disciplines. Recent relativity theories aiming to model phenomena occurring at the Plank scale (10^{-38} cm) and the cosmological scale (10^{+28} cm) as that proposed by the French physicists Laurent Nottale, suggest that classical concepts such as the space-time relationship should be reformulated in a fractal setting. A similar line of thought has been pursued by Stephen Wolfram in his book, A New Kind of Science, where the claims that a large variety of problems in science can be modelled using cellular automata.

The modelling and computation of phenomena occurring at multiple scales (the so called multiscale analysis) is also a topic of much current interest in the computational mechanics community. Typical examples are found in the analysis of heterogeneous (composite) materials and structures, the modelling of nanomaterials and nanoprocesses, the prediction of fracture lines in solids, the study of boundary layers and turbulence in fluids and many others.

The goal of multiscale computational methods in mechanics is not much different from the procedures for modelling the very large and the very small in physics. We basically aim to develop numerical approximations and computational algorithms which should provide accurate information on the phenomena occurring at the different scales. Indeed in many cases the emphasis of the analysis is put on the large scale outputs, whereas in some others the micro/nano behaviour is the focal target. In both situations the link between the behaviour of the small and the large scales should be consistently preserved by the mathematical description, the discretization method and the computational scheme.

The development of future multiscale computational methods in mechanics can benefit from the experiences of above mentioned scientists and many others in the modelling of the multiple scales occurring in the physical world. Concepts such as the existence of the zero and the infinity are being revised in the framework of the new multiscale relativity theories. The introduction of the space-time scales of the problem into the equations of the mathematical model seems to offer advantages for multiscale analysis in physics.

Indeed some of these ideas are at their infancy and others will prove to be just pure speculations. However we should not disregard the possibility that a new kind of multiscale computational mechanics world emerges from those observations.

Eugenio Oñate
President of IACM

Evolutionary Computation in Mechanics

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The term evolutionary computation (called also evolutionary algorithms) encompasses a host of methodologies inspired by natural evolution that are used to solve hard problems. This article provides an overview of evolutionary computation as applied to optimization and identification problems of mechanics. Presented numerical results have been elaborated at DSM&CM and ICM.

Introduction

Many problems from mechanics are formulated as minimization (or maximization) of certain functionals with respect to design variables.

From the point of view of optimal design of structures, minimization of the objective functionals, which describe the optimization criteria, with respect to design variables leads to the best structure. The process of looking for the best structure often gives not unique solutions and applications of methods of artificial intelligence (AI) enable to find the global optimal solutions. Evolutionary algorithms (AEs) belong to methods which are very promising in computer aided optimal design.

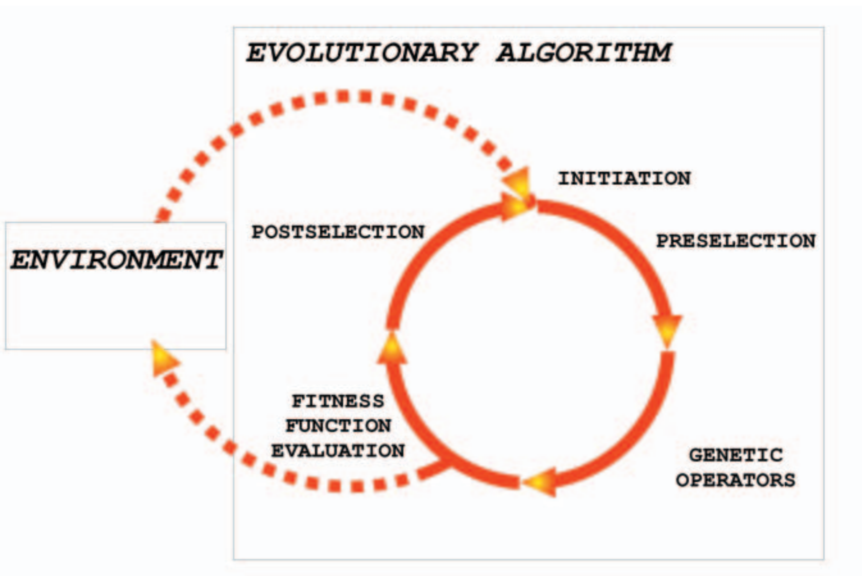


Figure 1:
Scheme of an evolutionary algorithm

The similar problem like the optimal design is also the identification of certain geometrical or material features (e.g. internal defects) in existing structures having some measurements of state fields or the control of the boundary conditions to secure suitable requirements. Such problems are formulated as minimization of certain functionals. They can be solved by using also AI techniques like evolutionary algorithms.

One of the specific features of considered problems is the fact that objective functionals or imposed constraints very often do not depend on design variables in the explicit way. In order to find the relationship between changes of design variables and changes of the objective functional or constraints one should solve a boundary value or a boundary initial value problem. It can be done by using the finite element method (FEM) or the boundary element method (BEM).

Evolutionary Algorithms

The domain of evolutionary computation involves the study of the foundations and applications of computational methods based on principles of synthetic theory of evolution (neodarwinism). Evolution in nature is responsible for the 'design' of all living beings on earth, and for strategies they use to interact with each other. Evolutionary computation employs this powerful design philosophy to find solutions to hard mechanics problems.

Generally speaking, evolutionary methods can be viewed either as search techniques, or as optimization techniques because the best solutions can be obtained as a result of an optimization process.

Evolutionary computation makes use of a metaphor and vocabulary of theory of evolution and genetics. According to this, a mechanics problem plays the role an environment wherein lives a population of individuals (chromosomes), each representing a possible solution to the problem. The degree of adaptation of each individual (i.e. candidate solution) to its environment is expressed by an adequacy measure known as the fitness function.

Mechanisms of evolution act on the chromosomes containing the genetic information of the individual (the genotype) or on the individual itself (the phenotype).

The working of the EA brings about to making of the loop *(Figure 1)* in which a pre-selection, genetic operators, a fitness function evaluation and a post-selection follow each other.

The pre-selection and the post-selection are called also as the selection.
The paradigm of EA consists of five main elements:

- population formulation of the problem (a set of solutions)
- the fitness function
- representation of the chromosomes
- genetic operators (crossover and mutation)
- selection techniques

The phenotype of each individual, i.e. the candidate solution itself, is generally encoded in some manner into its genome (genotype) *(Figure 2)*. Like evolution in nature, evolutionary algorithms potentially produce progressively better solutions to the problem. This is possible thanks to the constant introduction of a new genetic material into the population, by applying so-called genetic operators that are the computational equivalents of natural evolutionary mechanisms.

There are several kinds of evolutionary algorithms, among which the best known are: **genetic algorithms, evolutionary programming, genetic programming and evolutionary strategies**.

Classical genetic algorithms are based only on the fitness value information and coded chromosomes. They work on populations of solutions and use binary operators of the crossover *(Figure 3)* and the mutation (*Figure 4)* and the wheel roulette method of selection is applied *(Figure 5)*.

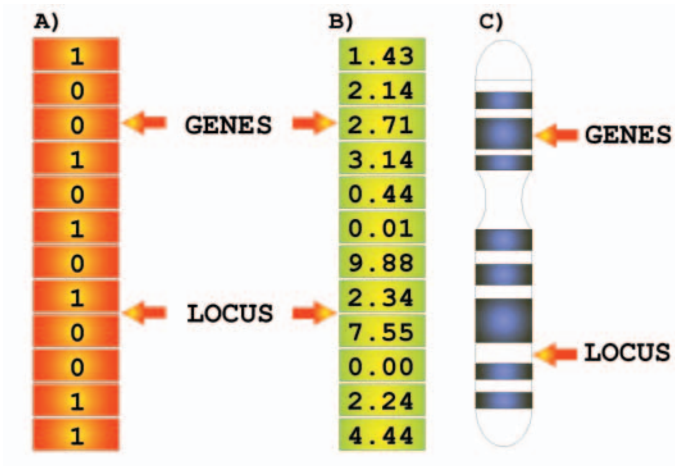


Figure 2:
Artificial and natural chromosomes:
A) binary-coded chromosome;
B) real-value chromosome;
C) natural chromosome

Figure 3:
Binary crossover

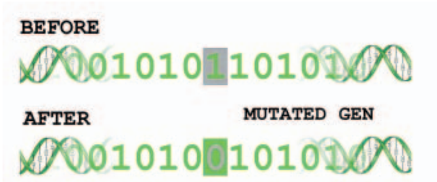


Figure 4:
Binary mutation

In the case when the floating point representation is used the modified genetic operators are applied as the simple, arithmetical and heuristic crossovers and the uniform, boundary, non-uniform and Gaussian mutations. The selection is performed in the form of the ranking selection or the tournament selection and the probability of operators can be variable.

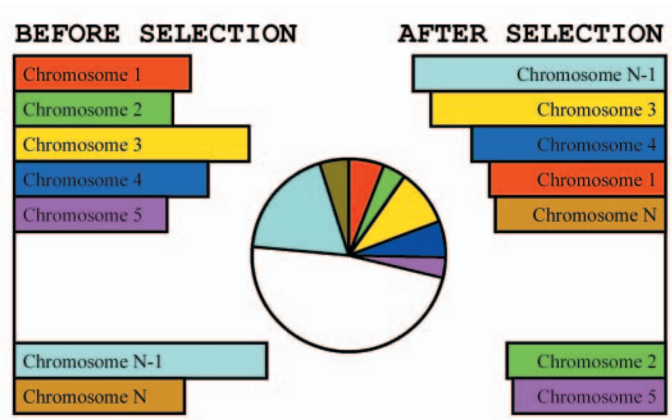


Figure 5:
The wheel roulette selection

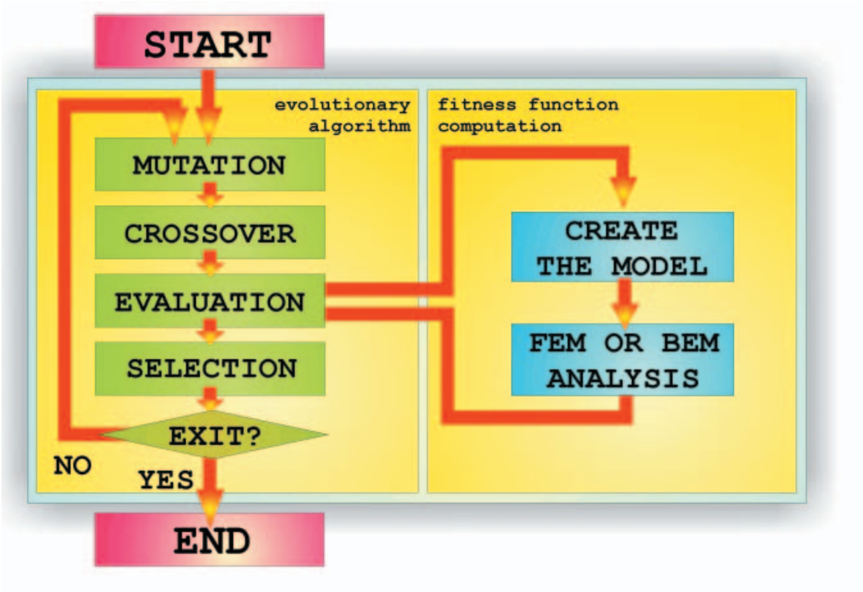


Figure 6:
The flow chart of evolutionary optimization

In the constrained optimization the penalty function method is applied. The modified objective function, in which the penalty function is taken into account, plays the role of the fitness function.

The flow chart of the proposed approach of the evolutionary optimization using FEM and BEM is presented in *Figure 6*.

Depending on the problem the various FEM and BEM approaches can be applied in evolutionary optimization.

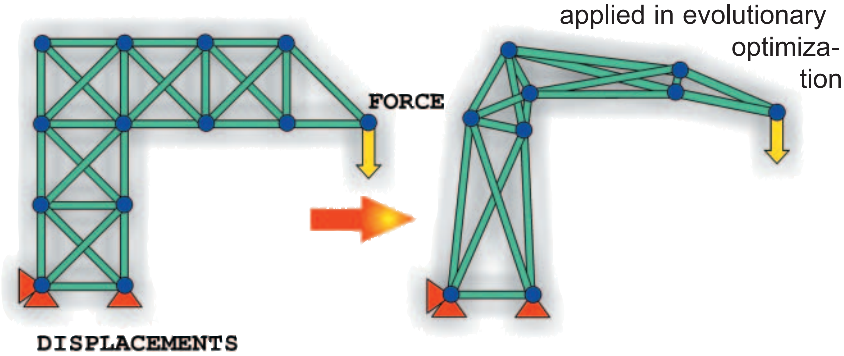


Figure 7: *The trussed structure:*
a) before and *b) after evolutionary optimization*

Evolutionary Computation in Optimizations

Optimization of Truss Structures
The criterion of optimization is minimization of the mass of a truss taking into account the following constraints:
(i) stresses in each truss member are lower than the allowable stress,
(ii) displacements in each truss joint are lower than the admissible value,
(iii) normal forces are lower than the buckling load. Design variables are split into three groups containing: (i) information about existing truss members,
(ii) information about areas of cross sections of truss members, (iii) coordinate of free truss joints. Each group is represented by different kinds of chromosomes. The evolutionary algorithm is used to optimization of:
(i) numbers of truss members, (ii) areas of cross sections of truss members,
(iii) coordinates of free truss joints, (iv) combinations of above items. In order to evaluate of the fitness function the FEM is used. In the trussed structure *(Figure 7)* after evolutionary optimization the reduction in the mass is 41%.

Generalized Shape Optimization
A new approach for generalized shape optimization (topology optimization + shape optimization) based on the evolutionary algorithm was proposed. The existing external boundary is described by means of the NURBS (Non-Uniform Rational B-Splines) curves (2-D) and surfaces (3-D). Control points of NURBS and the number of voids and their shapes and positions play the role of genes and the optimization process is entirely controlled by the evolutionary algorithm.

Topology and shape optimization of 2-D rectangular elastic structure *(Figure 8)* was performed for the criterion of minimum compliance with constraints imposed on the constant volume. The fitness function was evaluated by BEM.

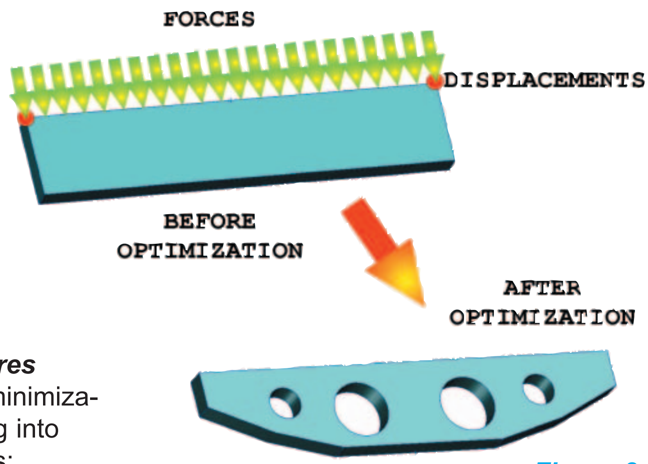


Figure 8:
Evolutionary shape and topology optimization

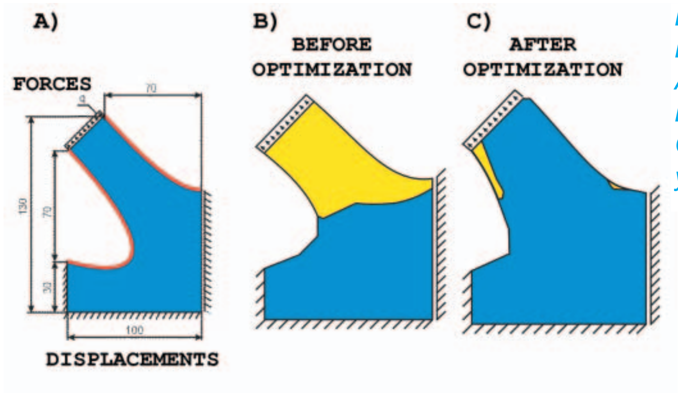
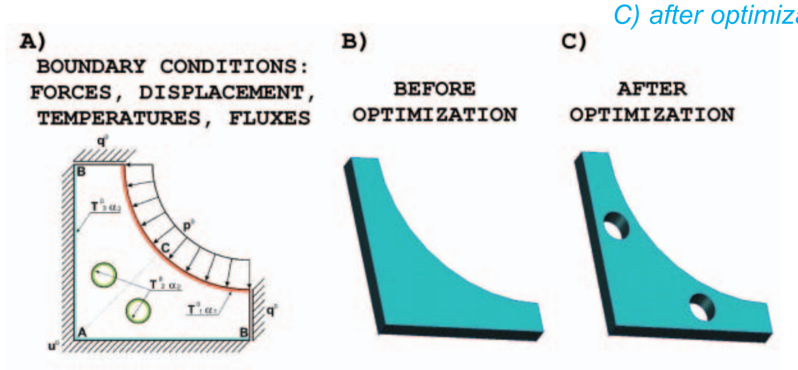


Figure 9:
Evolutionary optimization of a physically nonlinear structure:
A) considered structure;
B) before and
C) after shape optimization (plastic regions are shown using yellow colour)

Figure 10:
Evolutionary optimization of a thermoelastic structure:
A) considered structure with prescribed thermomechanical boundary conditions;
B) before and
C) after optimization



Shape Optimization of Elastoplastic Structures

In the physically nonlinear structures minimization of areas of the plastic regions in the body as the optimization criterion can be used. Constraints in the form of upper bound of the volume can be imposed. The boundary of the structure is described by NURBS. The FEM is used to solve nonlinear problems for elastoplastic material with hardening and evaluate the fitness function.

A 2-D structure (plane strain) *(Figure 9)* was optimized using EA and MSC/Nastran. Plastic regions are shown using yellow colour.

Shape Optimization of Structures Under Thermomechanical Loading

In the shape optimization of thermoelastic structures various mechanical, thermal and their combination criteria can be used. In order to evaluate the fitness functions the direct boundary-value problem of thermoelasticity theory is solved using BEM.

In the example a quarter of the square plate with a circular hole was considered *(Figure 10)*. One should find the optimal positions and radii of two internal holes with prescribed thermal boundary conditions to minimize displacements on the traction boundary.

Evolutionary Shape Optimization of Structures Under Dynamical Loading

The problem of shape optimization of structures being under the dynamical loading can be formulated as minimization of the volume of the body, with constraints imposed on boundary equivalent stresses and boundary displacements. Alternatively the problem can be formulated as minimization of the stress, strain or displacement functionals with imposed constraints on the volume.

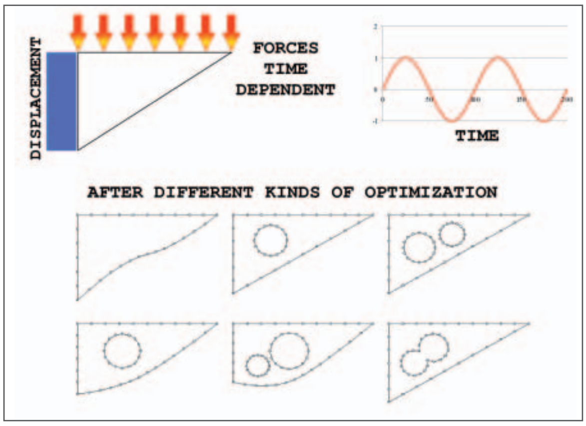


Figure 11:
Evolutionary optimization of a structure under dynamic loading

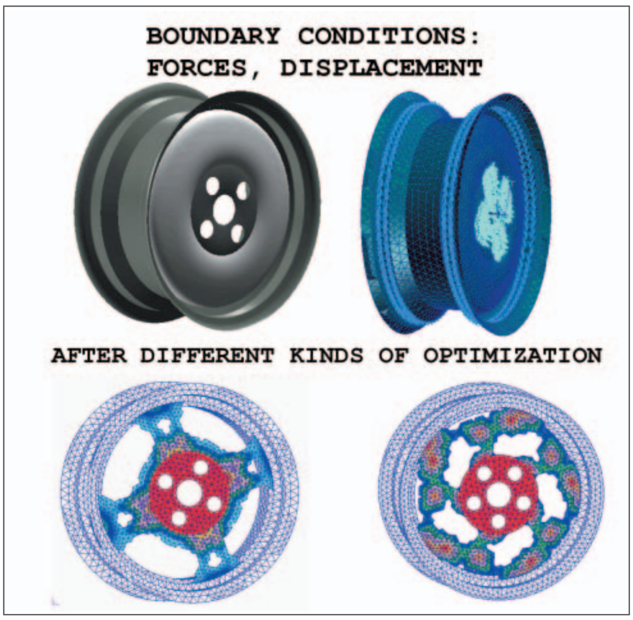


Figure 12:
Evolutionary optimization of a rim wheel

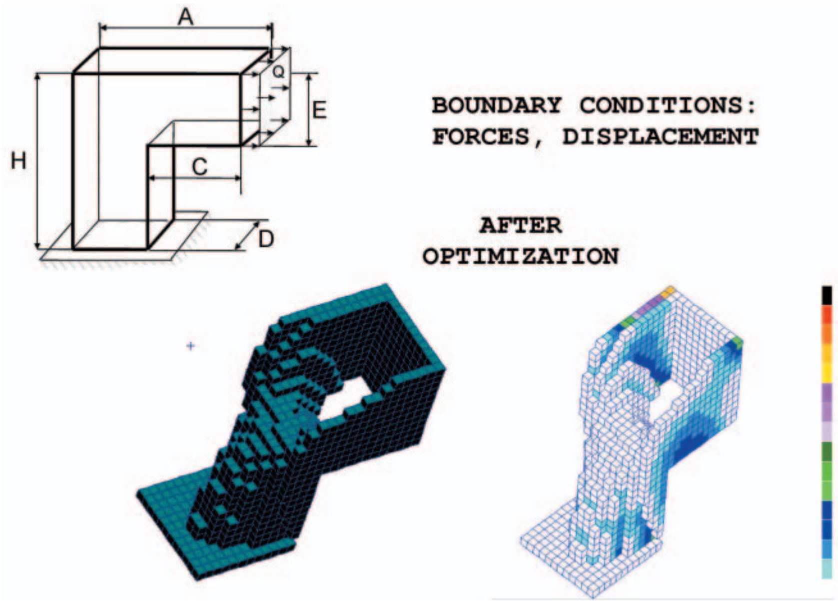


Figure 13:
Evolutionary optimization of a 3-D elastic structure

The displacement field is computed by solving a boundary-initial value problem of elastodynamics by BEM.

In the case of free vibration the shape optimization can be formulates for (i) maximum of the first eigenfrequency (ii) maximum of the minimal different between the eigenfrequencies and frequency of the loading force, (iii) maximum of the minimum different between the eigenfrequencies.

Different variants of evolutionary optimization the structure under harmonic loading *(Figure 11)* for the criterion of minimum mass when only an external boundary, or one or two holes as well as the external boundary and holes undergo shape optimization have been considered.

Evolutionary Generalized STM Optimization (STM=Shape+Topology+Material)

The idea of simultaneous shape, topology and material evolutionary optimization for 2-D and 3-D structures has been elaborated. The fitness function, which depends of stresses, is evaluated using FEM. Chromosomes contain genes, which are responsible for distribution of Young's modulus in the domain of the structure. If the value of Young's modulus of the e-th finite element is less than admissible value then this finite element is eliminated. This approach was used to evolutionary optimization of structures in plane stress/strain problems, bending plates, shells and 3-D bodies.

Generalized STM optimization of an automobile rim wheel *(Figure 12)*, considered as a shell, for two kinds of geometry parametrization was considered. STM optimization of a 3-D structure *(Figure 13)* and the equivalent stress distribution in the final optimal structure was also examined.

Evolutionary Computation in Identification

Evolutionary computation can be applied also to solving of inverse problems of mechanics in which one should find internal defects or material properties having some measurements at sensor points of state fields as displacement, temperature or natural frequency. Illustration of such a problem is presented in *Figure 14*. The problem is solved by minimizing a fitness function J, which expresses a norm between calculated and measured state fields, with respect to chromosomes whose genes describe number, kinds, shapes and positions of the defects or material coefficients.

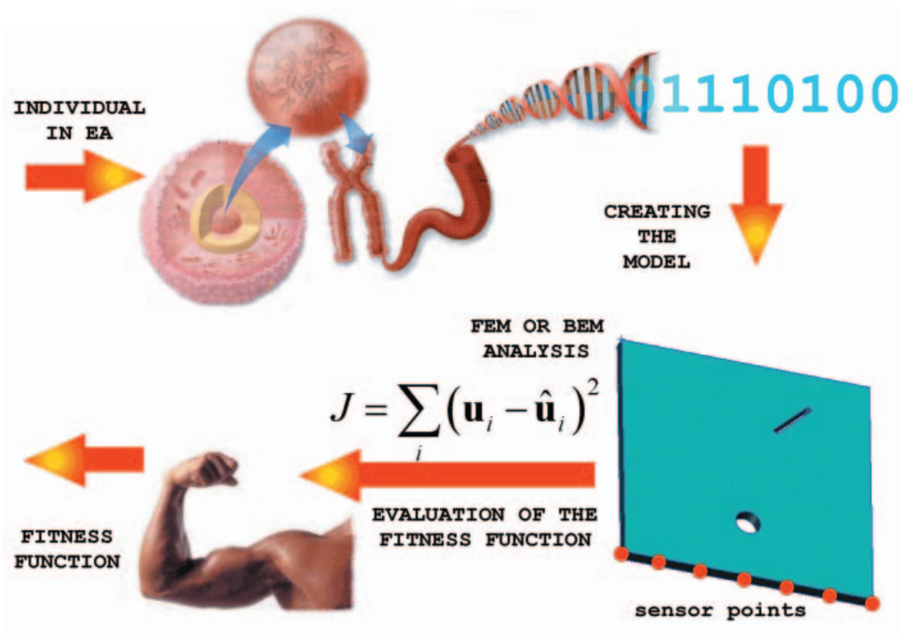


Figure 14:
Illustration of evolutionary computation in identification of internal defects

Detection of Voids and Cracks

A 2-D structure *(Figure 15)* being under dynamic loading contains actually two internal defects: a crack and a void. Each defect is parametrized as elliptical figure by co-ordinates of the figure center, two radii of the figure and the angle of rotate. The identification task is to find a number of defects and their shape having displacements sensor points.

Identification of Material Coefficients
Evolutionary computation was used to identification of material coefficients of a human pelvis. Model of the human pelvis consists of two types of bone *(Figure 16)*: the cortical bone (E_1,v_1)and the trabecular bone(E_2,v_2). One should find the Young's modulus E and Poisson's ratio v for both kinds of the bone having a field of boundary displacements. Displacements were measured by means of Electronic Speckle Pattern Interferometry (ESPI). 3-D FEM model of the pelvis was considered to evaluate the field of displacements. The problem was solved using AE to minimize of the fitness function J with respect to the chromosome ch.

Concluding Remarks

Coupling of evolutionary computation with FEM and BEM appears to be very convenient and useful artificial intelligence technique to optimization and identification problems of mechanics.

Various kinds of problems can be formulated and solved for linear and nonlinear structures being under static and dynamic mechanical and thermomechanical loading.

One disadvantage of the evolutionary methods is the time consuming calculation because in order to achieve a satisfactory solution one should produce many generations.

In order to omit this drawback hybrid approaches and the distributed evolutionary algorithms are proposed. ●

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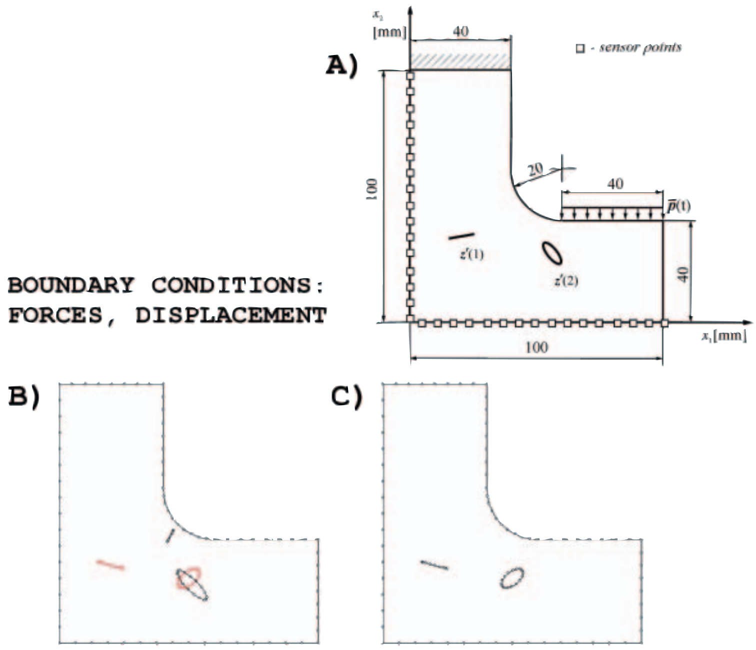
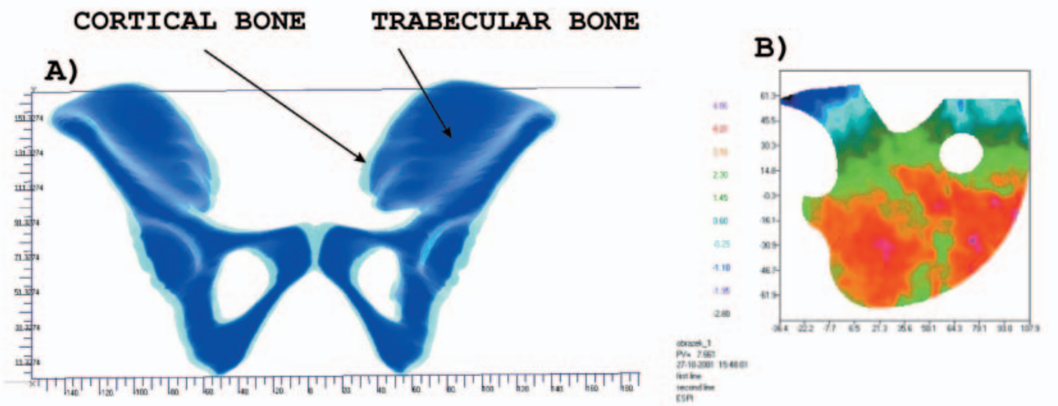
[3] Z. Michalewicz, **Genetic Algorithms + Data Structures = Evolutionary Programs**. Springer-Verlag, AI Series, New York, 1992.

Figure 15:
Evolutionary identification of internal defects in a structure being under dynamical loading:
A) a structure with two internal defects;
B) the best solution in the 1st generation;
C) the best solution in the 100th generation



$$\min_{\mathbf{x}} J = \sum_k \sum_i |\hat{u}_i - u_i|$$

$$ch \equiv \mathbf{x} = [E_1, \nu_1, E_2, \nu_2]$$



COMPUTED MATERIAL COEFFICIENTS

$$E_1 = 4283\,\text{MPa} \quad \nu_1 = 0.2 \quad E_2 = 531\,\text{MPa} \quad \nu_2 = 0.2$$

Figure 16:
Evolutionary identification of material coefficients in a human pelvis bone:
A) a model of human pelvis;
B) distribution of boundary displacement measured by ESPI

Some Notes on New Applications of Trefftz Functions in Continuum Mechanics

by
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University of Žilina
Slovakia

and
Frank Rieg
Faculty of Applied Natural Sciences
University of Bayreuth
Germany

E. Trefftz published in 1926 the paper [1] on interpolation functions satisfying all governing equations inside the domai, but not necessary boundary conditions (b.c.). More frequent applications of the method started about 50 years later by O. C. Zienkiewicz, J. Jirouπek and their co-workers. The functions are now known as T-functions and they can be polynomials, harmonic functions, Bessel, Hankel, Kelvin, Boussinesq, etc. functions. If such functions are singular (fundamental solutions) then they can be also T-functions for some subdomain with singularities outside of the domain.

One can say that a numerical model is as accurate as the governing equations and the boundary conditions are satisfied in the model. It is well known that in multi-domain numerical models some equations can be satisfied in the strong sense, i.e. in each point of the sub-domain (element) and on its boundaries (which form the domain, or inter-domain boundaries), or in the weak, integral form. The third possibility, the satisfaction of the equations in some discrete points only, can lead to global errors and to not convergent solutions.

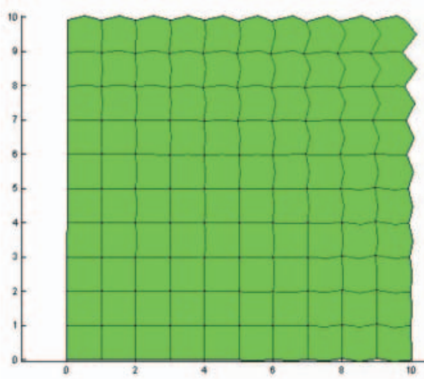
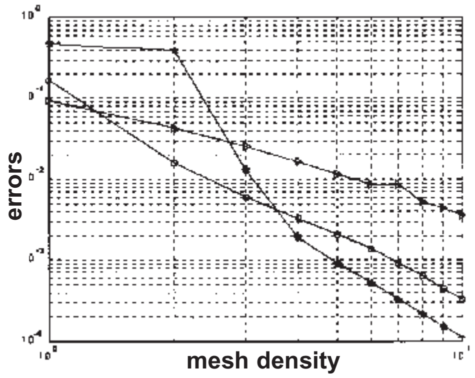


Figure 1:
Mesh of quadratic T-polynomial FE distorted by the displacement error. The largest gradient of displacements is in the upper right corner

Applying the T-functions to numerical models some considerable improvements of numerical models can be achieved. We will consider only some of them connected with the FEM, or multi-domain (MD) BEM formulations (more details see in [2]). In mostly used BEM formulation for linear solids the well known principle of reciprocity relates the work of done by forces of one stay of the body on the displacements of second stay of the same body to the work done by forces of the second stay on displacements of the first stay. The principle can be used also for a MD BEM formulation. Such formulation possess the advantages of both FEM and BEM, i.e. the system of equations is sparse, the sub-domains can be even multiply connected, the form of elements can be more general, the elements can be large and the accuracy of the element is better than the accuracy of similar elements obtained by other methods.

In the MD formulation, the number of d.o.f. of one sub-domain can be made lower than by classical BEM and so simpler, non-singular T-functions can be used as weighing functions without lost of numerical stability. T-polynomials for this purpose can be found analytically by symbolic mathematic software for both 2D and 3D problems. However, the numerical calculation of polynomial coefficients is preferred, because the analytic coefficients are more complicated for the higher order terms. The numerical coefficients are computed separately for each material (they depend on of corresponding material properties). If more complicated element is used, or the element has to have some special form, the non-polynomial Kelvin, Boussinesq, or other special functions, or even combination of such functions with T-polynomials are recommended in order to increase the efficiency of the model.

Figure 2:
*Rate of convergence of maximal errors: * displacements (= ~4); stress obtained in element corners (the worst points) = ~1.5; stress obtained by T-polynomials smoothing (= ~4).*



The principle of reciprocity can be obtained by applying the integration per partes and the Gauss integration theorem to Lame-Navier equilibrium equation weighted by T-displacement function. This procedure can be applied to non-linear problems, too. Using the total Lagrange formulation, the weighting function is related to infinitesimal displacements of the element domain in original, undeformed configuration. This is the way how non-linear problems can be solved using T-functions for multi-domain reciprocity based (RB) formulation.

As the stresses are discontinuous on inter-element boundaries and less accurate, if they are obtained from the nodal displacements, they are smoothed out in the post processing stage. Simple averaging improves their accuracy. Using low 2nd or 3rd order T-polynomial interpolation functions in connection with moving least squares (MLS) increases both accuracy and rate of convergence of the stress field considerably. If also the prescribed b.c. on the domain boundaries are taken into account in such procedures, the same rate of convergence is received in both displacement (primary field) and stress (secondary field) fields. Simple quadratic elements RB T-elements give the rate of convergence of quatric order for both displacement and stress.

For correct evaluation of bearing capacity and correct distribution of load it is necessary to model the stress and displacement fields in the regions with discontinuities (surface tractions) and their large gradients as accurately as possible. Applications in multibody contact of bodies with curved surfaces, bodies with inhomogenities, etc. can be mentioned as examples. Technique of superposition of the local solution obtained for some simpler domain (e.g. for the half space) and numerical solution for simpler sub-domains without great gradients can reduce the problem by several orders comparing to the classical FEM and BEM models. Another problem, a 2D problem with hard material inhomogenity solved by quadratic elements and that using model based on T-functions can be mentioned. Reduction of number of equations by 2 up to 3 orders was achieved using the BEM model for comparable stress results.

The homogenization of material models based on simplest modes based on the lowest T-polynomial fields is one of most accurate procedures for this aim. It enables to define simply the modes for general form of the domain and to evaluate simply the unknown material constants.

Further development of the method in the area of modelling of local effects is a topic of our Departments' cooperation and it is partially supported by bi-lateral German-Slovak DAAD project.

We did not mention here many other interesting formulations and results obtained by numbers of researchers using different procedures by T-functions like hybrid FEM, or meshless methods. Application of T-functions to the numerical solution of problems of fluid dynamics, acoustic fluids, fluid structure interaction, thermal fields, etc. are known, too and attract ever more researchers.

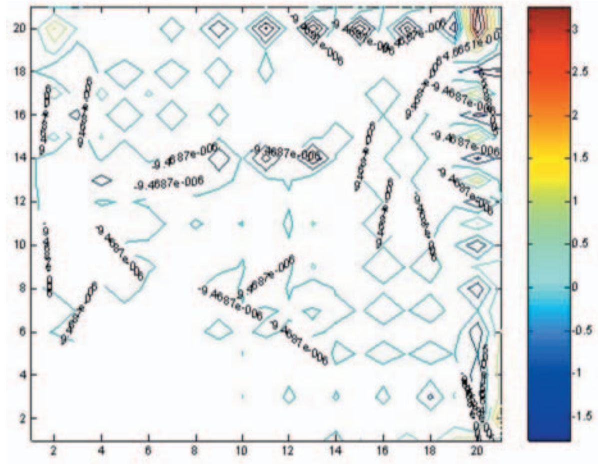


Figure 3:
Distribution of stress errors obtained by T-polynomials smoothing. Note the largest errors in the middle of elements where no displacements are calculated

The first international workshop on T-functions [3] was organised in Cracow, Polen, in 1996, i.e. 70 years after the Treffz,s paper was published, the next workshops were in Lisbon [3], Portugal in 1999 and in Exeter, U.K. in 2002. The 4-th workshop will be Žilina, Slovakia, in 2005. This could be an invitation to the event. •

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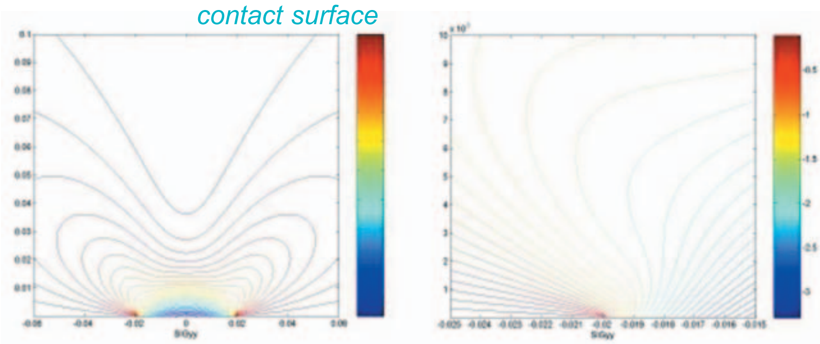
Figure 4:
Large gradients in the stress field near the contact surface of bodies with rotational surfaces. a) contact region, b) local incompatibility of stress derivative on the contact surface



The Key Challenges in Computational Mechanics

by
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In May of last year, there was a symposium at the University of California Berkeley in honor of Ray W. Clough and Joseph Penzien. I was invited to present at the symposium and my talk was entitled "Key challenges at 40 years after" [1]. Here the forty years refer to the paper by Professor Clough published in 1960, in which he coined the name "finite element method" [2]. While it is difficult to identify who "invented" the finite element method -- and indeed Clough in that same paper says "To apply the Argyris method in the analysis of a plane stress elasticity problem, the first requirement is to approximate the actual continuous system by an assemblage of structural elements ..." -- it is clear that Clough had a seminal impact on the development of the finite element method. Since I was a student of Profs. Ray Clough and Ed Wilson, it was a wonderful honor to address the attendees of the symposium.

Of course, the field of finite element analysis has exploded since the 1960s. The method is now applied in practically all areas of engineering and scientific analyses and is closely related to other numerical techniques, also widely used, such as the finite volume method. For some time, the finite element method and related techniques have been, frequently, simply referred to as "methods in computational fluid and solid mechanics".

With all these achievements in place and today's abundant applications of computational mechanics, it is surely of interest to ask "What are the outstanding research and development tasks ? What are the key challenges still in the field ?"
I addressed these questions in my presentation at the UC Berkeley symposium in May 2002 and would like to address them now as well, see also the Prefaces in refs. [3, 4].

While much has been accomplished, there are now -- as much as ever -- most exciting research tasks in computational mechanics. Indeed, we can predict that over the coming years we will attain a new level of mathematical modelling and numerical solution that will help us to reach a much deeper understanding of nature, and that will not only have a continuous and very beneficial impact on traditional engineering endeavours but will also lead to great benefits in other areas such as in the medical and health services (see figures, courtesy of ADINA R & D, www.adina.com). This new level of mathematical modelling and numerical solution does not merely involve the analysis of a single medium but must encompass the solution of multi-physics problems involving fluids, solids, their interactions, chemical and electromagnetic effects; must involve multi-scale phenomena from the molecular to the macroscopic scales; must include uncertainties in the given data and solution results; and, in engineering, must focus on the optimization of designs for the complete life spans of the systems. Based on these thoughts, we can identify

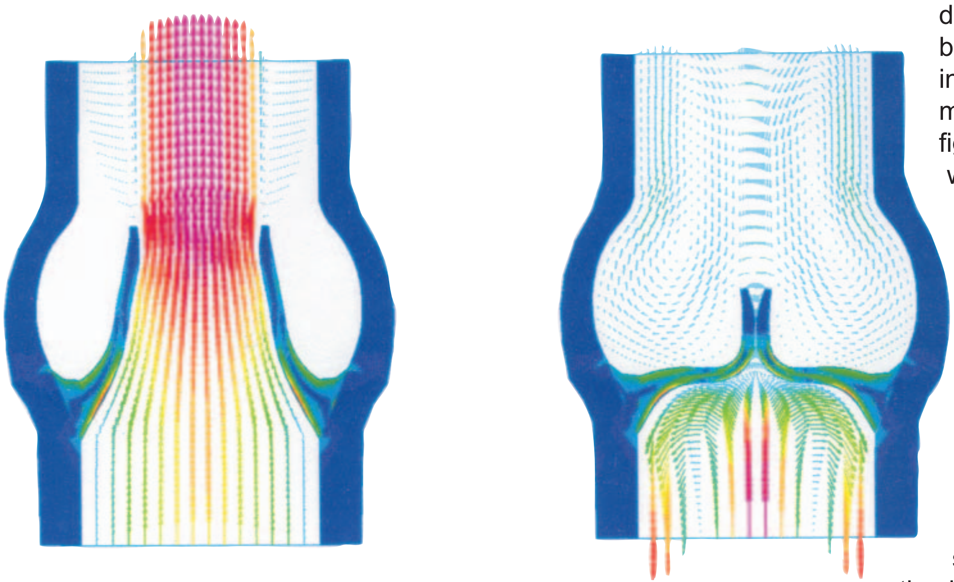


Figure 1:
Aortic valve, open and closed: blood velocities and arterial stresses

the following eight key challenges for research and development in computational mechanics.

Challenge 1.
The automatic solution of mathematical models. Many advances have already been made in the development of numerical procedures, and notably the finite element method, to automatically solve mathematical models for a given accuracy. However, there are many further advances needed in the meshing algorithms, in discretization schemes to have uniformly optimal schemes, in error measures, and so on, including actual practical implementations utilizing advances in hardware. A further step is to automatically create mathematical models, hierarchically, and establish error measures on these models.

***Challenge 2*.**
Effective numerical schemes for fluid flows. Numerous publications exist on the numerical solution of fluid flows, but the numerical methods proposed are far from satisfactory. "Ideal" solution schemes would be much more predictive, reliable and effective. Clearly, major advances are still possible.

***Challenge 3*.**
The development of an effective mesh-free numerical solution method. While much research effort has been expended on the development of meshless methods, only a few proposed techniques are truly meshless and these are not yet sufficiently effective. A reliable, general and efficient mesh-free method for solids and fluids will greatly advance the field of analysis and surely such a method can be developed.

***Challenge 4*.**
The development of numerical procedures for multi-physics problems. One major area is given by fluid flows, including heat transfer, chemical and electromagnetic effects, fully coupled to structures. Of course, there are in addition many other multi-physics areas involving thermo-mechanical, electro-mechanical, chemical, and other coupling effects. Advances have been made for simulations in these fields but significant further progress can be accomplished.

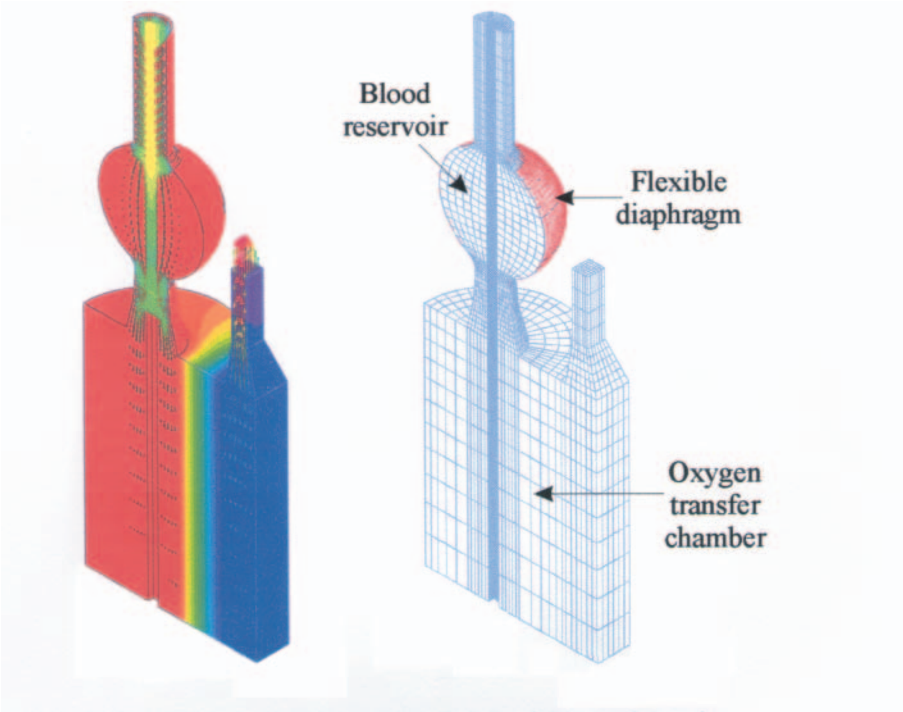


Figure 2:
Artificial lung: pressure, blood velocities and mesh

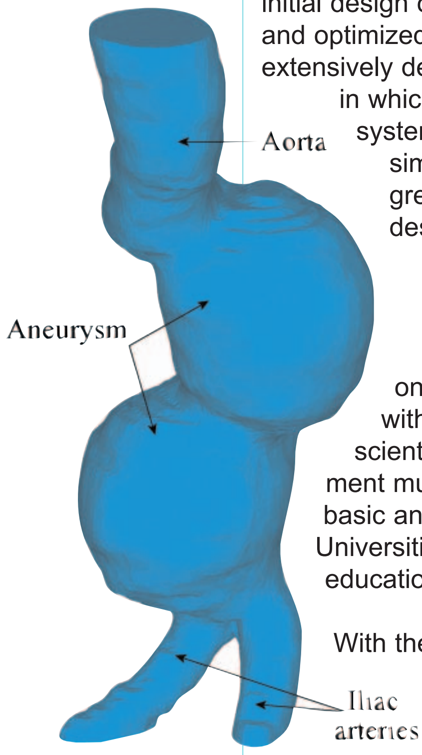
***Challenge 5*.**
The development of numerical procedures for multi-scale problems. Many devices and phenomena in engineering and the sciences involve multiple scales. The spanning of scales in analyses of engineering designs, notably those using nano-technology, in analyses of bio-medical applications, fluid flows, material modelling, and problems in the earth sciences, to name just a few, provides an exciting challenge.

Figure 3:
Crushing of a motor car model

***Challenge 6*.**
The modelling of uncertainties. The purpose of an analysis is to model nature, as represented in a new design or an already existing system. However, invariably there are uncertainties and these ideally would directly be included in many analyses. This will surely be possible.

Challenge 7.

The analysis of complete life cycles of systems. At present, largely, only the initial design of a system is analyzed and optimized. There is a need to extensively develop "virtual laboratories" in which complete life cycles of systems are optimized. Such simulations can be used to greatly advance engineering designs.



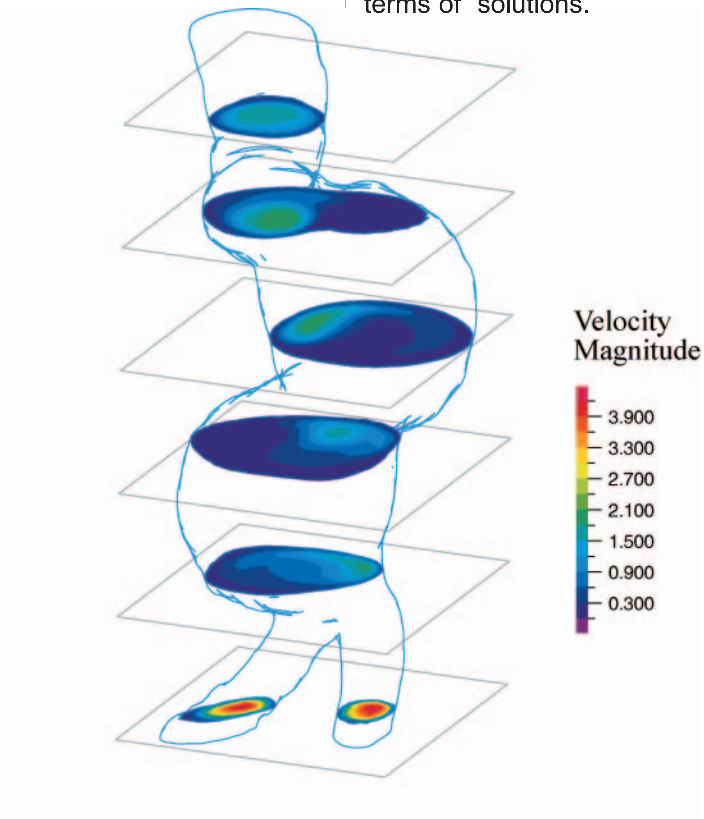
Challenge 8.

Education. The powerful tools for analysis are only of value if they are used with sound engineering and scientific judgment. This judgment must be created by a strong, basic and exciting education in the Universities and ongoing, life-long education in practice.

With these challenges identified, we of course should ask ourselves "How can we best meet these challenges ?" There are two important tasks.

Figure 4:* *(top and bottom)
Abdominal aortic aneurysm: Model and Velocity profiles

Firstly, Industry and Academia should work closely together. History has shown that - frequently - major scientific and engineering developments took place when there was a need for such developments. This need is today frequently driven by what Industry seeks in terms of solutions.



When referring to Industry we do so in the broadest terms. Hence, we include, on the one side, those branches that have used computational methods for some time and, on the other side, those branches that now hardly employ computational methods but could greatly benefit by the use of extensive numerical simulations.

Of course, to meet the above-enumerated challenges it is also much more exciting and valuable - because of the synergy that can result - if Academia and Industry work closely together.

Secondly, we need to make efforts to help the young people who work in the field of computational mechanics. The given challenges will need to be worked on for many years, and it is crucial that bright young people find the area of computational mechanics to be a very vibrant and exciting field to work in.

The future of computational mechanics belongs to the young researchers. It is this generation that will largely meet the challenges and establish the new level of mathematical modelling and numerical solution mentioned above. In these endeavours - namely, the research and development, and the fostering of the young colleagues - there is truly a wonderful future in computational mechanics for all of us, and for many years to come. •

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The Evolution of China
An Interview with Mingwu Yuan

Chairman of the next World Congress in Computational Mechanics (WCCM VI) to be held in Beijing on 5 - 10 September 2004

Tell us about your early life in China, the country we are soon to visit as host of the next IACM World Congress?
I was born in 1939, when the Japanese troops occupied most o China. My family was quite large (5 older brothers and one older sister). It was hard to survive as a large family, always worrying about enough food. My only early memory is of Japanese soldiers passing on horse back and the Chinese having to bow as they passed. My brothers also had to study using Japanese text books.

So when did this all change?
It was in 1949 when our real battle against poverty and hunger occurred. Things improved though when the communist party came into power, I was then ten years old. We had a better life, at least we could survive and we were happy to be ruled by our own and not occupied. I enjoyed high school and at least had no food shortages. I was 16 when I left my hometown near Shanghai and went to study at Peking University in Beijing. Here I completed 6 years undergraduate and 3 years graduate studies. Peking University is the oldest and best university in China with a beautiful campus. My dream was to become a mathematician.

Was your dream realised?
No. I was allocated mechanics as my speciality, so mechanics became my career for life. There was no degree system in China at that time and the first nine years of my study filled with the continuous political movements. The next 15, after graduation, were taken up with the Cultural Revolution. This time turned out to be my best research years. There were also sad times though; I lost two brothers during the Cultural Revolution. One disappeared after escaping from political persecution and another died of lung cancer after endless political investigation.

When would you say was the turning point for your family and China?
The turning point from a global point of view of China was in 1978. China started to open up and the economic system was transformed into a market system, an essential reform brought about by the communist party. Enormous change took place over the next 25 years. I was then a lecturer at Peking University, and had to wait many years for a coupon to buy a bicycle. My monthly salary was USD8 (which did not increase for 16 years) which was quite normal. We were a family of four and lived in 12 square meters. Many things only existed in my dreams, and some hardly brave enough to think about.

But what about your personal turning point?
1980. I never dreamed that I would be selected to study abroad. I attended UC Berkeley for two years and to listen to many famous professors in C.M., for example Ray Clough, Robert Taylor and Edward Wilson etc. I gained a lot of professional knowledge, research methodology and independent research ability. More importantly, I experienced the United States society and learned their concepts. My two years at Berkeley were perhaps my personal turning point. I was 40 when Professor Wilson changed my life. Computational Mechanics became my focus, for the rest of my life if it's not too late!

Was it difficult returning to China after this experience?
I returned in 1982 with a concept to develop a structural analysis programme based on SAP80, developed by Edward. I never received any financial support or grants from the government or university to support this research. I would ride my bicycle, with my student in tow, to various places where PCs could be lent to us for free, in order to make the programme useful to industry.

Did you succeed in the end with this programme you were developing?
Yes, after several years the programme was launched on the market at a very low price. Here we encountered problems. Users were used to free software. Paying was a strange concept when they were accustomed to sharing research results with others for free. Neither had my colleagues seen a professor making money. This caused various complaints and in fact even affected my promotion. Jealousy and gossip was prevalent and killing me. This was so unfair as it was during this time that the socialists were planning their market system. My only aim was for computational mechanics to serve industry and construction.

How do things stand today?
After 20 years of research and development, we dominate the FEM market in China and have made many important contributions to famous engineering projects. My monthly salary is 100 times greater than in 1980 and three of us live in 270 square meters. We now own a private car and the most advanced notebook computers. But it does show how difficult it was for intellectuals to work and serve their people. •

We thank ***Prof. Mingwu Yuan*** *from the Department of Mechanics & Engineering Science at Peking University, Beijing for sharing this with us.*

Natural Frequencies and Modes of Vibration for Elastic Beams

by
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Elastic Beam Theories and Methods

Flexural motion of elastic beams is a problem of interest in structural engineering. In particular, engineers need to calculate the natural frequencies of beam elements, that is, frequencies at which the elastic beam freely vibrates. The reason is that another part of the system may force it to vibrate at a frequency near one of its natural frequencies. If so, resonance brings about a large amplification of the forcing amplitude with potentially disastrous consequences.

The most realistic and accurate approach for computing eigenfrequencies is to model the elastic beam based on the fundamentals of elasticity theory, see [8][9]. Then compute eigenfrequencies by means of the finite element method (FEM) [11][12]. The model is three dimensional and consequently, the computational cost is high. In applications one dimensional models are preferred. Three fundamental effects are considered; Bending, Rotary Inertia and Shear. Following Russell [5] or Achenbach [1] we may consider the energy of the system to obtain the Timoshenko system (TS)

$$\begin{aligned} I_\rho \psi_{tt} - EI\psi_{xx} + K(\psi - \omega_x) &= 0 \\ \rho\omega_{tt} + K(\psi - \omega_x)_x &= 0 \end{aligned} \qquad (1)$$

Here $\omega(x,t)$ represents the vertical displacement of the elastic axis of the beam, and $\psi(x,t)$ the rotation angle due to bending and shear.

The physical constants in the model are: *p* ≡ linear density, *EI* ≡ flexural rigidity, *I* ≡ rotary inertia and *K* ≡ shear modulus.

By formal differentiation the system can be uncoupled to obtain the *Timoshenko equation (TE)*

$$\rho\omega_{tt} - I_\rho\omega_{ttxx} + EI\omega_{xxxx} + \frac{\rho}{K}\left(I_\rho\omega_{tttt} - EI\omega_{ttxx}\right) = 0 \qquad (2)$$

In this equation $-I_\rho\omega_{ttxx}$ is the contribution of rotary inertia and the term due to shear is $\frac{\rho}{K}\left(I_\rho\omega_{tttt} - EI\omega_{ttxx}\right)$. If both effects are neglected we obtained the well known Euler-Bernoulli equation

$$\rho\omega_{tt} + EI\omega_{xxxx} = 0 \qquad (3)$$

Equation (2) is also obtained from equilibrium considerations if shear and moment are assumed to arise from a distributed applied normal load and moment, each per unit length, see [7]. Therein a frequency study is presented for the Timoshenko equation, the work is limited by the computational resources of the time. A more qualitatively study of the fundamental effects in beam theory is presented in [6].

"... frequency study is presented for the Timoshenko equation, the work is limited by the computational resources of the time ..."

The works mentioned above, are only a few of the vast literature on the subject. Nevertheless, the fundamental problem, still of current interest, is to asses the accuracy of the different models obtained from the Timoshenko system and the Timoshenko equation when some, or all, of the effects are considered. In the next section we discuss this problem in the context of natural frequencies and modes of vibration

Table 1
First 10 Frequencies in radians per second

Frec.	3D-FEM	TS-B-RI-S	TE-B	TE-B-RI	TE-B-S
1	902.690	900.129	1025.4	1011.08	992.00
2	2153.09	2176.35	2826.52	2686.71	2521.25
3	3680.71	3751.71	5541.12	4997.98	4450.58
4	5354.43	5487.23	9159.75	7748.62	6554.28
5	7179.67	7323.26	13683.1	10780.2	8716.80
6	9121.56	9220.51	19111.1	13974.8	10883.8
7	10783.9	111154.2	25443.8	17254.1	13034.4
8	12703.8	12989.1	32681.1	20569.6	15162.2
9	13337.9	13392.8	40823.2	23892.8	17266.9
10	14619.1	14408.9	49869.9	27208.1	19350.5

Frequencies and modes of vibration

In order to make the problem of estimation of frequencies well posed, it is necessary to consider boundary conditions for the beam equations.
For instance a clamped-clamped beam satisfies dis placement and total slope zero in both ends, for a free end condition bending moment and shear force vanish.

Let us consider a rectangular beam in the clamped-clamped configuration with dimensions 30 cm width, 50 cm height, 300 cm length. The material properties are: Young Modulus $E = 200{,}000 kg / cm^3$, Poisson ratio $v = 0.2$, density $d = 2.449x10^{-6}\frac{kg-s^2}{cm}$
It is instructive to show some modes of vibration, see *Figure1*.

Using the 3D-FEM model [13], the estimated values for the first frequencies are shown in the second column of *Table 1*. The computation was carried out with a grid of 182406 tetrahedral elements and linear shape functions.

Next we consider 1D models. In what follows we write TE-B, to describe the Timoshenko equation when bending (B) is the only effect considered. Similarly with the TS model and other effects. In particular the classical models of Timoshenko, Euler-Bernoulli and Rayleigh are denoted by TS-B-RI-S, TE-B, and TE-B-RI respectively. Frequencies computed with FEM are shown in columns 3, 4 and 5 of *Table 1*. Finally we consider bending and shear effect in TE to obtain the frequencies in column 6. An important conclusion is that the TS model is more accurate if shear is to be considered. We have carried out similar computations for different type of beams with similar results. For a full discussion see [4].

Concluding Comments

It is readily seen that when shear is neglected, both models TE and TS are identical. Thus, we have a 1d model for the elastic beam incorporating bending and/or rotary inertia.

We recall that in the TE model shear and moment are assumed to arise from a distributed applied normal load and moment, each per unit length. In the derivation of the TS shear is regarded as an internal property. From a modelling prospective we can say that the latter is more physically sound.

Most of our computations are based on FEM but we are currently developing asymptotic methods. These methods allow to compute frequencies of any order at virtually no cost, and provide some insight on the different aspects of the vibration of beams.
See for instance [2] and [3].

If rotary inertia is neglected, then TE+B+S and TS+B+S lead us to two different models. To complete our analysis we need to consider these models, as well as the models with all effects activated. In particular, for the Timoshenko equation we are led to a quadratic eigenvalue problem. A solution to this problem is part of our ongoing investigations. •

Figure 1*. Fundamental modes of vibration*

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Prof. G. C. (Gyan) Nayak

1936-2003

Prof. Gyan Chandra Nayak passed away on 30th April 2003, at New Delhi after sudden cardiac problems and he was cremated the same day at Roorkee. He is survived by his wife Indra, and three sons, Arvind, Anurag, and Anupam.

Prof. Nayak contributed prominently to the early work on the finite element solution of plasticity problems. His doctoral thesis, "Plasticity and Large Deformation Problems by the Finite Element Method", was completed in 1971 and was a landmark in the development of numerical solutions to plasticity problems.

Prof. Nayak was born on 15th August 1936 at Damoh (MP), India. He graduated in Civil Engineering from Jabalpur University in 1959 and completed his Master's in Structural Engineering at the University of Roorkee (now Indian Institute of Technology, Roorkee) in 1960, following which he joined the Department as a faculty member and remained there until he retired as a Dean of the University in 1997. During the late 1960's and early 1970's he held a Commonwealth Fellowship and went to Swansea to work on a thesis involving finite element computations. Prof. O.C. Zienkiewicz was his thesis supervisor, the late Bruce Irons was his close friend and advisor during his doctoral work and many others were colleagues pursuing somewhat similar careers.

Before the contributions of Nayak, several other researchers developed finite element formulations to obtain solutions to plasticity and large deformation problems by using simple linear triangular elements. As was shown much later, the use of such elements was not permissible in problems where simple J2 plasticity was employed and where incompressibility was enforced. Nayak was the first to use isoparametric higher order elements in the quest for the numerical solution. By using quadratic elements and employing reduced integration (i.e., sampling a reduced number of points) he avoided the pitfalls of incompressibility and obtained some excellent results. This indeed marked the opening of a new era in which the use of such elements became widespread -- but he was the first to recognise this potential without doubt. His work was followed by many others, both at Swansea and elsewhere around the world. His thesis became a valuable source for those studying plasticity and indeed formed a foundation for a later text book published by his two younger colleagues, Profs. Roger Owen and Ernie Hinton.

A further significant achievement of Prof. Nayak was the introduction of the concept of large deformation into the analysis. Here for the first time he successfully used the standard matrix formulation, which by that time became a widespread form of presenting finite element algorithms for defining the higher order strains appearing in such studies. This was a very important piece of work at the time though in later years it was superseded by the more elegant - and useful in this context - tensorial notation. Other contributions attributed to Nayak's work are numerous. Here his rediscovery of the Lode angle and other parts of the general formulation allowed all of us to use a very elegant formulation of plasticity from the Tresca to the Mohr-Coulomb forms. He also introduced a form of iteration known as the Nayak-Alpha method.

Gyan Chandra Nayak held the position of Professor at Roorkee since 1974 and was the Head of the Civil Engineering Department during 1987-90. During his period at Swansea he was a well-respected colleague who developed many enduring friendships. For example, one of us (Dave Phillips) recalls sharing a room with Nayak for a period of two years. Early on they made an agreement which Nayak thought was a really good deal - that Dave would help him sort out his problems with the Gas Board, whilst he helped Dave sort out his problems with matrix formulations! Following his return from Swansea he was responsible for fostering a strong link between the two institutions, which saw more than ten further researchers visiting Swansea for postgraduate and postdoctoral study. Those of us who had the opportunity to visit Roorkee will remember the great hospitality he gave to each of us. We also know he spent much of his time and resources in charity work on the campus at Roorkee.

We all mourn his passing, but at the same time we should rejoice in the life and achievements of a remarkable person that we were all privileged to know.

Prof. O. C. Zienkiewicz,
Prof. D. R. J. Owen,
Prof. S. Valliappan,
Dr. D. V. Phillips and
Dr. R. D. Wood.

Passive Safety of Trains

by
Manuel Seabra Pereira
Department of Mechanical Engineering, Instituto Superior Técnico
Lisbon
PORTUGAL

As a form of transport, rail has always maintained lower accident levels than its counterparts, the car and the airplane. The railway industry, however strives for still better safety measures to be implemented - a fact which intensifies with each accident that occurs. In the last years the continuous developments in technology, computer modelling capabilities and know-how have opened up various research activities in the passive safety area, also known as crashworthiness. A suite of three major European projects TRAINCOL, SAFETRAIN and SAFETRAM[1] will complete a basic cycle of railways' and industry research in the field of passive safety.

Whereas the objective of active safety systems, such as signaling and automatic train protection systems, is to avoid accidents, passive safety only comes into effect in the event of collision and its objective is to significantly reduce the severity of accidents. Passive safety in railway transportation deals with means to provide a safe environment for its occupants during identified train collision scenarios. Injuries or deaths are caused by loss of survival space or severe occupant/interior contacts, which result mainly from significant damages in the vehicles' structures or from large decelerations sustained by a vehicle during the crash events.

Train crash events can be basically depicted in two phases:

- In a first phase, normally referred to as primary collision, the initial kinetic energy is progressively dissipated by means of plastic structural deformation resulting from the crash generated impact loads acting on the vehicle structure. In this phase occupant compartment integrity and acceptable vehicle acceleration levels are the most important design requirements to be considered.
- In a second phase, normally referred to as secondary collision, the occupant will be subject to a great variety of potentially harmful occupant/interior or even occupant/occupant contacts. Design requirements must involve the aspects of interior layouts, acceptable severity levels and biomechanical response to vehicle crash pulses.

High energy end

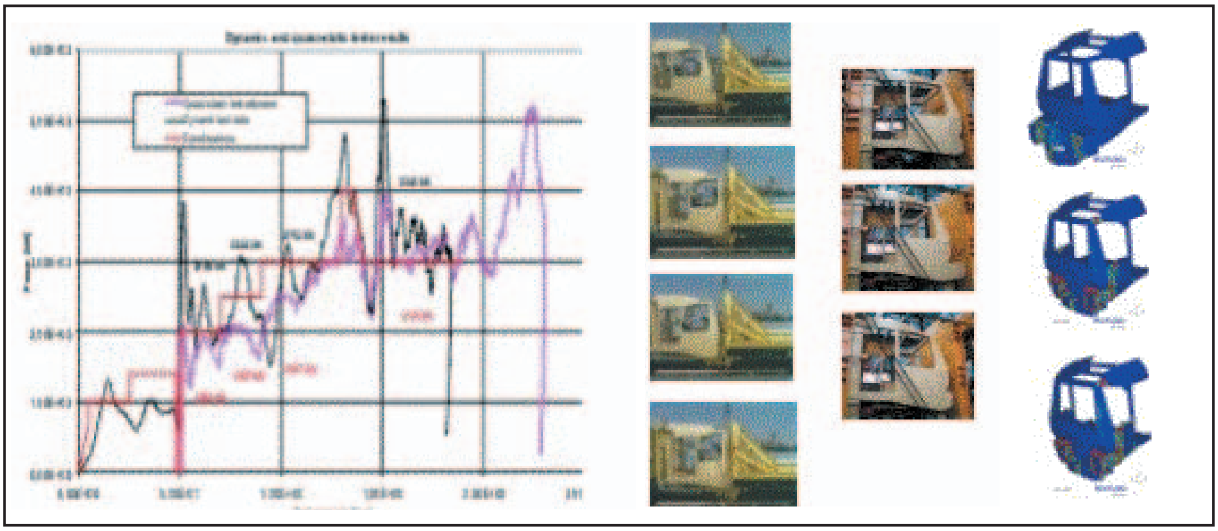
Sliding seat

Low energy extremities

Figure 1.
General Layout of High Energy (DUEWAG) and Low Energy (BOMBARDIER) Extremities and driver´s desk (BOMBARDIER)

Figure 2.
HE after test 1 (behind it HE before test 2)

Rail vehicles can now be designed to behave in ways that minimize the injuries of passengers and crew during collisions. Crashworthy vehicles contain in-built design features, which are not relevant in normal train operations, but protect the train occupants should an accident occur.



Force-displacement curves | Dynamic test | Static test | Dyn. sim

Figure 3.
Comparison of tests data: Force-displacement curves and pattern deformations

"Rail vehicles can now be designed to behave in ways that minimize the injuries of passengers and crew during collisions."

The development of a general framework for structural and interior design in train vehicles involve in a first step a review of past accidents, identification of reference collision scenarios and evaluation of their consequences. Risk assessment for improved passive safety must also be considered. From most frequent accidents three design collision scenarios were identified covering a wide range of train operations, e.g. high-speed, intercity, main line and regional trains and train configurations, e.g. loco-hauled, multiple units and motor coach trains. Vehicle override and train set collisions were analyzed to optimize basic train structural design parameters and provide information for detailed design requirements and test protocols. The following scenarios were considered:

- Scenario 1 - Train vs. train collision
- Scenario 2 - Train vs. buffer stops
- Scenario 3 - Train vs. lorry in level crossing

Two different types of energy absorbing structural arrangements were identified and designed to meet the design collision scenarios. These structural arrangements involve High-energy extremities (HE) at the front of the train and Low-energy devices (LE) located at the inter trailer areas. For the driver's safety a driver's desk and seat mounted on a sliding structure were designed to enable the seat to slide backwards during the crash and avoiding loss of survival space.

A prototype of the HE end underwent a quasi-static crush test to provide the force, displacement and energy absorption information that could be compared with similar data from both theoretical modelling and the dynamic tests. In the final year of the project three dynamic tests were conducted in a test ring in Poland. The test conditions covered the requirements of the representative collision scenarios.

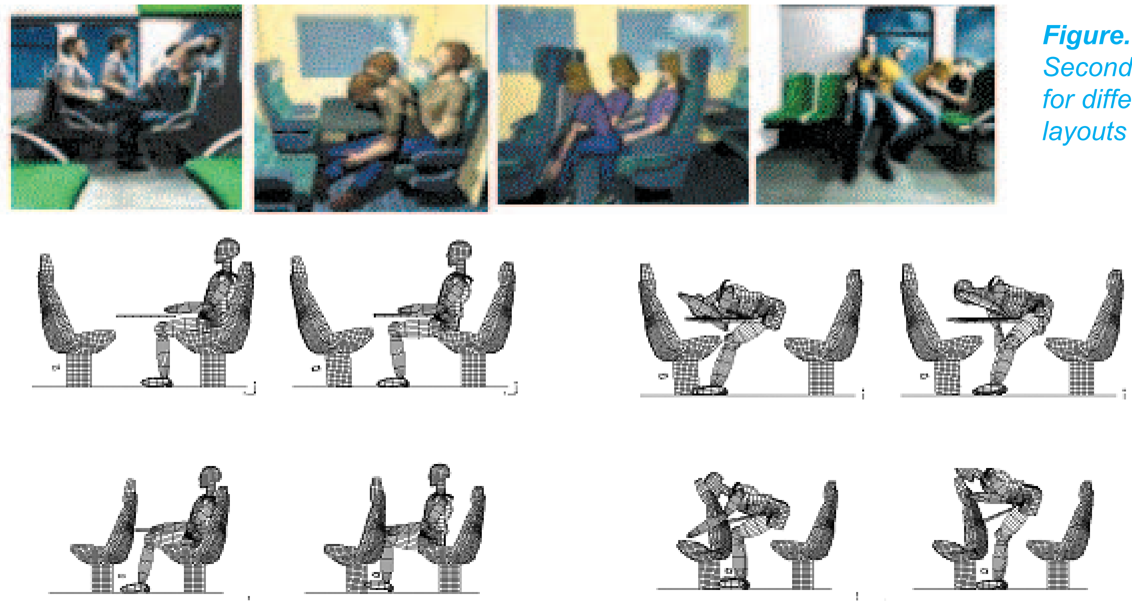


Figure. 4.
Secondary collisions for different interior layouts

Both quasi-static and dynamic tests allowed validation of the requirements on energy absorption levels and on crushing force level of the front end. Force-displacement and energy curves and energy absorption were in a very good agreement between the two tests. Results also shows a favourable comparison of the crushing evolution as obtained from the dynamic and static tests and the dynamic numerical simulation.

The design of vehicle interiors to minimize secondary impact injuries is extremely complex. Whilst many measures, such as preventing a relative velocity build up between the occupant and his surroundings, the provision of "soft edges" etc are obvious, a means of specifying such features is much more difficult. Recent advances in the car industry and in modelling vehicle interiors now allow the rail vehicle interior designer to provide more specific requirements. Agreed collision pulses and injury criteria are recommended to enable seats and tables, in particular, to be modelled and/or tested. Finally, drivers are at extreme risk in collisions. Modelling and test work have indicated mitigation measures which should significantly enhance their likelihood of survival.

Railway rolling stock crashworthiness is achievable and recent research efforts contributed to its acceptance by manufacturers and railways. As the most important manufacturers were involved in the developments, railways can expect to receive cost benefits due to the competition now possible between the manufacturers.

The consortium partners decided to supply up to date conclusions to European entities such as the Committee of European Standardization (CEN), the AEIF - European Association for Railway Interoperability and UIC - International Union of Railways for the production of standards and regulations for the future trains in Europe in order to guarantee that the same level of passive safety is applied to both high-speed and conventional trains.

In this way present research efforts have decisively contributed for a fast implementation of crashworthiness in future trains. An important outcome of the project is to provide the same optimized level of safety for all European citizens whenever they travel by train in Europe. •

"… to provide the same optimized level of safety for all European citizens whenever they travel by train in Europe."

[1] *Projects financially supported by the European Commission, coordinated by BOMBARDIER TRANSPORTATION - Portugal, involving altogether: operators CP, SNCF, DB, PKP, manufacturers, BOMBARDIER, CAF, ALSTOM, ALCAN, ANSALDO BREDA, SIEMENS (Duewag), research institutions: ERRI, CNTK, AEA, CIC, MIRA, IST, FMVH, TUB, IFS, UVHC, FMH..*

Are there Too Many Conferences on Computational Mechanics ?

by
Eugenio Oñate
Univesidad Politécnica de Cataluña
Barcelona
Spain
and
President of IACM

There seems to be a growing concern in some members of the computational mechanics community by the increasing number of scientific meetings worldwide in topics related to computational mechanics. The fact that the World Congress of Computational Mechanics (WCCM) has changed its periodicity to a two year interval adds arguments for those who claim that soon there will be not enough attendants to cover the unlimited offer presented by organizers of innumerable workshops, conferences and congresses in the five continents.

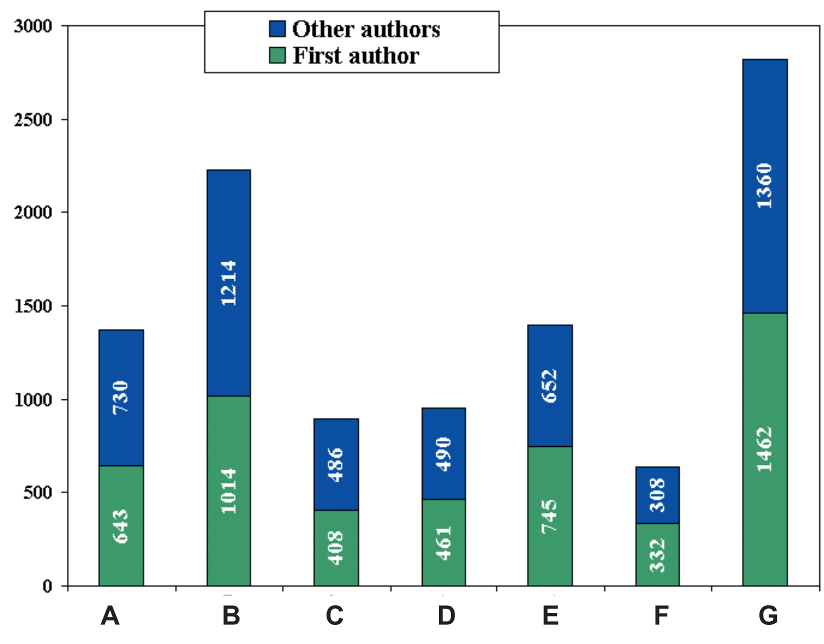
In order to analyze this matter with some perspective it can be instructive to quantify the "offer" and the "demand" in the field. By 'offer' I mean the number and type of meetings in the area of Computational Mechanics organized around the world, whereas 'demand' means the number of potential attendants to the meetings.

Quantifying and classifying the number of conferences in the field of Computational Mechanics is not a simple task and the risk of ignoring many important meetings exists. The information provided next is only a first tentative classification. I apologize for any exclusion.

IACM organizes now the WCCM every two years interval. The next WCCMVI and WCCMVII will take place in 2004 and 2006 in the cities of Beijing (Japan) and Los Angeles (USA), respectively. In addition, IACM supports a series of Special Interest Conferences organized by distinguished scientists from IACM affiliated organizations (see www.iacm.onfo).

Regional Associations in the field of Computational Mechanics with links to IACM (such as ECCOMAS in Europe, APACM in the Asian-Pacific region and the USACM in the United States) organize meetings of different sizes with some periodicity. ECCOMAS, for instance, holds a general Congress every four even years and specialized conferences in CFD and Solid and Structural Mechanics every two even years in between the general ECCOMAS Congresses. In the odd years ECCOMAS promotes the organization of Thematic Conferences and Workshops and seven of these meetings are being held in 2003. See the Conference Day planner and www.eccomas.org for details of the ECCOMAS activities.

Table 1.
Number of participants to the seven conferences



A **Computational Mechanics (IV WCCM)**
Buenos Aires, Argentina - June 29-July 1998

B **European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2000)**
Barcelona, Spain - 11-14 September 2000

C **First MIT Conference on Computational fluid and Solid Mechanics** - 12-15 June 2001

D **2nd European Conference on Computational Mechanics**
Cracow, Poland - 26-29 June, 2001

E **USACM - Sixth U.S. National Congress on Computational Mechanics**
Dearborn, Michigan - 1-3 August 2001

F **ECCOMAS CFD 2001**
Eccomas Computational Fluid Dynamics
Swansea - 4-7 September 2001

G **WCCM V**
Fifth World Congress on Computational Mechanics
Vienna, Austria - 7-12 July 2002

APACM organizes a general conference at every three years interval (the next APACM meeting will be held in 2004 in conjunction with WCCMVI in Beijing) whereas the USACM holds a large conference in Computational Mechanics in odd years at every two years interval. The last USACM meeting was recently held in Albuquerque on 28-30th July 2003.

In addition to above IACM related events there are many more other conferences in the field of Computational Mechanics organized by individuals and other associations with mathematical or industrial oriented perspective. Examples of these meetings are the MAFELAP conference, the MIT Conference, the ICES Conference, etc.

This is the "offer" scenario. Indeed nothing can be concluded without analysing the "demand". This is the key point which I will deal with next.

The study of the demand has been carried out by analyzing the number of contributors to seven selected major meetings in the field of Computational Mechanics held within the period 1998-2002. The meetings are:

Fourth World Congress on Computational Mechanics (WCCM IV)
Buenos Aires, Argentina, June 29-July 1998

European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2000)
Barcelona, Spain, September 2000 11-14 September 2000

First MIT Conference on Computational Fluid and Solid Mechanics
MIT, Boston, USA, 12-15 June 2001

2nd European Conference on Computational Mechanics ECCM II)
Cracow, Poland, 26-29 June, 2001

Sixth U.S. National Congress on Computational Mechanics (USACM VI)
Dearborn, Michigan,USA , 1-3 August 2001

Eccomas Computational Fluid Dynamics Conference (ECCOMAS CFD VI)
Swansea, U.K., 4-7 September 2001

Fifth World Congress on Computational Mechanics (WCCM V)
Vienna, Austria, 7-12 July 2002

Only meetings involving 500 or more authors have been considered here for this preliminary study. Indeed the collection of meetings can be easily extended for future statistics.

Contributors to the different meetings were extracted from the papers in the Conference Proceedings. A distinction has been made between the first author and the rest of the authors in a paper. Authors contributing to more than one paper were only recorded once.

Indeed, the list of contributors does not coincide with that of the actual participants at the meetings. Nevertheless, it is probably a good indicator of the strength of the Computational Mechanics community. In addition it provides other interesting information as presented next.

Table 1 shows the number of authors contributing to each of the seven meetings listed above. The green line indicates the number of first authors in the different papers, whereas the blue line indicates the number of other authors in the proceedings. A total of 7592 authors in the seven meetings were recorded.

The **red line** in *figure 1* shows the number of authors contributing to 1, 2, 3, 4, 5, 6 **or more** conferences. Indeed all 7592 authors contributed to one or more conferences, 176 contributed to four or more conferences, 20 authors contributed to six conferences and only 3 authors contributed to seven conferences.

The **blue line** in *figure 1* indicates the number of authors which contributed **precisely** to 1, 2, 3, 4, 5, 6 or 7 conferences. Note that 1206 authors (16% of the total) contributed to two conferences, 116 authors (1,46%) contributed to four conferences and 17 authors (0,22%) and 3 authors (0,004%) respectively contributed to six and seven conferences only.

"... whereas some hundreds of attendants will participate in a national conference, only a small percentage of these will take part in a wider international meeting."

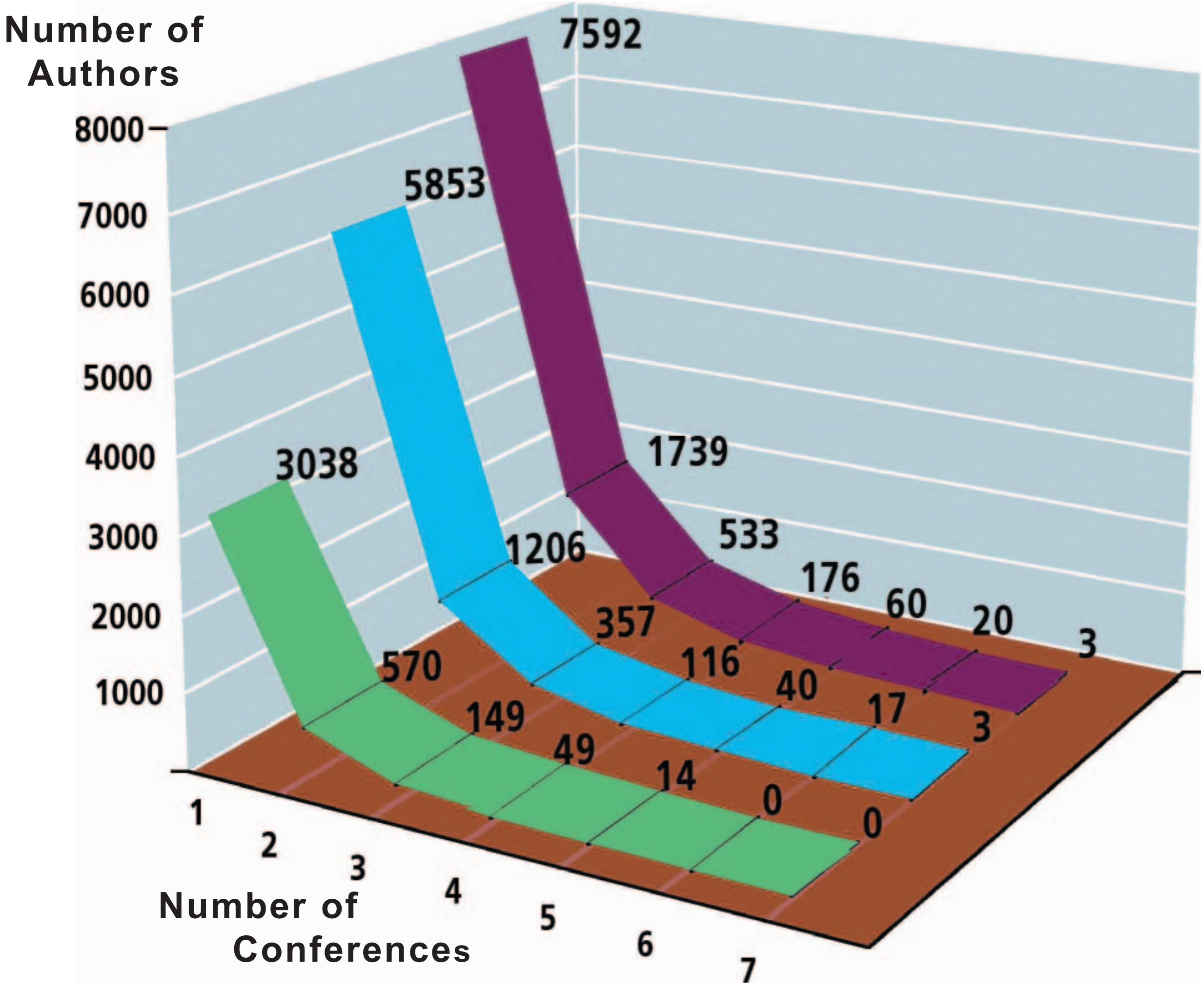


Figure 1

Red Line
*Number of **authors** contributing to 1, 2, 3, 4, 5 and 6 conferences or more.*
Blue Line
*Number of **authors** contributing exactly to 1, 2, 3, 4, 5, 6 or 7 conferences. (Total number of authors: 7592)*
Green Line
*Number of **first authors** contributing exactly to 1, 2, 3, 4, 5, 6,or 7 conferences. (Total of 3083 first authors)*

The **green line** *in figure 1* finally shows the number of **first authors** contributing precisely to 1, 2, 3, 4, 5, 6 or 7 conferences. Out of a total of 3820 first authors, none contributed to six or seven conferences; only 14 first authors (0,36%) contributed to just 5 conferences, 49 first authors (1,6%) contributed to 4 conferences, 149 first authors (4%) contributed to 3 conferences, 570 first authors (15%) contributed to 2 conferences and 3038 first authors (80%) contributed to just one conference.

I believe the figures in the charts speak for themselves and I will just draw here two simple conclusions (information on above figures is available for those who are willing to go deeper in the statistics):

1) The Computational Mechanics community is growing at considerable rate. Total contributors to WCCMIV (1998) and WCCMV (2002) grew from 1373 in Buenos Aires (Argentina, 1998) to 2822 in Vienna (Austria, 2002). This represents a growth of 113% between the last two consecutive IACM world congresses.

2) Despite the apparent "competition", two relevant meetings in Europe held in 2001 (ECCM and ECCOMAS CFD) and two meetings in USA (USACM and MIT) held the same year within relatively close dates attracted between 540 contributors (ECCOMAS CFD) and 1392 contributors (USACM VI). *See Table 1*.

Therefore, the success of the four meetings did not seem to suffer much from the existence of other "competing" conferences.

In summary, I believe that the Computational Mechanics community has nowadays grown to include a large number of "non-official" members which is difficult to quantify. A kind of multiscale effect is detected in the participation of our community members to local (national), regional and worldwide conferences. Thus, whereas some hundreds of attendants will participate in a national conference, only a small percentage of these will take part in a wider international meeting. A last example: some 350 participants from Spain and Portugal attended the conference organized in Madrid jointly by SEMNI and APMTAC in 3-6 June 2002, whereas only 63 of those attended WCCM V in Vienna only one month later. The reasons of this spread in the participation of individuals in national and international meetings are probably due to economical, scientific and/or technical interest, work load and family reasons among others.

In view of above preliminary study my conclusion is that there is no sign of recession in the number of contributors to the actual offer of conferences in the field of Computational Mechanics. The balance between national and regional conferences and world congresses, complemented with smaller size thematic events seems a good model to fit the different interests of the growing computational mechanics community worldwide. •

" The reasons ... are probably due to economical, scientific and/or technical interest, work load and family reasons. "

we are not alone!!

The acronym **IACM** means to many people much more than just an international association of scientists and engineers interested in computational mechanics. Its meaning is indeed much broader. As an example we list below some other distinguished organizations which have also adopted the same **IACM** letters as brand name. And there are probably more…

International Association for Conflict Management - http://www.iacm-conflict.org/

International Association for Cannabis as Medicine - http://www.acmed.org/

International Association of Catholic Missiologists - http://www.missionstudies.org/IACM/

International Association of Customs Museums - http://www.etat.lu/IACM/

International Association of Color Manufacturers - http://www.iacmcolor.org/

International Administration of Christian Ministry - http://members.tripod.com/iacm/

Indiana Association of Credit Management - http://www.iacm.org/

Internet Alert Call Manager - http://www.otherlandtoys.co.uk/

Inter-agency Consultative Meeting - http://accsubs.unsystem.org/ccaqfb-intranet/references/IACM/iacm999.htm

Instituto para os Assuntos Cívicos e Municipais (Macao) - http://www.iacm.gov.mo/iacmlaw/structure_p.htm

Institute of Applied and Computational Mathematics - http://www.iacm.forth.gr/

The information has been kindly contributed by
Prof. Manuel Casteleiro
University of La Coruña
Spain

www.iacm.info

For all inclusions under AMCA please contact:

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http://venus.arcride.edu.ar/AMCA

CIMEC

International Centre for Computer Methods in Engineering

CIMEC is located in Santa Fe, Argentina, and it is dedicated to the research and development of numerical methods applied to engineering sciences. The centre is part of INTEC, a technological institute at the National University of Litoral (UNL) and the National Council for Scientific and Technological Research of Argentina (CONICET). It began in 1981 and since has accomplished intensive research and development activity in the field of numerical methods in engineering.

Figure 2. *Part of CIMEC staff. Today, 25 people including 8 doctorates*

CIMEC has and is participating in several International Joint Research Projects. For instance the International Centre for Numerical Methods in Engineering (CIMNE) of the Catalan Politechnic University, Barcelona, Spain; with the Laboratoire de Techniques Aeronautiques et Spatiales (LTAS) of the University of Liege, Belgium; with the Universite Pierre et Marie Curie, Paris, France; with the National Science Foundation, USA; with the University of Birmingham, U.K.; with the University of Graz, Austria; and with the Institute National de Recherche en Informatique et Automatique (INRIA), France. In this sense, CIMEC is willing to be partner in future International Joint Research Projects with well known institutions of all over the world.

Figure 1. *Building where CIMEC is located at the Parque Tecnológico del Litoral Centro, Santa Fe, Argentina*

The main research areas are: naval hidrodynamics; surface and subsurface hydrology; nonlinear material modeling; combustion engines; mechanics of mechanisms; biomechanics; numerical methods; advanced programming (parallel computing, object oriented programming). Within current research projects under development, we can mention:

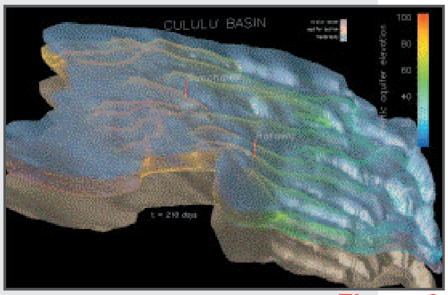

Figure 3. *Model for the surface and subsurface hidrologycal flow in Santa Fe state.*

- **Meshless methods:** involving the development of new methods for computing solutions of partial differential equations on moving domains.
- **Modelling of surface and subsurface water flow:** numerical modelling of aquifer water balance coupled with surface streams (channels and rivers) involving several aquifers and layers per aquifer.
- **Modelling of processes in steel production:** development of methods and algorithms to accurately model: the multiphase flow inside metallurgical ladles, the solidification inside the continuous casting mould and the stress development during thermal cooling. The project involves the participation of Instituto Argentino de Siderurgia, which belongs to a consortium formed by the main argentine steel producers.
- **Methods for synthesis of aeronautical mechanisms:** the objective of this project is to build an integrated general-purpose software for the structural (type) and dimensional syntheses of mech anisms, starting from specification of functional requirements.
- **Parallel computing:** The flow shown around a car-like body has been obtained with a free CFD finite element code named PETSc-FEM that is being developed at CIMEC. This code runs on Beowulf clusters and can be downloaded for free (GPL license) and extended by coding new element routines. (http://www.cimec.org.ar/petscfem, http://www.cimec.org.ar/twiki/bin/view/Cimec/PETScFEMResults).

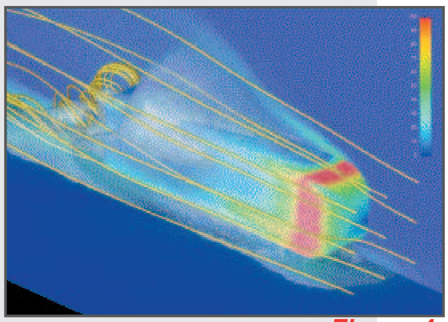

Figure 4. *Flow around a car-like body*

Web: http://www.cimec.org.ar

ENIEF '2003

XIII Congress on Numerical Methods and their Applications

Bahía Blanca, Argentina
November 4-7, 2003

DEPARTMENT OF ENGINEERING
UNS

REGIONAL FACULTY OF BHAÍA BLANCA
UTN

Further information:

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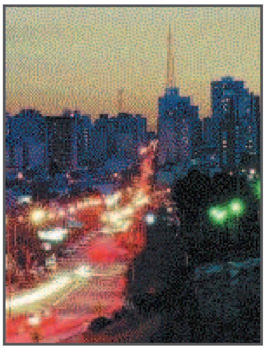

Organized by:
Department of Engineering, Universidad Nacional del Sur and Regional Faculty of Bahía Blanca, Universidad Tecnológica Nacional.

The Argentine Association for Computational Mechanics (AMCA) announces the XIII Congress on Numerical Methods and their Applications, ENIEF 2003. The congress is of interest for engineers, mathematicians, physicists, researchers, and other professionals who develop numerical methods or use them as part of their professional practice. The ENIEF meetings started in 1983 as the only national meeting of users and researchers of the Finite Element Method. The success that the meeting had in the computational mechanics community in Argentina and neighbouring countries promoted a sequence of periodic ENIEF events, which alternate with the national MECOM congress.

The topics to be covered in this congress are Fluid Mechanics, Heat Transfer, Solid Mechanics, Structural Analysis, Discrete Mathematics, Mesh Generation, Visualization, Software Development and Algorithms.

Invited Speakers:
Dr. Gregory Kopp from University of Western Ontario, London, Canada. Dr. Rubens Sampaio from Pontificia Universidade Catolica do Rio do Janeiro, Brazil. Dr. Manuel Pastor Pérez from Universidad Politécnica de Madrid, España. Dr. Guillermo Creus from Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil. Dr. Antonio Huerta from Universidad Politécnica de Cataluña, Spain.

Congress Location
Bahía Blanca is located in the southern part of Argentina. It is, with more than a quarter-million citizens, the second largest southernmost city in the world. It is Argentina's second busiest port. This is due to the proximity to agricultural activity. Bahía Blanca has important oil, gas and chemical industries and its port houses one of Argentina's largest naval bases. The climate is sub-tropical. The cultural and academic activity is remarkable, with two national universities as well as several colleges.

The Centre for Industrial Research

In 1989 the TECHINT GROUP OF COMPANIES founded the nonprofit organization Fundación para el Desarrollo Tecnológico (FUDETEC), which houses the Center for Industrial Research (CINI) – the R&D center for the TECHINT steel industries. CINI is located in Campana (Argentina), a city 80 km north of Buenos Aires.

The objectives of CINI are to develop scientific and technological research supporting the steel companies of the TECHINT group in the fields of: development of new products and optimization of existing ones; development and optimization of production processes; and to provide research training to young engineers and scientists.

CINI is organized in four Departments and a specialized lab, named as follows:
Materials & Corrosion Department, Computational Mechanics Department, Applied Physics Department, Mechanical Technology Department, Full Scale Testing Lab

Besides this departmental organization, CINI has structured three Technological Areas and each one coordinates the research activities that are focused on a given technology: Steelmaking Technology Area, Furnace Technology Area, Mechanics of Tubular Products Area

The CINI staff comprises 62 persons (as of September 2002): 11 with doctoral degrees granted by universities in Argentina and abroad.

To find out more, visit our web site at **www.fudetec.com**

Figure 1: *CINI Full Scale Testing Lab Premises*

Figure 2: *CINI Office Building in Campana*

USACM Chronicle

Seventh U.S. National Congress on Computational Mechanics

Albuquerque, New Mexico, U.S.A.

July 27 - 31, 2003

http://www.esc.sandia.gov/usnccm.html

For all inclusions under USACM please contact:

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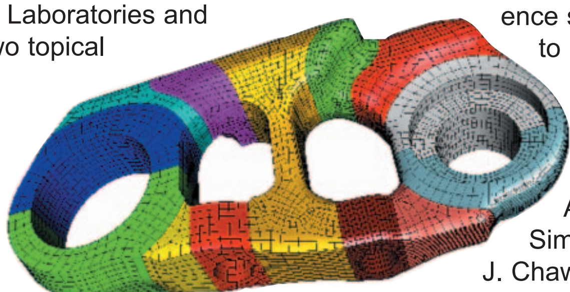
The 7th US National Congress on Computational Mechanics (USNCCM7) was held July 28 – 30, 2003 in Albuquerque, New Mexico. The USNCCM7 meeting was hosted by Sandia National Laboratories and featured sixty-two topical minisymposia. Cutting-edge applications, such as multi-scale modeling, biomechanics and nano-technology, were well represented. From computational fluid dynamics to unstructured meshing and mesh-free methods, all of the latest developments in numerical methods research were well represented. The technical program featured nine plenary lectures that focused on new directions and fundamental advances in comptational mechanics.



There were five pre and post-conference short courses offered to complement the themes of the USNCCM7 technical program: Mesh Generation and Automated Simulation (S. Owen, J. Chawner, M. Shephard), Verifications & Validation in Computational Mechanics (W. Oberkampf, L. Schwer), Discontinuous Galerkin Methods (B. Cockburn, J. Flaherty), Verification of Computer Codes in Computational Science & Engineering (P. Knupp),

Figure 1: Discontinous Galerkin Methods short course presented by Bernardo Cockburn, U. of Minnesota and Joe Flaherty, Rensselaer Polytechnic Institute.

Multiscale Multiphysics Computational Solid Mechanics (J. Fish).

The USNCCM7 was an international event with an attendance of over 1200 representing 36 countries. The next Congress, the 8th US National Congress on Computational Mechanics, is planned for the Summer of 2005 in Austin, Texas.

Visit the USNCCM7 Website:
http://www.esc.sandia.gov/usnccm.html •

The 2006 (Seventh) World Congress on Computational Mechanics (WCCM)

will be held at
The Century Plaza Hotel & Spa
2025 Avenue of the Stars, Century City, California
from
July 16-22, 2006

Both Northwestern University and the University of California at Los Angeles will be the co-hosts of this WCCM. The general Chairman is Professor Wing Kam Liu of Northwestern University.

For further information, please email: **WCCM2006@northwestern.edu,** and for more conference details please go to webpage: www.**WCCM2006.northwestern.edu**

CM Glossery - A Riddle

Dan Givoli
IACMM

An alphabetic CM Glossery is given, Complete the words according to the given definitions. Then you will be able to read out a question in the marked column which expresses a well-known current dilemma.

Answers to be published in the next issue of IACM Expressions

A	One of the FE pioneers
B	A type of an enriching function
C	Close encounter of solids
D	A key tensor in continuum mechanics
E	The difference between what we want and what we get
F	Type of an algebraic linear solver of FE equations
G	Whatever it is, FEM can deal with it!
H	Family of FE methods based on mesh refinement
I	A key operation found in any FE scheme
J	Transformation array
K	A computer program with a bug
L	An algorithm for accelerating Newton iterations
M	Collection of nodes and elements
N	Very small scale, yet a hot Buzz-word
O	Appears in the PDE
P	A general enrichment-based procedure (shortening)
Q	A family of nonlinear algebraic solvers
R	What is left from an unsatisfied equations
S	An important property of matrices, bilinear forms, etc.
T	A great challenge in CFD
U	The property of a "non-organized" mesh
V	What we want the E-word to do
W	Multiplies the residual to obtain a weak form
X	A typical axis in 1D problems
Y	Associated with a surface in plasticity
Z	No definition needed for him…

NEWS

For all inclusions under GACM please contact:

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LAUDATIO
for Professor John H. Argyris
on the occasion of his 90th birthday
(August 19th)

Professor Argyris in 1995

John H. Argyris was born in the city of Volos, 300 km north of Athens, Greece. After receiving his initial education at a classical Gymnasium in Athens, he studied Civil Engineering at the National Technical University of Athens and continued his studies at the Technical University of Munich where he obtained his Engineering Diploma in 1936. With the outbreak of World War II, he decided to interrupt his studies at the Technical University of Berlin and fled to Switzerland where he completed his Doctoral Degree at ETH of Zurich in 1942 in Aeronautics. From 1943 to 1949 he worked as a technical officer at the Engineering Department of the Royal Aeronautical Society of London.

In 1949 he joined the Imperial College of the University of London as Senior Lecturer and in 1955 became Full Professor and director of the Division of Aeronautical Structures until 1975, when he became an Emeritus Professor. However, he continued his collaboration with Imperial College as a visiting Professor until 1980. In 1959 he accepted an offer from the University of Stuttgart and became the director of the Institute for Statics and Dynamics of Aerospace Structures where he created the aeronautical and astronautics campus of the University of Stuttgart. After becoming an Emeritus Professor at the University of Stuttgart, he continued to work with the same vigor, writing books and scientific papers with a compelling vitality and creative thinking.

It is extremely difficult to summarize in just a few lines the impressive accomplishments of John Argyris. He has written more than 500 scientific papers and 10 books including three important textbooks: Introduction into the Finite Element Method, vols. I, II and III, 1986-88, Dynamics of Structures, 1991, An exploration of Chaos, 1994. His textbooks and extensive journal publications are essential reading material for students, engineers and researchers around the world and have become benchmarks for later treatises on Computational Mechanics.

In the paper which coined the name "finite element method", published in 1960, the world-renowned author Ray Clough refers to the finite element methods as "the Argyris method" and considers Argyris work "Energy theorems of Structural Analysis", published in 1954, to be the most important series of papers ever published in the field of Structural Mechanics. Von Karman's prophetic statement that Argyris' invention of the finite element method entailed one of the greatest discoveries in engineering mechanics and revolutionized our thinking processes more than 50 years ago has proven to be even more so true than expected.

One of his most important contributions in the engineering community was the founding and the editorship of the Computer Methods in Applied Mechanics and Engineering Journal, a publication that has provided much of the lifeblood of computational methods in applied mechanics and engineering for more than three decades. John Argyris took great interest and pride in this venture and insisted on running the journal on a meticulous and diligence level. He and his co-editors succeeded in making CMAME one of the leading journals in Computational Mechanics available today.

John Argyris has received numerous awards and distinctions. He has received 33 Doctorate Degrees "Honoris Causa" from universities from all over the world and more than 25 other awards and distinctions. Among them the von Karman metal from the ASCE, the Timoshenko metal from ASME, the Prince Philip gold metal of the Royal Academy of Engineering, the Grand Cross of Merit of the Federal Republic of Germany. He is a honorary member of 18 scientific societies and a member or corresponding member of 6 academic institutions among then the Academy of Athens and the US National Academy of Engineering. He is also Fellow of the Royal Society of London and an Honorary President of GACM and IACM.

Professor Argyris in 2000

John Argyris has been blessed with many talents. He is not only one of the brilliant scientists of our era, with a career that spans more that 60 years, he is also a teacher, a philosopher, a linguist, a visionary and a great patriot. John Argyris is a 21st Century Rennaissance Man.

In closing, we would like to express our deepest gratitude and appreciation to John, not only for his outstanding contributions to the profession and to humanity at large, but even more importantly, for his spirit and his friendship. We wish him happiness, prosperity and continuing health in the years to come.

Manolis Papadrakakis
National Technical University Athens

GACM Short Notes

Meeting under the Auspices of GACM

It is our pleasure to announce two new events that are currently being organized under the auspices of the German Association for Computational Mechanics:

IWCMM 13:
The 13th International Workshop on Computational Mechanics of Materials
will be held in Magdeburg during September 22-23, 2003. It is organized under the auspices of GACM by A. Bertram, T. Böhlke (both from Universität Magdeburg) and S. Schmauder (Universität Stuttgart). Deadline for contributions is July 31, 2003. Further information can be found at www.uni-magdeburg.de/ifme/iwcmm13.

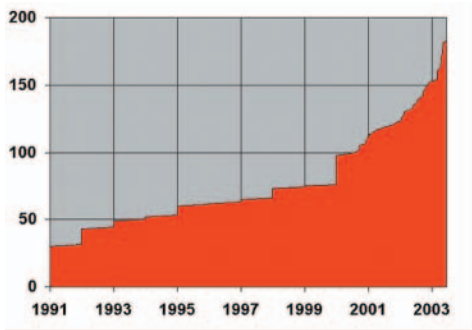
IASS-IACM 2005:
The 5th International Conference on Computation of Shell & Spatial Structures will be held in Salzburg, Austria during June 1-4, 2005. Further informations on this event that is organized by E. Ramm, W.A. Wall, K.-U. Bletzinger & M. Bischoff (Universität Stuttgart / TU Munich) can be found on the evolving webpage http://www.iassiacm2005.de.

GACM - Hausse

In the last IACM expressions editorial the president of IACM, Eugenio Onate noticed "the field of Computational Mechanics being a rare exception in this strange kind of recession we are living in some other sectors". As a kind of proof to this statement we are sketching here the development of the German Association of Computational Mechanics since it was founded during the second World Congress on Computational Mechanics in Stuttgart in August 1990.

The eligible development indicator that we use is the number of members. And the enjoyable progression of GACM that we see is really almost the opposite to most of the graphs that we get dished up in nowadays economic news. And even if the exponential growth will not continue forever, the current development is an encouraging fact for the whole field of Computational Mechanics and Computational Methods in Applied Sciences and Engineering in Germany and beyond. •

Figure 1:
Number of GACM Members - from its creation until today



Honorary Doctors Degree for Prof. Michael Kleiber

"On May 14, 2003 the Technical University of Darmstadt awarded Professor Michal Kleiber, Minister of Science of the Republic of Poland and Director of the Institute of Fundamental Technological Research, Polish Academy of Sciences, Warsaw, Poland, with the honorary doctors degree Dr.-Ing. E. h.(Doctor Engineer honoris causae).

The award was launched by the Department of Mechanics of theTU Darmstadt in recognizing his 'exceptional scientific work especially in the field of computational solid mechanics and its application to technical systems'.

We congratulate Professor Kleiber and hope for the continuation of our scientific collaboration.Dietmar Gross, Professor of Mechanics, Technical University Darmstadt." •

Figure 2:
Professors Erwin Stein, University of Hannover, President of ECCM, Johann-Dietrich Wörner, President of the TU Darmstadt, Michal Kleiber, our new Dr.-Ing. E. h., and Dietmar Gross, TU Darmstadt, (from left to right) during the dinner in honour of Professor Michael Kleiber on 14 May 2003 at the castle of Kranichstein near Darmstadt.

Israel Association for Computational Methods in Mechanics

by
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http://www.iacmm.org.il*

The Israel Association for Computational Methods in Mechanics (IACMM) was founded in 1995 by Pinhas Bar-Yoseph from the Technion, Isaac Harari from Tel-Aviv University and the author (also from the Technion). Immediately it became very active, and attracted the attention of practitioners and researchers of Computational Mechanics (CM) all over Israel.

During the last eight years IACMM has grown, now having many tens of active members from both academia and industry, and has established itself as the leading CM force in the country.

Figure 1:
*Prof.Michel Bercovier from the Hebrew University in Jerusalem during his talk on Computer Aided Design.
Prof.Bercovier serves as the Liaison-to-ECCOMAS in IACMM*

One major type of activity that IACMM has constantly been involved in is the IACMM Symposium. IACMM Symposia are usually held twice a year, in the fall and spring. 14 IACMM Symposia were held so far; the 15th will be held in October 2003 at the Tel-Aviv University. Each Symposium consists of one full day of lectures.

A typical program includes two invited keynote lectures, two full sessions of contributed talks, and a "tutorial". The latter, which has become a very popular series, is a long lecture (usually 90 minutes) in which an expert tries to teach the audience the fundamentals of a chosen topic.

Previous topics have been:

- "Multigrid Methods" - *by Irad Yavne*,
- "Computer Aided Design" - *by Michel Bercovier; see Figure 1*,
- "*p*-version FEM" - *by Zohar Yosibash*,
- "High Performance Computing" - *by Moshe Goldberg*,
- "Structural Optimization" - *by Moshe Fuchs*, and
- "Computational Aeroelasticity" - *by Mordechay Karpel*.

See *Figure 2* for a view of the audience during such tutorials.

Figure 2:
Part of the audience in a "Tutorial" lecture.

Often IACMM invites eminent scientists from abroad to give keynote talks at IACMM Symposia. Past speakers included Rafi Haftka from the University of Florida, who talked on new optimization techniques, Olivier Pironneau from University of Paris VI, who spoke on domain decomposition methods, and Michel Romerio from EPFL at Lausanne, Switzerland (whose invitation was kindly supported by the Cray company), who talked on computational models for metal processes. (*See Figure 3*).

Figure 3:
Dr Michel Romerio from EPFL at Lausanne, Switzerland, who was an invited speaker to the 13th IACMM Symposium held in the Hebrew University in Jerusalem. Dr.Romerio talked about computational models for metal processes.

The list of invited speakers has also included prominent Israeli researchers, such as Achi Brandt from The Weizmann Institute of Science (the chief inventor of the multigrid method), who talked about fast multiscale solvers.

IACMM especially encourages graduate students and young practitioners and researchers from industry to present their work in the IACMM Symposia. As part of this effort, IACMM occasionally holds paper competitions, where the second-place winner receives three years of free membership in IACMM and the first-place winner travels with IACMM support to a CM conference abroad to present his/her work. *(See Figures.4 and 5 for more details.)*

Figure 4:
Prof.Bar-Yoseph (left), the former President of IACMM, grants a certificate to Mr.Ishay Rinat, a Technion graduate student, who won the first prize in the 1st IACMM Paper Competition. As a consequence, Mr.Rinat presented his work at the conference ECCOMAS-2000 held in Barcelona, Spain, with IACMM support.

IACMM is naturally affiliated with IACM. In addition, IACMM is also affiliated with the European CM body, ECCOMAS. One recent event worth mentioning in this context is the two-day Joint France-Israel Workshop in Applied Mathematics and Scientific Computing that was held in the Hebrew University in Jerusalem in early February 2003, and was organized by Olivier Pironneau and Michel Bercovier.

Figure 5:
Prof.Isaac Harari, the current President of IACMM, grants a certificate to Ms.Victoria Suponitsky, a Technion graduate student and the winner of the first prize in the 2nd IACMM Paper Competition. Ms.Suponitsky will present her paper at the 16th AIAA Computational Fluid Dynamics Conference in June 2003 at Orlando, Florida, with IACMM support.

IACMM has its own Newsletter which is published in Hebrew twice a year and is edited by the author. This is much more than a CM bulletin board. It includes short articles and surveys on various CM topics, book reviews, etc. As a single example, the last IACMM Newsletter includes an article by Moshe Fuchs on Topology Optimization of Structures. And one of the older issues included a crossword puzzle consisting only of CM-related words.

Look in our website for issue no.3 if you would like to try it out; be warned, it's in Hebrew! •

Birthday Keynote Lecture at JSCES

For all inclusions please contact:

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Professor Valliappan delivered a Keynote Lecture on the topic 'Numerical Analysis of Smart Structures with Uncertainties' to the participants of the Symposium of the Japan Society of Computational Engineering Science (JSCES) during May 19-21,2003 in Tokyo. The Symposium was attended by nearly 500 delegates. About 290 papers were presented in 5 parallel sessions on various topics such as parallel computing, soft computing,high performance computing,multiscale analysis, impact analysis, environmental simulation, free surface and moving boundary problems,fluid-structure interaction problems, damage mechanics etc.

At the end of the Symposium, a number of Professor Valliappan's friends from the Japanese computational mechanics community gave him a party to celebrate his birthday. The participants included Professor Kawai,former Vice President of the International Association for Computational Mechanics (IACM), Professor Yagawa, Executive Council Member, IACM and Professor Ohtsubo, President, JSCES.

Figure 1:
Professor Ohtsubo welcoming the participants at the reception

Figures 3:
A group of friends at Professor Valliapan´s party

Figures 2:
Professor Valliappan delivering the Keynote Lecture

In Memory of

Dr Gyan Chandra Nayak

Professor G.C.Nayak of Roorkee University, India passed away on April 30,2003 in New Delhi. He was a Member of the Founding Council of IACM and a prominent member of the Asian Pacific Association for Computational Mechanics. He completed his Ph.D.under the guidance of Professor Zienkiewicz in Swansea. He is well known for his contribution to computational mechanics in the development of Alpha Method of acceleration for the initial stress approach adopted for the elasto-plastic analysis of engineering structures. He is survived by his wife and three sons.

A full obituary can be found elsewhere in this issue of the 'Expressions'. ●

VII Congress on Applied and Computational Mechanics

14th to 16th April 2003, Portugal

The VII Congress on Applied and Computational Mechanics was held, from **17th to 19th April 2003, in University of Évora,** located in Évora, a world heritage city. The conference was organized by Centro de Geofísica de Évora (Geophysics Research Center of Évora, a research center of the Department of Physics of the University of Évora), under the auspice of the APMTAC - Associação Portuguesa de Mecânica Teórica Aplicada e Computacional (Portuguese Society of Theoretical, Applied and Computational Mechanics).

The number of participates that attended to the VII Congress was 239. The Congress had 4 invited plenary sessions in the fields of Computational Modelling of Advanced Materials and Structures by Prof. J N Reddy (Texas A&M University), Finite Volume Method in Non Structured Mesh for the Parallel Computation of Fluid Flows by Prof. José Carlos Pereira (IST - Technical University of Lisbon), Some Problems in Computational Mechanobiology, by Prof. Patrick J Prendergast (University of Dublin) and Meshless Methods by Prof. Vítor Azevedo Leitão (IST).

The Congress was based in invited Parallel Sessions that were coordinated by Senior Researchers in the main areas of Applied and Computational Mechanics that are presently carried out in Portugal. There were presented a total of 217 papers in 40 Parallel Sessions in 5 rooms. The main areas and Senior Researchers were :
Acoustics - Prof. Miguel M Neves (IST - Technical University of Lisbon), *Adaptive and Smart Structures* - Prof. Afzal Suleman (IST), *Ancient Constructions* - Prof. P Barbosa Lourenço (University of Minho), *Applied Mechanics* - Prof. Mourad Bezzeghoud (University of Evora), *Biomechanics* - Prof. Helder Rodrigues (IST), *Composite Materials* - Prof. Cristóvão Mota Soares (IST), *Computational Fluid Mechanics* - Prof. Paulo Pimentel Oliveira (University of Beira Interior), *Concrete Structures* - Prof. Rui M Faria (FEUP - Engineering College of Porto University) , *Discrete Element Models* - Prof. Vieira de Lemos (LNEC - National Laboratory of Civil Engineering), *Electromagnetism and Electronic Instrumentation* - Prof. António Cruz Serra (IST), *Experimental Mechanics* - Prof. Paulo Piloto (Polytechnic Institute of Bragança), *Genetic Algorithms and Neural Networks* - Prof. Rogério Leal (FCTUC - University of Coimbra), *Geomechanics* - Prof. Luís Ribeiro Sousa (LNEC), *Hybrid and Mixed Elements* - Prof. José Moitinho Almeida (IST), *Hydraulics and Fluid Mechanics* - Prof Matos Silva (IST), *Industrial Applications* :, *Mechanical Engineering* - Prof. Manuel Seabra Pereira (IST),, *Civil Engineering* - Prof. Carlos A Pina (LNEC), *Metal and Mixed Structures* - Prof. Paulo Vila Real (University of Aveiro), *Meshless Methods* - Prof. Vítor Azevedo Leitão (IST), *Multibody Dynamics* - Prof. Jorge Ambrósio (IST), *Non Linear Analysis of Structures* - Profª. Maria Helena Melão Barros (FCTUC), *Numerical Method*s - Prof. Carlos Santos Alves (IST), *Seismic Engineering* - Prof. Raimundo Delgado (FEUP), *Stability and Non Linear Analysis of Metal Structures* - Prof. Dinar Camotim (IST), *Structural and Multidisciplinary Optimization* - Prof. Carlos Conceição António (FEUP), *Thermal Engineering* - Prof. Pedro Coelho (IST)

The Proceedings of the Congress (ISBN 972-778-058-X), were published by the University of Évora. Copies may be obtained by request from email: jib@uevora.pt •

Joaquim Infante Barbosa
Department of Physics, Univerisyt of Évora, Portugal

Figures 1 & 2
APMTAC Meeting and Congress Dinner

Book Report

Trends in Computational Structural Mechanics

W.A: Wall, K.U. Beltzinger and K. Schweizerhof (Eds.)
CIMNE, ISBN 84-89925-77-1, 2001, Price EUR 72

In this book a number of renowned scientists discuss different aspects and most recent developments in the broad field of Computational Structural Mechanics. It provides insight into the state of the are and indicated new trends in this fascinating field. All papers cohere with presentation made a the International Conference on Trends in Computational Structural Mechanics which was held May 20-23, 2001 at Schloss Hofen, Lake Constance, Austria.

The conference has been organised under the auspices of GACM, an affiliate of the IACM. •

Parallel Computational Fluid Dynamics 2002

K. Matsuno, A. Ecer, J. Periaux, and N. Satofuka (Eds.)
Elsevier North-Holland, ISBN 0-444-50680-2, 2002, Price EUR 12

This volume is proceedings of the international conference of the Parallel Computational Fluid Dynamics 2002. In the volume, up-to-date information about numerical simulations of flows using parallel computers is given by leading researchers in this field. Special topics are "Grid Computing" and "Earth Simulator". Grid computing is now the most exciting topic in computer science. An invited paper on grid computing is presented in the volume. The Earth-Simulator is now the fastest computer in the world. Papers on flow-simulations using the Earth-Simulator are also included, as well as a thirty-two page special tutorial article on numerical optimization.

The audience aim is Engineers, CFD Researchers and Graduate students. •

Book Report

The Scaled Boundary Finite Element Method

J. P. Wolf (Ed.)
Wiley, ISBN 0-471-48682-2,
378 pages, Price $130.00

The Scaled Boundary Finite Element Method describes a fundamental solution-less boundary element method, based on finite elements. As such, it combines the advantages of the boundary element method:
spatial discretisation reduced by one boundary condition at infinity satisfied exactly with those of the finite element method:
no fundamental solution required no singular integrals the processing of anisotropic material without any additional computational effort

Other benefits include the fact that the analytical solution inside the domain permits stress singularities to be determined directly, and also that there is no spatial discretisation of certain boundaries such as crack faces and free surfaces and interfaces between different materials.

The scaled boundary finite element method can be used to analyse any bounded and unbounded media governed by linear elliptic, parabolic and hyperbolic partial differential equations. The book serves two goals which can be pursued independently. Part I is a primer, and Part II derives the fundamental equations and discusses the solution procedures from scratch in great detail. •

iacm news

GRACM new Executive Board.

Recently the Greek Association for Computational Mechanics (GRACM) has elected a new Executive Board. The new President of the Executive Board has been confirmed as **Professor Manolis Papadrakakis** of the School of Civil Engineering, National Technical University, Athens, Greece.

Professor Tom Hughes receives Honorary Doctorate.

The Université Catholique de Louvain in Belguim recently bestowed upon **Professor Tom Hughes** the title of Doctor Honoris Causa. Through this distinction the University pays tribute to his major contributions to the development of numerical simulation methods in fluid and solid mechanics.

Austrian Academy of Sciences Elections.

Professor Herbert Mang was recently elected to President of the Austrian Academy of Sciences. His term as the 21st President since the foundation of the Academy in 1847 will begin on October 1st, 2003 and is the second engineer in this function.

Prof Michael Kleiber receives Honorary Doctorate

Prof. Michael Kleiber, from the Institute of Fundamental Technological Research of the Polish Academy of Sciences, has received a Honorary Doctor Degree from the Technological University of Darmstadt, in Germany. Prof. Kleiber is currently the Minister of Science and Technology of Poland.

Prof. K.-J. Bathe receives Honorary Doctorate

We commend **Prof. K.-J. Bathe** who on September 8, 2003 was awarded an Honorary Doctorate of Slovakia and the University of Žilina (Žhilina), Slovakia for his achievements and dissemination of the FEM. Professor Bathe is a renown scientist from Massachsetts Institute of Technology, Cambridge, MA, USA.

82nd Birthday of Prof. O.C. Zienkiewicz
Prof. O.C. Zienkiewicz celebrated his 82nd birthday at CIMNE (Barcelona, Spain) in the company of (from left to right) Profs. J. Miguel, E. Oñate, B. Suarez, S. Idelsohn, R.L. Taylor, J. Oliver and CIMNE staff.

COMPLAS VII
Seventh International Conference on Computational Plasticity

The Seventh International Conference on Computational Plasticity (COMPLAS VII), took place in **Barcelona** on **7-10 April 2003**. The Conference chairmen were Prof. R. Owen (University of Wales - Swansea, UK) and Prof. E. Oñate (Universitat Politècnica de Catalunya, Barcelona, Spain)

The first six conferences in the series were also held in Barcelona in April 1987, September 1989, April 1992, April 1995, March 1997 and September 2000. The continuing importance of this research topic is demonstrated by the fact that the number of papers presented has increased from just over 100 papers in the first COMPLAS conference to over 260 papers at this meeting.

COMPLAS VII succeeded in collecting excellent state-of-the-art papers on new scientific developments as well as innovative practical applications of computational methods to problems involving plasticity and similar material non-linearities.

Among the new research directions we note a stronger interaction between the phenomenological and micro-mechanical modelling of plasticity behaviour. The use of inverse identification techniques is also more prominent. The development of adaptive strategies for plasticity problems continues to be challenging goal, while it is interesting to note the permanence of element modelling as a research issue. Industrial forming processes, geo-mechanics, steel and concrete structures are the core of the applications of the different numerical methods presented.

Plenary speakers of COMPLAS VII included the following: F. Armero, R. Borja, R. de Borst, A. Gens, W. Krätzig, P. Ladevèze, W. K. Liu, H. Mang, C. Miehe, X. Oliver, M. Ortiz, D. Peric, E. Ramm, B. Schrefler, E. Stein, P. Wriggers and O. C. Zienkiewicz.

COMPLAS VIII is planned to take place, again in Barcelona, on the week **5-8 September 2005**. For information on COMPLAS Conferences, visit http://congress.cimne.upc.es/complas/ •

15th International Conference on Computer Methods in Mechanics CMM-2003

15th International Conference on Computer Methods in Mechanics CMM-2003 took place in the Golebiewski Hotel in Wisla, Poland on June 3-6 2003. The Conference was the continuation of Polish Conferences on Computer Methods in Mechanics which have been organised every two years since 1973. The immense contribution of these conferences to the promotion and development of the computer methods in Poland cannot be overestimated. CMM-2003 was an international conference and Prof. O.C Zienkiewicz - an outstanding British scientist of Polish origin, who has had contributed to the development of computational mechanics in a significant way, and an honorary doctor of Silesian Technical University at Gliwice, Poland, was its Honorary Chairman. It was also the first conference of the Central European Association for Computational Mechanics. The Scientific Committee was chaired by Prof. T.Burczynski,

Figure 1
Complas Inflatable Conference Leisure Area

Figure 2
A Group of Delegates attending one of the lectures at Complas VII

the Organising Committee by Prof. E. Majchrzak, and Prof. P. Fedelinski was the Scientific Secretary. During the Conference 185 papers were presented, including 9 plenary lectures, 14 keynotes and 165 contributed papers.
The Conference, in the opinion of many participants was very successful, in both scientific and organisational respect. The detailed information on the Conference can be found on the web-site:
http://www.cmm-2003.polsl.gliwice.pl.

CMM-2003 Opening Ceremony

*From left: **Prof. T. Burczynski** - Chairman of Scientific Committee, **Prof. B. Schlefler** - General Secretary of International Centre for Mechanical Sciences in Udine, **Prof. G. Szefer** - President of Committee of Mechanics of Polish Academy of Sciences, **Prof. A. Borkowski** - Deputy Chairman of Division IV Technical Sciences Polish Academy of Sciences, **Prof. E. Majchrzak** - Chairman of Organizing Committee, **Prof. W. Cholewa** - Vice-Rector of Silesian University of Technology, **Prof. V. Kompiš** - President of CEACM , **Prof. P. Fedelinski** - Scientific Secretary*

IACM-News

A new way to communicate between all members of the International Association of Computational Mechanics

The goal of **IACM-News** is to keep a close relation with the Computational Mechanics Community, by regular dissemination of new activities and social events related to the International Association for Computational Mechanics; we also think of it as a discussion forum.

Subscribers to the bulletin will receive monthly at least one **IACM-News** by e-mail.

Four different topics are included in IACM-News:

I. Future Activities
Scheduled IACM events like Congresses, Seminars, Workshops, as well as any other issue of general interest like Awards and Nomination to prominent status positions of IACM members, are announced in this section.

2. Discussion Forum
Different topics related to IACM are discussed in this section.
You can participate right now in some very interesting discussions concerning political directions to take in the IACM community on the following web address:
http://www.cimec.org.ar/iacm-disc-forum
or you can propose your own requirements to be discussed. Please, see the rules to participate on:
http://www.cimec.org.ar/twiki/bin/view/IACM/GeneralRules

3. Technical Discussion
Different technical subjects can be asked or discussed in this section . You can participate right now in some of the very interesting technical discussion presented before on the following web address:
http://www.cimec.org.ar/iacm-tech-deb
or you can ask or present new subjects. Please, see the rules to participate on:
http://www.cimec.org.ar/twiki/bin/view/IACM/GeneralRules

4. Social Events
This section is to show pictures related to recent IACM Congresses or Conferences, and social activities of IACM members.

*If you are not yet subscribed to **IACM-News** you can do it right now by sending an e-mail to*

IACM-News@venus.ceride.gov.ar

conference notices

IASS-IACM 2005
5th International Conference on Computation of Shell & Spatial Structures

Following the big success of the previous colloquium in Crete in 2000 we are pleased to announce the Fifth International Conference on Computation of Shell & Spatial Structures to take place in **Salzburg, Austria** from **1-4 June 2005**.

The meeting is organized under the auspices of the International & German Associations for Computational Mechanics (IACM/GACM) and the Working Group 13 (Numerical Methods in Shell & Spatial Structures) of the International Association for Shell & Spatial Structures (IASS).

The main objective of this Conference is to provide an international forum for presentation and discussion of recent advances on a large variety of aspects in the analysis and design of shell and spatial structures. In particular, it will reflect the state of the art of computational methods in mechanics, software development and engineering practice of shell and spatial structures. The conference themes will range from all aspects of static and dynamic analysis of these structures to material modelling, optimization, coupled problem and multiscale aspects.

Updated information on IASS-IACM 2005 can be found at the conference web site http://www.iassi-acm2005.de. For further information, or to be included in the distribution list for continuous updates, on the Conference please contact info@iassi-acm2005.de. •

LUXFEM 03
1st International Conference on Finite Element for Process Analysis, Design and Research

The first Conference on finite element applications - **LUXFEM** - will be held from **13-14 November 2003** at Luxembourg city (Luxembourg).

The conference will provide a worldwide forum for the exchange of ideas within the finite element research community as well as communicating new developments to the practicing engineer.

The scope of the conference encompasses all aspects of finite element analysis, ranging from new developments on a purely mathematical level to applications in analysis and design, process control and parameters identification.

The focus will be on advanced numerical procedures, software developments and industrial applications.

LUXFEM will bring together finite element experts from industry and academia to exchange their experiences. It will thus help industry to discover the opportunities offered by the most recent developments in finite element technologies while offering academia an insight into the challenges arising from the state of the art industrial design and manufacturing process.

For more information please contact:
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III International Congress on Numerical Methods in Engineering and Applied Science

The congress to be held in Monterrey, **Mexico** from **22-24 January 2004** will collect relevant contributions related to recent research and applications of numerical methods in engineering and applied sciences.

The first edition of this congress took place in the University of Conception (Chile) in November 1992 and gathered some 200 participants from 15 different countries. The second edition was held in January 2002 in the city of Guanajuato (Mexico) and it was attended by some 220 scientists and engineers from different countries interested in the development and application of numerical methods.

The Guanajuato meeting also served for the official launching of the newly created Mexican Association for Numerical Methods in Engineering and Applied Sciences, an affiliated of the IACM. The President of the new association is Prof. I. Herrera (http://www.cimat.mx/smmni/). More information on the Guanajuato conference can be found in the issues nos.11and 12 of this magazine.

The Monterrey meeting is organised by the new Mexican Association. The congress chairman is Prof. Sergio Gallegos from the Monterrey Technological Institute where the conference will be held. Keynote speakers participating in the meeting include B. Kroplin, C. Farhat, E. Dvorkin, I. Herrera, J. Peraire, J. Periaux, M. Casteleiro, M. Doblaré, M. Ortiz, T. Oden, T. Tezduyar, X. Oliver and E. Oñate.

A high participation from Mexican scientists is expected and this will be an opportunity for participants from other countries to establish new contacts in Mexico and get a perspective of the activities carried out in that country in the field of numerical methods and their applications.
The official languages are Spanish and English.

For more information please visit
http://congress.cimne.upc.es/mty2004 •

Announcement of the John Argyris Award

for the best paper by a young researcher in the field of Computational Mechanics

It is our pleasure to announce the second competition for the John Argyris Award for the best paper by a young researcher in the field of Computational Mechanics. This Award has been initiated to honor Professor John Argyris whose research work for more than 50 years had a pioneering impact on computational mechanics both in theory and in practice. The award recognizes his significant contribution both to the field and to the international journal Computer Methods in Applied Mechanics and Engineering, of which he is a founding editor, and is sponsored by Elsevier, publisher of the Journal.

The award certificate and a prize of 2000 euros will be conferred on the winner by the President of the International Association for Computational Mechanics (IACM). The presentation is scheduled to be made at the VI World Congress on Computational Mechanics (WCCM VI) to be held in Beijing, China, from 5 to 10 September 2004.

Papers to be judged:
Each applicant may submit a paper published not earlier than 31 March 2002, or accepted for publication, in the journal Computer Methods in Applied Mechanics and Engineering. The papers are to be submitted either electronically or by surface mail, by 31 March 2004, to the President of IACM, Professor Eugenio Oñate, at the following address:

Professor Eugenio Oñate
The John Argyris Award
IACM Secretariat
CIMNE
Edificio C1, Campus Norte UPC
Gran Capitan s/n
08034 Barcelona, Spain
e-mail: iacm@cimne.upc.es

The winner will be notified by the president of IACM during **June 2004**.

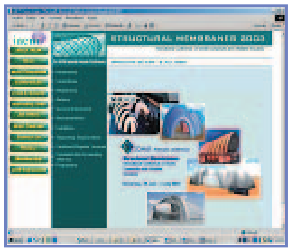
Where a paper has more than one author, the part contributed by the applicant is to be clearly indicated and certified by the applicant's supervisor or Head of Department.

All applicants must be under the age of 35 on 31 March 2004.

Selection procedure:
An international panel nominated by IACM will select the winner. The panel's decision is final. •

Our Web Site

www.iacm.info

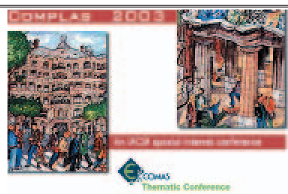
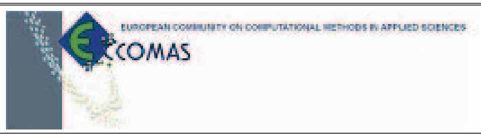


The IACM web page is an electronic space to share information associated to Computational Mechanics and related topics. IACM members and organizations are invited to send us information of interest to the computational mechanics community or different suggestions. We thought the IACM web site as a tool to disseminate information on the activities organized or supported by IACM affiliated associations, job offers, general news... as well as any other issue of general interest, and they are welcomed!

The site has links organized in a simple way for consulting different matters of interest:

iacm

international association for computational mechanics

About IACM	• How IACM is organised with their affiliated organisations, lists of Executive and General Council Members
News	• Space where all IACM members and organisations can publish relevant news of interest for the Computational Mechanics community
World Congresses	 • Upcoming and past IACM World Congresses on Computational Mechanics
Conferences	• Upcoming and past Conferences supported by IACM, as well as different interesting events 
Prize & Awards	• List of IACM awards to recognise outstanding contributions on Computational Mechanics
Interesting Links	 • Links with International Organisations
Job Offers	• Job opportunities in the field are welcome!
Short Courses	• Announcements of calls for short courses on different areas of Computational Mechanics Nano Mechanics and Materials
Contact Us	• You can send your contributions, comments, and/or suggestions to the IACM Secretariat
History	• A brief story about the origin of the International Association of Computational Mechanics
Membership	• Instructions on how to become individual, laboratory or corporate member of IACM
IACM Expressions	 • Here you can find our bulletin, IACM Expressions in its electronic versions

conference diary planner

20 - 23 October 2003	**CAIP 2003 - VI Interamerican Congress on Computation Applied to Processes Industry** *Venue:* Puebla, Mexico *WWW:* http://mail.udlap.mx/~caip2003/
4 - 7 November 2003	**ENIEF 2003 - XII Congress on Numerical Methods and their Applications** *Venue:* Bahía Blanca, Argentina *WWW:* www.frbb.utn.edu.ar/enief2003
5 - 7 November 2003	**AI-METH 2003 - Conference on Methods of Artificial Intelligence** *Venue:* Gliwice, Poland, *WWW:* www.ai-meth.polsl.gliwice.pl
13 - 14 November 2003	**LUXFEM 03** *Venue:* Luxembourg City, Luxembourg *WWW:* http://www.luxfem.lu/.
18 - 21 January 2004	**SACAM'04 - Fourth South African Conference on Applied Mechanics** *Venue:* Johannesburg, South Africa *Contact:* Tel: (27) 11-717-7353 *Email:* radiwank@mech.wits.ac.za
22 - 24 January 2004	**III International Congress on Numerical Methods in Engineering and Applied Sciences** *Venue:* Monterrey, Mexico *WWW:* www.cimne.com/Congress/mty2004
31 May - 2 June 2004	**International Congress on Computational Methods in Engineering** *Venue:* Lisbon, Portugal WWW: www-ext.lnex.pt/APMTAC/cmce2004/
24 - 28 July 2004	**ECCOMAS 2004 - Eccomas Congress on Computational Methods in Applied Sciences and Engineering** *Venue:* Jyväskylä, Finland, *WWW:* www.eccomas.org
6 - 11 September 2004	**IASS 2004 - Shell and Spatial Structures from Models to Realization** *Venue:* Montpellier, France *Contact:* motro@lmage.univ-montp2.fr
5 - 10 September 2004	**WCCM VI - 6th World Congress on Computational Mechanics** *Venue:* Beijing, China *Contact:* Prof. M. Yuan Email: yuanm@pku.edu.cn, *WWW:* www.wccm6-apcom04.org.cn/
9 - 12 December 2004	**ICCMS 04 - International Congress on Computational Mechanics and Simulation** *Venue:* Kanpur, India *Contact:* ngri@iitk.ac.in, ashwini@iitk.ac.in WWW: www.iitk.ac.in
1 - 4 June 2005	**IASSIACM - 5th Int. Conference on Computation of Shell & Spatial Structures** *Venue:* Salzburg, Austria *Contact*: info@iassiacm2005.de *WWW:* http://www.iass-structures.org
17 - 17 June 2005	**Third M.I.T. Conferenceon Computational Fluid and Solid Mechanics** *Venue:* Massachusetts Institute of Technology, Cambridge, U.S.A. *Contact:* http://www.thirdmitconference.org/
24 - 28 July 2005	**USNCCM'05** *Venue:* Austin, Texas, USA
5 - 8 September 2005	**COMPLAS VIII - VIII International Conference on Computational Plasticity** *Venue:* Barcelona, Spain *Contact*: Secretariat, complas@cimne.upc.es *WWW:* http://congress.cimne.upc.es/complas
4 - 8 June 2006	**CSSM 2006 - III European Congress on Computational Solid and Structural Mechanics** *Venue:* Lisbon, Portugal *Contact:* Prof. Carlos A. Mota Soares. E-mail: carlosmotasoares@dem.ist.utl.pt WWW: www.dem.ist.utl.pt/~cssm2006
16 - 22 July 2006	**WCCM7 - VII World Congress on Computational Mechanics** *Venue:* Century City, California, USA *Contact:* WCCM7@mail.mech.northwestern.edu.
5 - 8 September 2006	**Computational Fluids Dynamics - ECCOMAS CFD 2006** Venue: Rotterdam, The Netherlands *Contact:* www.eccomas.org

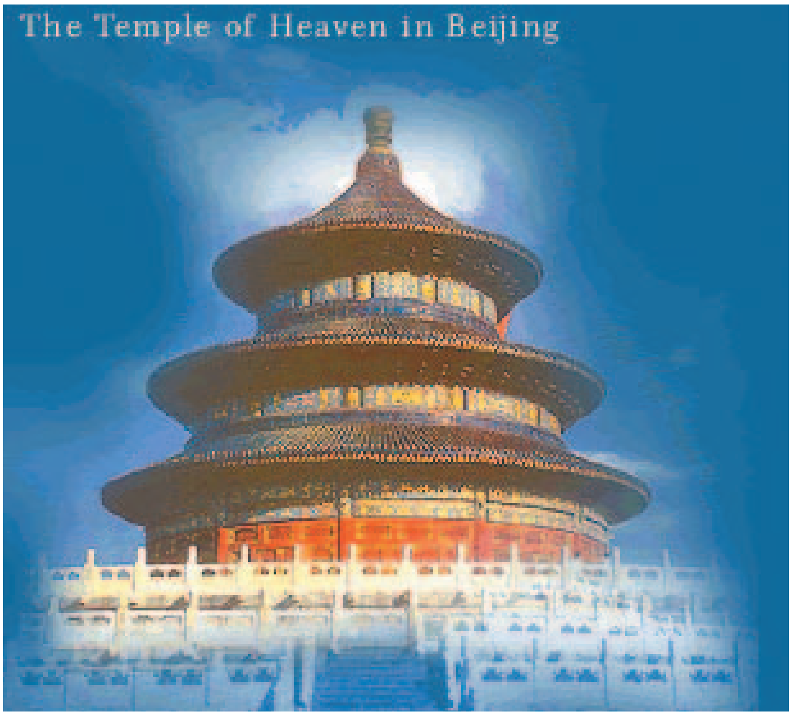
Six World Congress on Computational Mechanics

WCCM VI

Beijing, China

5-10 September 2004

Incorporating the Second Asia-Pacific Congress on Computational Mechanics



http://www.wccm6-apcom04.org.cn

Important Dates

1 March 2004	Deadline for organising of minisymposia
1 March 2004	Deadline for abstract submission
1 April 2004	Notification of final acceptance for abstracts & minisymposia
1 April 2004	Deadline for submission of full length papers
1 April 2004	Open for early registration & sending invitation letter for visa application
1 July 2004	Deadline for early registration