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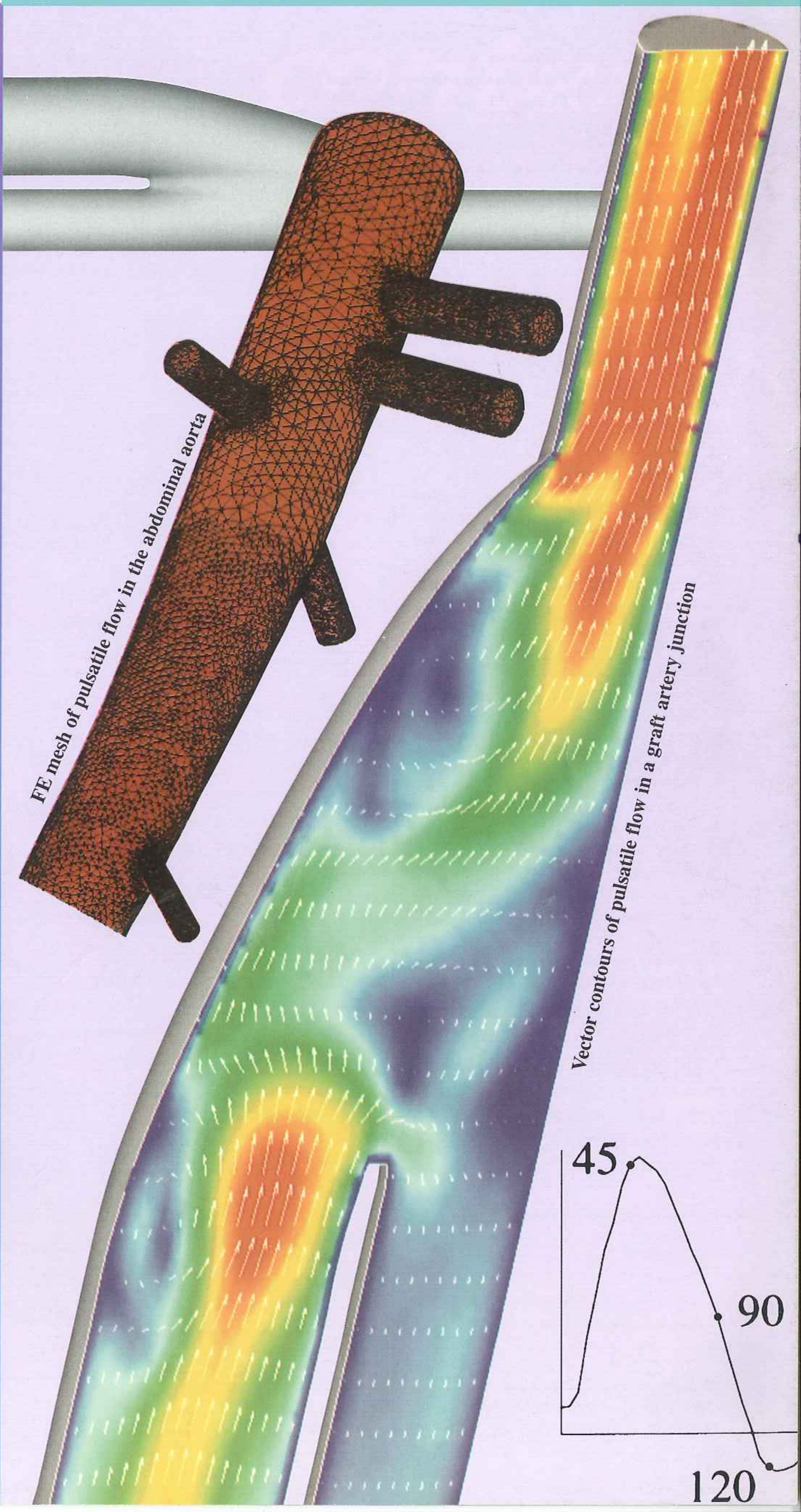

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Front Cover
Collage from 'Finite Element Modelling of Blood Flow in Arteries', Pages 4 - 6, Figures 1 and 2.

contents

editorial

The IACM and IUTAM courtship

I have just attended the second IUTAM - IACM symposium on "Discretization methods in structural mechanics" in Vienna 2 - 6 June 1997 chaired by Prof. H.A. Mang and F.G. Rammerstorfer. The same venue as the first such IUTAM - IACM symposium on the same subject back in 1989 as well as the first conference arranged jointly by the two organizations. Both symposia have been very successful mainly due to the many good lectures.

Adding to the success was the organization which stipulated a limited number of invited speakers and only one session. It was a real symposium, where all problems could be discussed in a relaxed atmosphere. This type of conference has a long tradition in the IUTAM and has been found to work well.

I believe it is important that the IACM and IUTAM support each other in all matters of common interest. The whole community of mechanics will gain from it.

Alf Samuelsson
IACM President

Finite Element Modelling of Blood Flow in Arteries

by
C.A. Taylor
Department of Surgery
T.J.R. Hughes
C.K. Zarins
Department of Mechanical Engineering
Stanford University
California

Hemodynamic (blood flow) conditions, including velocity, shear and pressure, play an important role in the modulation of vascular adaptation and the localization of vascular disease [1,6,7]. Consequently, understanding the local hemodynamic environment in a region of the vascular system is an important field of research. In recent years the combination of improved numerical algorithms and increased processing power has enabled the use of computer models to understand vascular blood flow[4,5]. In the near future, these advanced computational methods have the potential to enable clinicians to predict the outcome of interventions to restore blood flow, *a priori.*

Virtual Vascular Laboratory - A Virtual Vascular Laboratory was constructed, using the knowledge-based engineering software, the *Adaptive Modeling Language* ™ (AML), to aid in the numerical solution of vascular blood flow problems [8]. The Virtual Vascular Laboratory incorporates an object-oriented environment to create a unified model combining data input from computer aided design (CAD) or medical imaging sources, geometry, mesh generation techniques, solution strategies, and visualization techniques within a common graphical user interface. *SHAPES* ™ is incorporated within AML and used as the geometry kernel [9]. The automatic finite element mesh generator, *Finite Octree* ™, is used to generate the finite element discretizations from the solid model [3]. Input files are automatically created for the finite element analysis program, *Spectrum* ™, which supports the multiphysical computations typifying vascular mechanics [10]. The *Spectrum* ™ *Visualizer* is utilized to view the results of the computations and extract quantities of interest including pressure and velocity fields, wall shear stress distributions and particle residence times [11].

Examples - Hemodynamic conditions, including low shear stress, are hypothesized to be one of the factors in artery wall thickening leading to the failure of bypass grafts[1]. A computer simulation of pulsatile blood flow in a model of a graft-artery juncture was performed and compared with experimental data obtained using laser-doppler anemometry[2]. The contours of blood velocity and a comparison with experimental data are shown

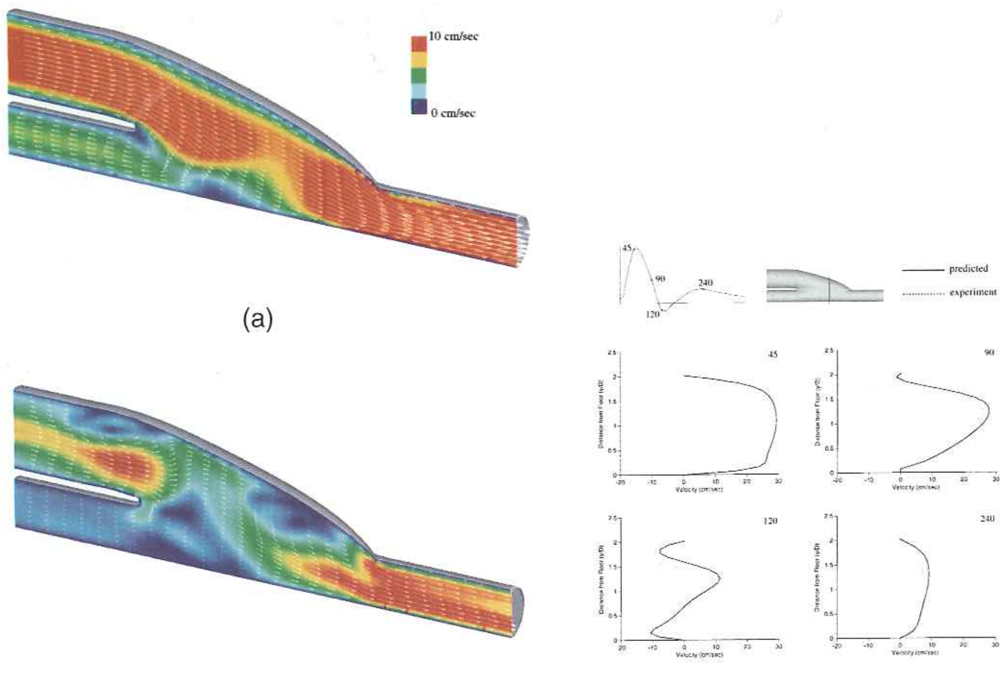

Figure 1
Pulsatile flow in a graft-artery juncture.
(a) Velocity contours and vector field at a phase of 45 °
(b) Velocity contours and vector field at a phase of 240°
(c) computed and experimental velocity component in axial direction at a cross-section near the center of the juncture.

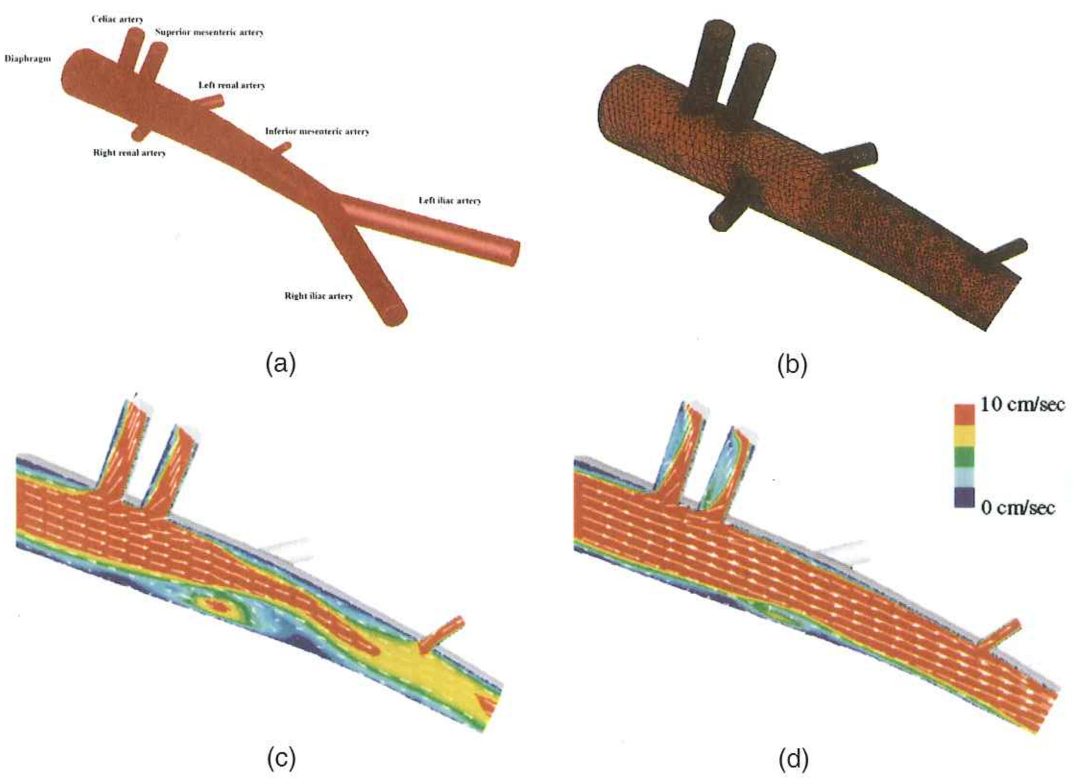

Figure 2

Pulsatile flow in the abdominal aorta.
(a) Computer model.
(b) Finite element mesh.
(c) Contours of velocity magnitude and velocity vectors under resting conditions at mid-diastole. Note flow recirculation region in infrarenal aorta.
(d) Contours of velocity magnitude and velocity vectors under moderate exercise conditions at mid-diastole.

in figure 1. Excellent correlation between predicted velocity profiles and experimental data was observed. These simulations of blood flow in graft-artery anastomoses can provide a means to quantify the hemodynamic conditions for comparison with observed sites of wall thickening. Further, once the mechanisms of this thickening are better understood, computer modeling techniques can be used to design bypasses which minimize adverse hemodynamic conditions.

It is hypothesized that the beneficial effect of exercise in retarding the progression of cardiovascular disease is due, at least in part, to the elimination of adverse hemodynamic conditions including high particle residence time and low wall shear stress. A computer model of a normal human abdominal aorta, shown in figure 2a, was created to simulate aortic blood flow under rest and graded exercise, *pulsatile*, flow conditions obtained by altering flow rate and distribution. The pulsatile blood flow equations were solved, blood flow patterns noted, and shear stresses and particle residence times computed throughout the cardiac cycle. The surface of the finite element mesh with 268,563 tetrahedral elements and 58,151 nodes is displayed in figure 2b. Note the refinement of the mesh in the region below the renal arteries. The nonlinear evolution equations were solved over 3 cardiac cycles with 200 time steps per cardiac cycle on a 16 processor IBM SP-2 parallel computer. Figure 2c depicts contours of velocity magnitude and velocity vectors at mid-diastole under resting conditions. Moderate levels of exercise were sufficient to eliminate most of the adverse hemodynamic conditions in the infrarenal (below the renal arteries) aorta present under resting conditions as evidenced in figure 2d. Shear stress increased over 400% and particle residence time decreased by a factor of 3 in the infrarenal aorta. Complex, recirculating, flow patterns disappeared. This data supports the body of evidence that moderate levels of exercise have a beneficial effect on limiting vascular diseases. These studies also provide impetus to examine exercise hemodynamics *in vivo* using magnetic resonance imaging techniques, and to assess the validity of common assumptions made regarding the normal distribution of blood flow under varying physiologic conditions.

Figure 3a displays a geometric model reconstructed from CT data of a patient with an aneurysm in the abdominal aorta. The equations governing the pulsatile blood flow in this model were solved on an 8 processor SGI Power Challenge. Figure 3b depicts a slice of the axial (primary) component of velocity along a plane through the aortic bifurcation. A slice plane was used to remove the top of the aneurysm for visualization of the flow. Also shown is the large clot along the side wall of the aneurysm. As seen in figure 3b, the flow decelerates as it enters the aneurysmal cavity

"... the potential to enable clinicians to predict the outcome of interventions to restore blood flow ..."

"... development of quantitative, predictive tools to test hypotheses and address important clinical vascular problems ..."

and a vortex develops in the anterior-posterior direction as noted by the negative flow (blue) along the back wall of the aorta and the positive flow (red) along the anterior wall just above the bifurcation. Reverse and stagnant flow is observed close to the wall of the aneurysm along the anterior and posterior wall of the aorta. These numerical investigations into blood flow in an individual patient's vasculature can be used to augment the anatomical data provided by medical imaging diagnostics. Presumably, with knowledge of the effect of hemodynamic conditions on vascular adaptation and disease, and the knowledge of the actual hemodynamic conditions in an individual patient, obtained using imaging and computer modeling techniques, better treatments can be devised to improve individual patient care.

In conclusion, a novel approach to research into the relationship between hemodynamic factors and vascular adaptation and disease has been developed. Work to date has focused on the development of a theoretical and computational framework for future research in the application of computational methods to vascular blood flow problems. Methods have been established which will permit the incorporation of mass transport and vessel deformability into the models, thereby enabling new investigations into the mechanics of vascular disease and adaptation.

Ultimately, computational methods could serve as the basis for the development of quantitative, predictive tools to test hypotheses and address important clinical vascular problems. •

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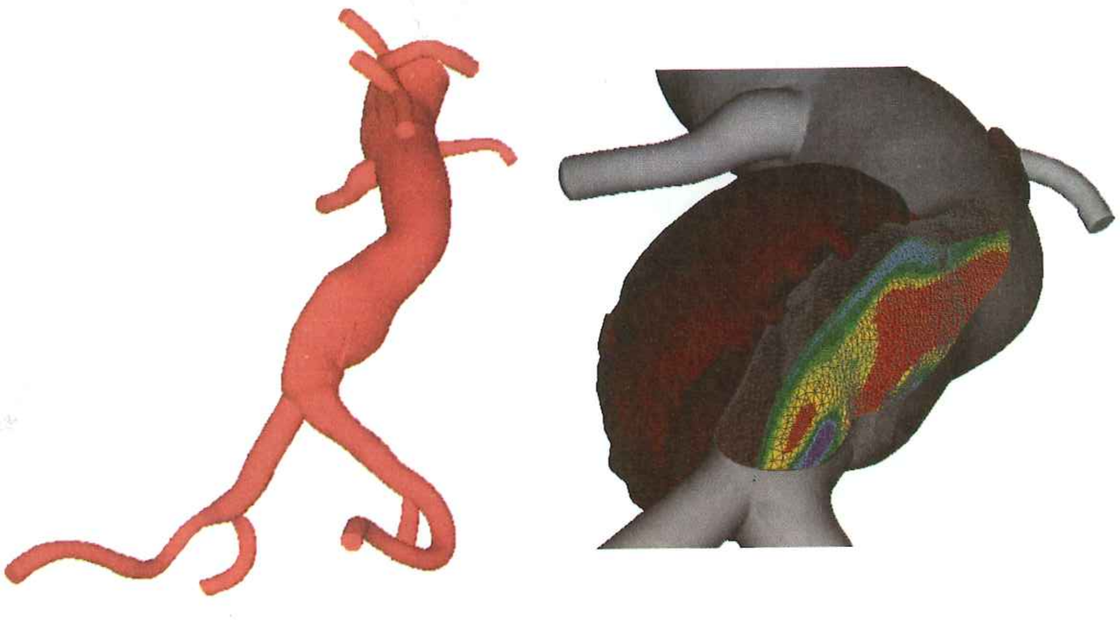

Figure 3
3-D reconstruction of an abdominal aorta from spiral CT, (a) geometric model (b) axial velocity contours in the aneurysmal region (large clot as shown).

(a) (b)

Life before Engineering

an interview with Olgierd Cecil Zienkiewicz

Shall we start very briefly with your family's roots?

My father was born in 1873 in the Ukraine, Russia. His ancestry is that of Polish nationality with a Lithuanian background. It appears that the family originated from a Bojar named Zenko and started some time during the Union of Lithuania and Poland which took place around 1400. At that time the family was given Polish nobility and a Coat of Arms named Siekierz which we still proudly preserve. Father graduated from Kiev University in 1896 with honours in law and immediately joined a legal practice. Mother was born in 1890 in Somerset, England and at the age of 22 decided to travel with her sister to Poland. Both started teaching and my father was her first pupil. From my mother's memoirs of that time, it appears that he was not a very capable and enthusiastic pupil, but much more interested in her. They were married a year later and moved to England in 1917 where I was born 4 years later.

But your first language as well as all your schooling was polish, is that right?

Yes. In 1922, at the age of one, I moved back to Poland with my fathers work. Here he practiced law as a judge and barrister, enabling us to move extensively within Poland.

For someone of such high achievements, tell us about the rocky start to your educational life.

After attending kindergarten and state school, at the age of of 10 I had to take an entrance examination for the Gymnasium. As we entered, some problems were given and we were told to start writing when the teacher indicated. However, looking at the very easy problems, I started immediately and was thus asked to leave exam. Not knowing what else to do, I just went home, never telling my parents. Some weeks later, after someone mentioned to my father that it was a real pity his son was thrown out of school so early, he was able to get me back into school through his connections.

Where were you when the war started and what were your first experiences?

I wanted to study naval architecture, but as this was not available in Poland, I decided on civil engineering at the polytechnic in Warsaw. I was in Warsaw with my mother to arrange accommodation and take a special entrance exam as selection was rigorous. My father stayed back in Katowice, our home town, for work reasons. War started on 1 September and it was many weeks before we heard from him or saw him again. On the third or fourth day a very close friend from school days, Andrew Sokolowski, and I received orders to build barricades that night as the Germans were approaching. It was quite exciting and I remember overturning trams and dragging cars into place to form barricades. The next day orders were given for all young people to leave Warsaw and assemble a new army in Garvolin. Together with my Mother, my sister Dona, Andrew, and a few hurriedly packed possessions we started the three day journey on foot. Unfortunately the Germans moved closer, there were many fatalities, and on day three we were ordered back to defend Warsaw. Immediately on our return Andrew was approached by the motorcycle unit to help with transportation as he was a proficient driver. We parted company deciding to meet again in a few days - we did by chance. Three days later, on the very square outside our house, I found a little cross where burials were taking place. Andrew Sokolowski the young motorcyclist was killed there.

Olek Zienkiewicz - Reliving his youth with his grandchildren at Tibidado Amusement Park - Barcelona

You finally decided to leave Poland and head for France. This surely could not have been easy.

Yes, things got worse. When my father located us about a month later, plans for getting out of Poland were started. We wanted to try and leave the country legally and a German lawyer who was trying to acquire my father's practice proved helpful. Our destination was to be Italy, then still neutral and hopefully within easy reach of France. We travelled through Czechoslovakia, Austria and into Italy, carrying as much luggage and valuables as possible. Czechoslovakia nearly proved to be our undoing but father's smooth talking (from his legal background) managed to contain the situation and send us on our way. It was only in the middle of January, with official visas obtained in Rome, that we entered France and headed for Paris where the Polish Government had formed. Soon after the Government was moved to Angers and by February all of us were well ensconced in Angers where I had started learning French seriously. Suddenly planes appeared over Angers and we were were to move on again on a special train headed for Lourdes in southern France. From here every man was for himself as no official transport was available. Father decided to return to Bordeaux but the Germans had already occupied the town. Bayonne seemed the next best but due to circumstances the ship upped anchor and went with us still on the quay. From here it was pure good fortune that took us to England. A passing car with Polish friends of my sister offered us a lift to St. Jean de Luz where a Polish ship was waiting to leave. Somehow we all managed to get in the car, luggage and all, and three days later we were in Plymouth, England.

So the engineering career you anticipated starting in Warsaw finally evolved in London.

Again, luck came my way. We found that Imperial College was providing a scholarship for a Polish student which I duly applied for. I was interviewed by Sir Henry Tizzard, then rector of Imperial College and after yet another entrance examination I was accepted. In 1943 I received my Bachelor's degree and, after converting my Masters into a PhD, my PhD was accepted in 1945. At the same time I was awarded the bonus of 'Diploma of Imperial College'. •

Simulation makes use of Parallel Computing

by
R. Campo
ESPRIT HPCN
European Commission
DG III Industry

In order to stay competitive, facing the globalisation of the marketplace, industry in Europe needs to be at the forefront of the development and utilisation of the new technologies.

The R&D Programme in Information Technologies (ESPRIT)[1] is there to help the European industry to carry the high costs and the investment risks involved in this fierce challenge.

Since its original conception in the early 1980s, ESPRIT has evolved from the initial technology push, supply-side approach towards IT application and technology take-up with an increasing involvement of the users. In fact IT is now perceived as an area which is underpinning the competitiveness of the whole European economic fabric. This is clearly shown by the rapidly increasing percentage of value-added represented by IT in many traditional products and in all business and industrial processes.

The total ESPRIT budget from 1994 to 1998 is 2 Billion ECU. Funding to the industrial participants is on a 50 per cent shared-cost basis.

Esprit Project Logo

The Programme is implemented through two main types of actions:

- *R&D projects*
- *Preparatory, Support and Transfer (PST) activities*

As mentioned above, it is believed that innovation comes mainly from close interaction between technology developers and users. This is why R&D and technology take-up should proceed together. The PST activities, in particular, are designed to facilitate this interaction: they include awareness raising and promotional campaigns, trial applications and demonstrators, best practice initiatives, first user actions, skills development and support for the rapid acceptance of new technologies. They are also meant to help widen dissemination of results and boost product adoption in the marketplace.

The ESPRIT work programme is revised annually in the light of evolving needs and technological developments and on the basis of broad consultation[1].

In this article the HPCN (High Performance Computing and Networking) domain and in particular the simulation tasks are presented. The domain addresses "HPCN at large". Applications may exploit parallel systems and distributed and heterogeneous infrastructures, including high performance workstations or PC clusters and heterogeneous architectures with multiple processors. The objective is to help all sectors of industry exploit the opportunities offered by advanced computing and networking systems to enhance the functionalities and the quality of products and services, and to reduce their costs and time-to-market. Advanced networking services have become an integral part of these systems and infrastructures, enabling applications

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1 For further information see the ESPRIT Home Page: http://www.cordis.lu/esprit/home.html

which allow sharing and provide interactive use of remote resources, and which support interaction between concurrent activities in geographically dispersed locations.

Simulation and prototyping play a crucial role in the design of new and better products as well as in the optimisation of production processes. Simulation consists of predicting the behaviour of real physical systems in actual or hypothetical circumstances based on models of these systems. Simulation is widely used to support engineering design since it allows prediction of the performance of a product based on design data only, without the need to build a prototype. It thereby reduces the need for long and costly experimental tests.

Simulations need to be accurate and often require massive amounts of computation. While the first large simulation codes have been developed in universities in the 60's, powerful simulation codes for a number of disciplines are now available through licensed products, while others have been developed in-house by leading-edge user industries.

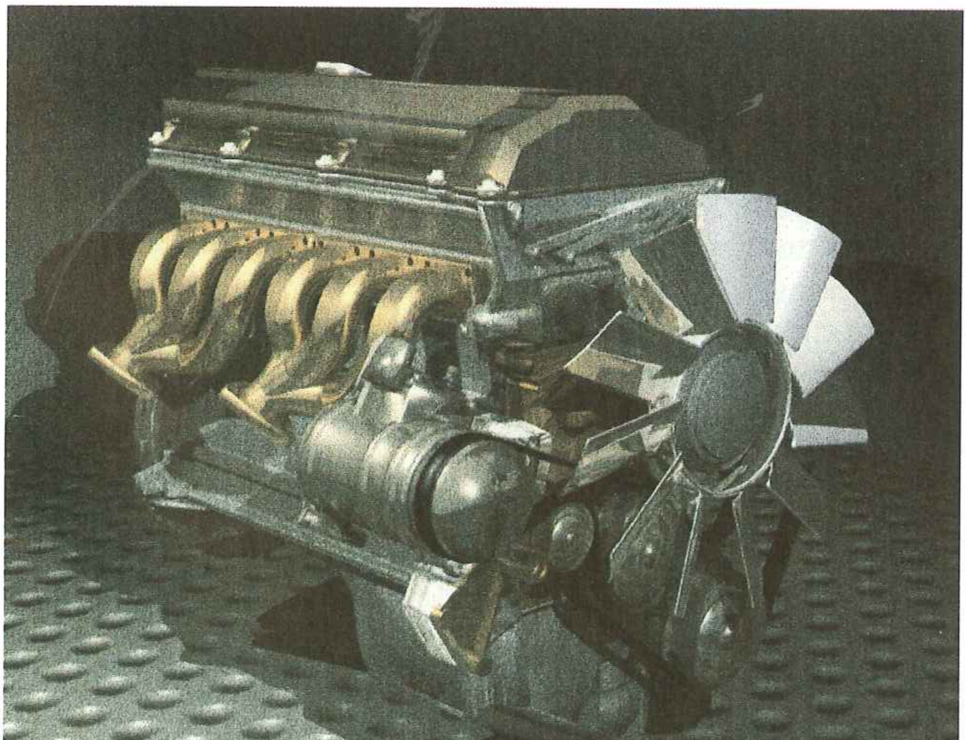
The multi-physics approach, for its computationally intensive character, has been identified as a natural candidate for the adoption of HPCN. In fact extension of the scope of simulation packages through the coupling of systems from different disciplines is an important objective in different industrial sectors.

Another highly computationally intensive process demanding high performance computing resources is the evaluation of a design within an optimisation setting. The advancement of the state-of-the-art in solving large non-linear optimisation problems will have an extensive and widespread impact across many industrial sectors.

As far as **advanced networking services** are concerned, the role that they can play in design and modelling and the importance of collaborative work are clear if one takes into account that the know-how is normally scattered across many heads of the company and also across different companies, all being necessary for the correct design of a single product. If an environment for collaborative work is put in place, the elaboration of alternative concepts will be possible, and parameters will be kept open until a much more advanced stage of design than it was possible before.

"... innovation comes mainly from close interaction between technology developers and users ..."

Digital image of a car engine obtained with the CATIA Visualization Studio of Dassault Systémes. Courtesy of BMW.



"A wide deployment of simulation codes will be greatly facilitated by improving their integration in the environment of design or operation engineers ..."

A wide deployment of simulation codes will be greatly facilitated by improving their integration in the environment of design or operation engineers. In fact a trend is observed in the manufacturing industries to move the engineering analysis up to the concept design phase, instead of confining it to the last stages of the design process. Another trend is also observed towards the extension of the simulation and modelling beyond the design phase to the entire life-cycle of products and to manufacturing processes, involving interactions with the operational environment. Both these trends add to the need for improvements in the pre-processing and post-processing packages, as well as in the user interfaces.

An important aspect of **pre-processing** in product design is the generation of a mesh covering the geometry of complex parts being designed. The use of appropriately designed meshes is essential for controlling the accuracy and timeliness of simulation runs. The integration of CAD modelling and simulation via mesh generation remains a major challenge in which standards play a major role.

The main bottle-neck in **post-processing** is efficient visualisation, i.e. the reduction of large amounts of data into forms that can help engineers make design decisions.

Virtual reality (VR) is certainly the most challenging user interface technique. VR gives the user the possibility of a real "immersion" inside the simulated environment: he can not just see, but "touch", "grab" and in general "interact" with the simulated objects.

When the first HPCN activities were launched in 1992 a pre-condition for the widespread adoption of HPCN simulation was identified as crucial: the adaptation of existing software. This was the objective of EUROPORT (European Porting Project), managed by the German centre GMD and by the British company Smith System Engineering and involving over 100 organisations, two thirds of which were industrial companies. 38 serial codes, chosen for their commercial and industrial relevance, have been ported to parallel platforms. Among these, subsets of the well-known codes for structural mechanics were ported on parallel machines: FORGE3, LS-DYNA3D, MSC-NASTRAN, PAM-CRASH, PERMAS and SAMCEF. End-user requirements were always the driving force behind the porting exercise. Another focus of the project was to achieve the highest efficiency in a machine-independent and portable way. Primary targeted platforms were distributed memory machines and workstation clusters working with message passing interfaces so that codes could also be easily run on shared-memory parallel systems. The positive acceptance of the project by industry (both large and medium-small enterprises) and the world-wide recognition of its success demonstrated clearly the maturity of HPCN.

As mentioned above, as greater computational resources become affordable, the computational environment and software infrastructure has to be developed to avoid end-user bottlenecks in pre- and post-processing. This was addressed by the recently completed **CAESAR**[2] Project, lead by British Aerospace, via the development of the Parallel Simulation User Environment (PSUE). This tool supported the definition of complex geometrical models (through a "Geometry Builder" capable of importing CAD data), the possibility of overcoming topological inconsistencies often found with CAD data (through a "Geometry Repair" module), and the definition of unstructured grids for subsequent engineering analysis.

The **DESIRE II** Project, lead by the German company Mental Images, will complete the development of the rendering software (started in the DESIRE project) for interactive design based on visual feedback. The DESIRE rendering software has been integrated in CATIA, the CAD/CAM package of Dassault Systëmes sold by IBM, and is also the core rendering component of SOFTIMAGE, now part of Microsoft. It is suitable for a wide range of application areas: BMW and Mercedes use it to design concept cars, Boeing uses it to create realistic images of interior layouts, and it has also been used in the digital film production (in particular in the film "Asterix in America").

A general approach addressing (loosely) coupled problems will be offered by the **CISPAR**[3] Project, that will develop a general communications library enabling the coupling of message-passing versions of existing commercial or in-house codes and the interfaces to it. The consortium, lead by the German company Pallas, includes some leading European software vendors (ESI, Computational Dynamics, Intes) and industrial end-users in the aeronautics (Aérospatiale), automotive (Mercedes-Benz), ship certification (Germanischer Lloyd) and medical engineering sectors (Sulzer).

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2 http://www.telecall.co.uk/~srcbae

3 http://www.pallas.de

The Commission of the European Communities

The accurate design of fluid-loaded structures is the goal of the **FSI-SD** Project, lead by the Norwegian centre Sintef. The project will address problems such as wind-induced motion of bridges and frame structures (Ramboell) and hydrodynamic loads on submerged floating tunnels, pipelines, risers and anchor lines (Norsk Hydro).

The **ODESIM**[4] Project, lead by the Spanish centre CEIT, addresses the problem of the optimum design of multibody systems. The consortium includes CASA, the research centre of FIAT, Matra Datavision, Siemens and Cerfacs. ODESIM, attaining a tight integration with the CAD system, will allow the designer to create a parametric or variational model of each mechanical part of the system that will be later optimised according to the specified objective function and design constraints. ODESIM followed a PST activity where the CEIT multi-body code COMPAMM had been ported to a network of heterogeneous workstations.

The **FRONTIER** Project, lead by British Aerospace, will develop a system for product design optimisation based on multiple objectives. Within the system, users will be able to employ their own individual calculation methods for the analysis of candidate designs. Test cases will be provided from five major industrial sectors: aerospace (DERA), shipbuilding (Kvaerner), domestic appliances (Zanussi), heating (Calortecnica) and diesel engineering (Diesel Ricerche).

The **PROMENVIR** Project, lead by the Spanish aerospace company CASA, illustrates an example of "meta-computing" that is the possibility of defining a virtual parallel computer, allowing a consistent view on a set of distributed computers linked via networks. PROMENVIR makes use of the intrinsic parallelism of Monte Carlo simulations. Although both Finite Element Method (FEM) and Multi Body Dynamics (MBD) codes have reached a considerable level of sophistication and versatility, these codes do not normally address the scatter or uncertainty of structural parameters and loads, which has to be taken into account in order to quantify the degree of reliability of a mechanical system. PROMENVIR will make it possible to handle complex stochastic mechanical problems on industrial scale. Applications are provided by CASA (space) and Italdesign (automotive).

The **CANET**[5] Project is a good example of the adoption of advanced communications services for collaborative working. Experiments are set up over an ATM wide area network, involving Renault and Siemens Automotive in four different locations. The results of the trial are expected to impact on the whole automotive business process.

This quick and necessarily incomplete survey of projects clearly shows the role that HPCN can play in the rapidly evolving industrial scenario and in the re-engineering process that industry is currently undertaking to meet strategic economical and productive challenges. This situation opens new prospectives for the application of simulation to a broader range of engineering and technological tasks and for extending its use to new sectors. •

" ...opens new prospectives for the application of simulation to a broader range of engineering and technological tasks ... "

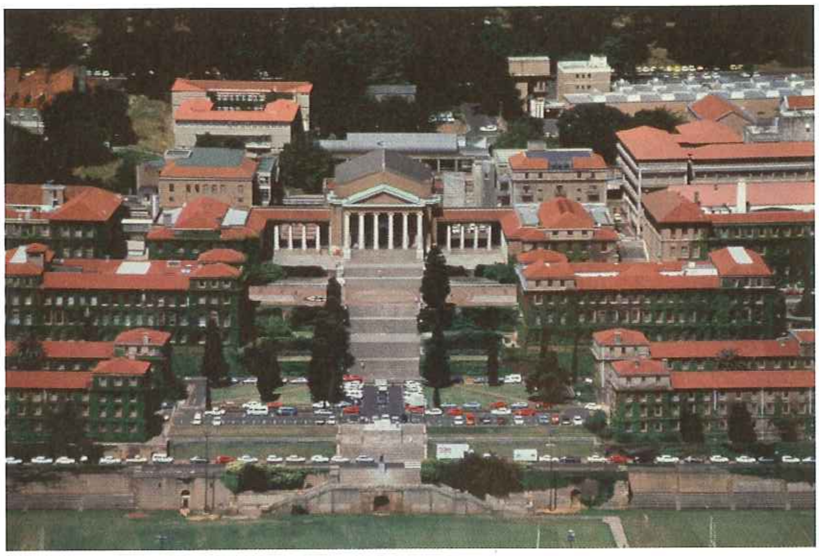
4 http://www.ceit.es

5 http://www.expertel.fr/CANET/

Computational Mechanics
at the
University of Cape Town

by
B.D. Reddy
UCT Centre for Research in Computational & Applied Mechanics
University of Cape Town
South Africa

Computational Mechanics is a relatively young discipline, and it is even younger in South Africa. In highly developed countries such as the United States, Britain and Japan, to name some examples, the finite element method experienced its first growth spurt as early as the 1960s; much of the early advances were to be associated with research at universities, primarily in civil & mechanical engineering departments.



University of Cape Town Campus

South Africa has a mere eight engineering schools, and engineering departments have historically been quite traditional in their outlook, with the emphasis being placed on professional aspects of the discipline. Interest in the finite element method was slow to take root, with some exceptions. By the 1980s, however, the method had become fairly well established in some universities, as well as in the professional sector, as an important tool for both analysis and design. Interest and activity in the method was found largely at the graduate level at universities, though, and not many inroads had been made at undergraduate level.

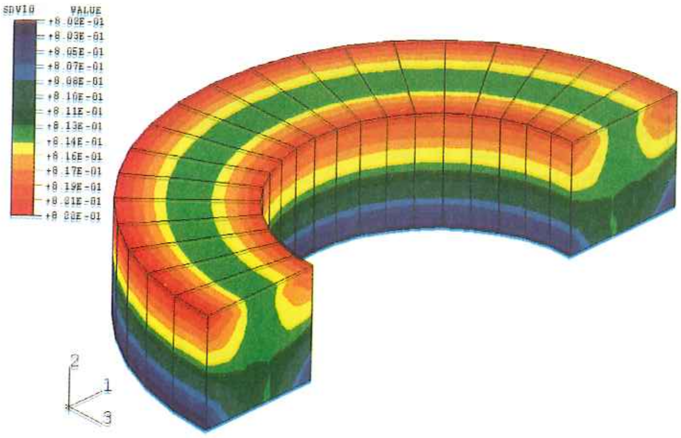
"...graduates are playing a major role in ensuring that South African industry remains globally competitive."

It is against this background that computational mechanics was established, and has come to flourish, at the University of Cape Town. There had been at Cape Town some activity in the area of finite elements since the early seventies, though on a small scale. Around this time John Martin, then Chair of the Civil Engineering Department, was starting to establish a research group in solid and structural mechanics, with the emphasis on aspects of plasticity. In due course computational issues became more prominent amongst the group's activities, and indeed came to be favoured by the majority of graduate students as the area in which to carry out their research. In addition to research activities, Martin's group also became involved in an increasing number of industrially related projects, in areas as disparate as nuclear safety and the manufacture of synthetic diamonds.

By the early eighties all of the ingredients for the formal establishment of a research unit were in place: a small core of faculty, graduate students, research projects and industrial projects. The group was formally constituted in 1981 as the Nonlinear Structural Mechanics Research Unit (NLSMRU). The Unit's activities were centred on inelastic material behaviour, with a large number of projects having a computational component.

The mining industry in South Africa is very well developed, and the country has the deepest gold mines in the world, some of these extending to as much as 3 000m below the surface. Mining activities of this nature are accompanied by complex geotechnical problems such as, for example, the behaviour of rock in the vicinity of shafts and excavations. These kinds of problems were ideally suited to the skills and interests of the NLSMRU which, for many years, was to be involved in research sponsored by the mining industry. This work was of much practical value, but there were also significant theoretical and computational dividends in the area of damage mechanics.

During the mid-1980s national research support in the natural sciences and engineering was reviewed and fundamentally restructured, and a new statutory body, the Foundation for Research Development (FRD), came into being, its main function being very similar to that of the National Science Foundation in the USA. While the rationale of the FRD's funding procedures was focused on support of individual researchers, it also recognised and rewarded good quality research carried out by groups. The title 'Research Unit' was one which the FRD was empowered to bestow on research groups having the requisite stature, while those groups which performed consistently well at an international level could be awarded the title 'Research Centre'.



Power compaction of an iorn ring:
the figure shows the dendity distribution after compaction

- analytical & computational studies in nonlinear mechanics: *plasticity, damage mechanics, analysis of algorithms*
- design & analysis of improved low-order elements
- biomechanics: *orthopedic & soft-tissue*
- metals processing: *recrystallization, deep drawing, powder compaction*
- dynamic plasticity: *seismic problems, impulsive loading, vehicle crashworthiness*
- computational fluid dynamics: *theoretical & computational studies of non-Newtonian fluid flow in arteries, convective-diffusive flows in settling tanks, aerodynamic drag*
- nondestructive evaluation
- fracture mechanics: *effects of shot peening, post-weld heat treatment, early damage detection, micromechanical behaviour*

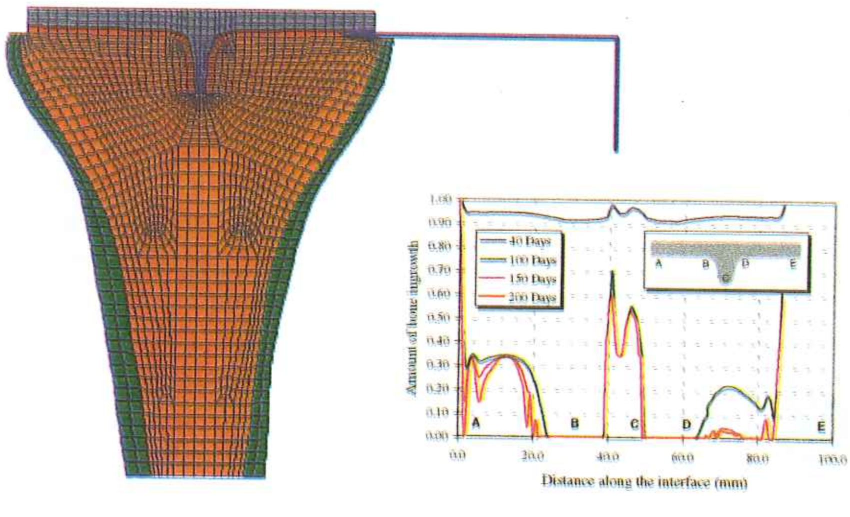
These developments led to the NLSMRU changing its name twice: when awarded Research Unit status by the FRD it became the FRD/UCT Applied Mechanics Research Unit, and later, in 1989, it was awarded Centre status and became the FRD/UCT Centre for Research in Computational and Applied Mechanics, or CERECAM. The fledgling group of the early 1980s had grown, both in numbers and in diversity, to become an interdisciplinary grouping, with its members drawn from Civil and Mechanical Engineering, and from Applied Mathematics. Today the Centre has a total of ten affiliated faculty, three postdoctoral researchers, and 36 graduate students, and is led by John Martin and Daya Reddy. As far as numbers go the centre of gravity has shifted somewhat, in that the majority of members are now from Mechanical Engineering. A research group of this size is perhaps not exceptional by world standards, but in the South African context it says much about the extent to which the Centre has become the pre-eminent group in computational mechanics, and indeed in applied mechanics generally.

Research projects range from those having a very direct practical benefit, such as work on deep drawing of stainless steel components, while other research, such as that concerned with the development of improved low-order finite elements, is more theoretical in nature, though with important practical consequences. In addition to theoretical and numerical activities, there are also extensive experimental programmes in progress. Biomechanics has become an important focus of the Centre's activities. Initial work in this area was confined to aspects of orthopedic biomechanics: adaptive bone remodelling, with particular reference to the femur, and the behaviour of hip implants. Current interests have shifted towards soft tissue mechanics, though, and members of the Centre are involved in a collaborative project with researchers at the UCT Cardiothoracic Research Unit, the main goal of the project being that of understanding the behaviour of both real and artificial arteries. Nonlinear material behaviour, finite elements and fluid-solid interactions are some of the topics in mechanics that play a central role in this project.

The list of projects given below will give some idea of the breadth of current activities in the Centre:

CERECAM places great emphasis on the education and training of graduates in computational and applied mechanics, and many of its students now occupy important positions in industry and academia. In an industrial environment that has not generally been aware of the full range and scope of applications of the finite element method in design processes, these graduates are playing a major role in ensuring that South African industry remains globally competitive. Other graduates have taken up equally challenging positions abroad; to mention one example, Hibbitt, Karlsson and Sorenson, the company which develops and markets ABAQUS, has on its staff a total of four CERECAM PhD graduates. •

Prediction of bone ingrowth on the under-surface of a porous coated tibial component used in total knee replacement.



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The Advances of Computational Mechanics in China

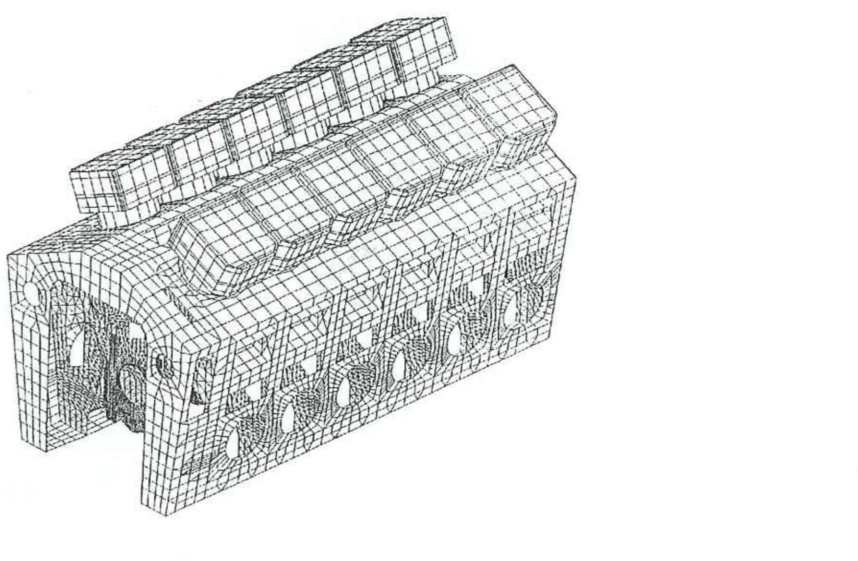
by
W. Zhong & G. Cheng
Research Institute of Engineering Mechanics
Dalian University of Technology, China
Members of the Chinese Academy of Science

"...economic development in China will be carried forward with quick steps and amazing enhancements..."

The development of computational mechanics in China can be traced back to the early sixties, when Prof. Qian Lingxi, a member of the Chinese Academy of Science, and Chen Baiping used matrices to express the governing equations of structural mechanics to solve problems in large scale structural mechanics. Unfortunately, due to the cultural revolution, scientific research in China came to a standstill from 1966 to the early seventies. In early 1972 rapid development once again started, adjusting the research direction to computational mechanics. Under the supervision of Prof. Qian Lingxi, Zhong Wanxie organized a research team to work with the direct stiffness method for truss - beam structures and to develop the relevant computer program. Furthermore, they devoted much effort to spread their program's application into design offices, giving impetus to the use of computers for design and research in civil engineering. As soon as the cultural revolution ended, Qian Lingxi proposed to bring computational mechanics into line with the state plan 'The outline for developing mechanics in China'.

Chinese scientists have made considerable contributions to the basic aspects of computational mechanics such as the fundamental theories, the methods and engineering software. Due to historical reasons as well as finite element methods being a general procedure first applied to solid and structural mechanics when it arose in the sixties, the emphasis of the following review will be put on computational solid and structural mechanics. The traditional finite difference method still occupies an important place in fluid mechanics.

Structural analysis and design optimization of a diesel locomotive



Early in 1954, Hu Haichang, a member of the Chinese Academy of Science, presented the variational principle of elasticity, i.e. the well known Hu - Washizu principle, which is one of the most versatile and generalized principles. This has laid a solid foundation for hybrid and mixed finite elements. Feng Kang, a member of the Chinese Academy of Science, presented the numerical solution for partial differential equations on the basis of the piece-wise interpolation and variational principles in the sixties. This can be regarded as the earliest proof of the convergence for finite elements of 2d continua. Tang Limin, Long Yuqiu, Shi Zhongzhi and Chen Wanji studied the theoretical aspects of finite elements, including mixed elements, the hybrid element and the quasi-conforming element and developed many elements for plates, shells, 2d and 3d continua with high accuracy and efficiency and their nonlinear versions.

Due to the less developed economy in China, the computer conditions provided for Chinese scientists working in mechanics are much less powerful than their foreign colleagues. This reality makes the researchers working on computational mechanics devote greater efforts to the development of numerical algorithms. Zhong Wanxie presented a numerical method based on group theory and the cyclic matri method to solve generalized symmetric structures in different forms. He successfully analyzed the spatial frame structures of a television tower in Shanghai, a large scale cooling tower, etc. on small computers with only 8K or 16K in-core storage in the seventies. Based on the finite strip method initiated by Y.K. Cheung, the finite strip method, the finite line method, the super-element method and other semi-analytical methods were paid comprehensive attention and applied to solve a number of geotechnical problems. Wu Jike has made many improvements in the pseudo arc-length method to solve the non-linear problems and, therefore, increase the efficiency and robustness of the algorithm for the numerical determination of bifurcation points. The finite difference method with symplectic conservation for the Hamilton dynamic system presented by

Feng Kan gives a guidance to the numerical integration for conservative systems. Based on the analogy between computational mechanics and optimal control, Zhong Wanxie has elegantly applied the Hamilton formulation to the theory of elasticity, and also developed the precise integration algorithm in both time and space domains [3]. Lin Jiahao proposed a determinate algorithm with high accuracy for random vibration problems, the computational efficiency increasing typically by one to two orders of magnitude. The algorithm has been employed inside and outside China for analyzing seismic or wind excited responses for dams, bridges and high-rise buildings.

Qian Lingxi was first in China to advocate research in structural optimization. In early 1973 he gave a keynote lecture titled "The recent development in the theory and the method of the optimal design in structural engineering". The lecture evoked responses catching the attention of researchers in mechanics as well as engineers in industry. Lingxi and his group studied the unification of optimality criterion approach and mathematical programming approach with special emphasis on the mechanical behaviour of structural response. With this they successfully overcame a number of existing difficulties in the traditional methods in structural optimization and developed the sequential quadratic programming technique, including improvements in the approximation method of constrained functions with high accuracy. They also integrated their research achievements into a general purpose structural optimization software programme - DDDU. The achievement in the optimization problem of thin solid elastic plate contributed by Cheng Gengdong can be regarded as the pioneering work on the modern theory of optimization of structural layout. Wang Guanyuan studied the fuzzy optimal design of structures and presented the soft design theory in engineering. Zhu Bofang applied the theory of structural optimization to large scale dam designs and obtained remarkable economic benefits. Sun Huanchun devoted himself to the optimization of the discrete structures and proposed a number of effective algorithms.

A large number of complex mechanical phenomena in science and engineering can be described as coupled problems of different types. Among these are the problems in which coupling occurs on interfaces of domains with different types of media, and where one single medium covers the whole domain and the governing equation describing mechanical phenomenon interacts with governing equations describing other physical phenomena. The examples of coupled problems studied here can be cited as the construction process of bridges and high rise buildings, the flow of water/oil mixtures in oil formation during oil recovery, the interaction between structures and foundations, the coupled problems in the metal and plastic forming process, biomechanical problems and the reliability problems of structures. San Jun, Li Xikui, Ge Xiurun, Cao Zhiyuan and their groups have respectively gained remarkable achievements in finite element analysis for coupled problems and their applications to engineering.

Software development is one of the most important activities of computational mechanics. It converts the newly developed theories, methods and algorithms into software tools for design offices and supports the industry. To analyze the mechanical behaviour of complex structures in major projects, an integrated software system with multi-functions and high performance is required. In the early seventies, Chinese researchers in computational mechanics started to develop finite element software for special purposes. They have developed numerous software for large scale general purposes since the late seventies. The research group at Dalian University of Technology, headed by Zhong Wanxie, has developed a general purpose program JIGFEX (and its simplified version DDJ/W) for finite element analysis and DDDU for structural optimization with the finite element analyzer. The research group in the aeronautic industry developed a general purpose program HAJIF for finite element analysis. The finite element software MAC developed by Deng Dahua has been widely used in the mechanical industry. It can be found that design strategies used to develop the above software are often sophisticated and algorithms implemented in the software are remarkable efficient. Cui Junzhi and Zhong Wanxie published special books to introduce design methods of finite element software. Through the application of some imported software to the industries, not only a large number of engineering problems were solved with success but also knowledge of the finite element were disseminated. With the development of computer technology, in particular the comprehensive application of microcomputers, emergence of software tools and development platforms with powerful functions, functions in post-processing and graphics in software developed in recent years, (such as SAP94 developed by Yuan Minwu at Beijing University and MCADS by Gu Yuanxian at Dalian University of Technology), has been remarkably enhanced. The software is also increasingly orientated to the design office demands in the civil, mechanical, aeronautic, astronautic and ship building engineering departments. The CAD software, i.e. TBSA system and Tech-Sino software series DASTAB based on the finite element analysis for the structures in architecture, (developed by the Research Institute of Architecture Design of China, and the Tech-Sino Corporation respectively, cooperating with relating universities in China), has dominated the chinese markets. A great number of the newly built civil architectures with complex structures and the engineering structures in the aeronautic and astronautic engineering were already designed using software based on computational mechanics.

In the coming ten to fifteen years, the economic development in China will be carried forward with quick steps and amazing enhancements, with achievements in computer technology, software and hardware. All of these will provide a unprecedented opportunity and environment for the development of computational mechanics in China. Computational mechanics in China definitely has brilliant prospects. •

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Finite Element Education & Training

& their impact on the

Technological Community

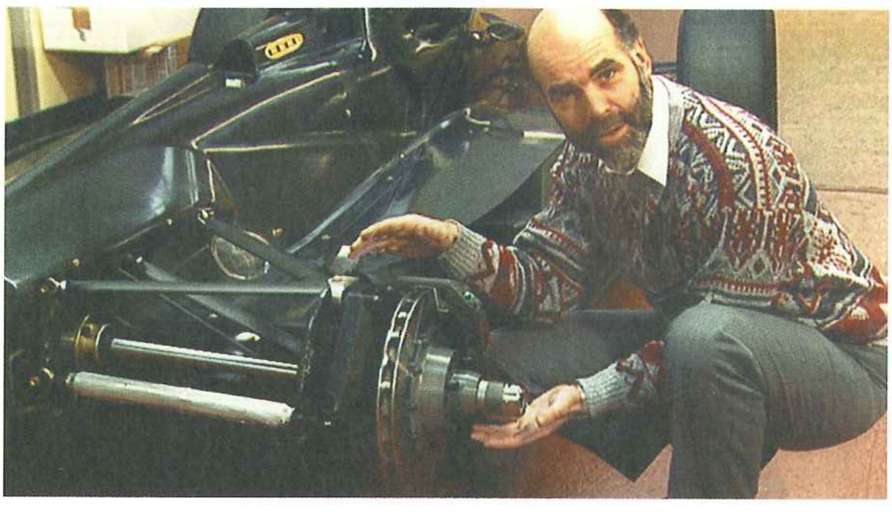
by
D.R.J. Owen
University of Wales
Swansea U.K.

When asked to provide an article on education and training issues associated with finite element technology, it was with some reluctance that I agreed to accept. Since most readers of this publication emanate from a research community, and from that body an overwhelming number are also educators, it would seem to be writing an article for the already converted. However, using my alternative position as Chairman of Rockfield Software Ltd., which is a leading European supplier of finite element methodology to industry, it would seem that the issue of providing adequate training in the application of finite element technology still remains an unsatisfied requirement. In some respects, this article leads on, or more accurately regresses from, the contribution from Ted Belytschko in Issue No. 2 of this publication. Prof. Belytschko raises the question of whether nonlinear finite element analysis is competently within the reach of practitioners in industry. The conclusion would appear to be, and which is one that I wholly agree with, that while some restricted classes of problems can be treated with confidence, there are still many pitfalls for industry end users in more esoteric application areas.

"...while some restricted classes of problems can be treated with confidence, there are still many pitfalls for industry end users..."

The point of view of the present article is that for an overwhelmingly large percentage of industrial users the use of finite element technology on even a linear basis requires a large measure of support in the form of continuing education and industrial training. It is easy to assume that the level of industrial finite element usage is undertaken by practitioners in high technology companies (e.g. aerospace, automotive, defence industries, etc.) who, naturally have a considerable communication with code developers and academics which make up a high percentage of readers of this publication. Unfortunately, a large proportion of commercial finite element usage is undertaken in industries where the knowledge of computational mechanics is low. This is not intended as a disparaging remark, rather than recognition that usage of finite element methodology now pervades most engineering disciplines and application fields at almost all levels. The remaining sections of this article, therefore, discuss some practical steps which have been taken by the author, together with other participating institutions, to provide a degree of interactive computer aided learning approach to finite element education and training.

Lola Indy car rear hub unit



Development of a Distance Learning Package. The Open University in the UK recently decided to introduce a finite element module within its distance learning degree schemes. This involved development of a comprehensive study package for students and other users to follow the subject at their own pace, which was designed and implemented by a group of partners each bringing their specialist expertise to the project, with the support funding from the COMETT initiative of the European Community. The principle partners were The Open University - UK, The Institute for Numerical Methods - University of Wales / Swansea, CIMNE - Barcelona, Rockfield Software and NAFEMS Ltd. The COMETT programme specifically provides funding for distance learning activities and support of continuing professional development. The 'mission statement' for the project can be summarised as the '*the aim to raise the level of understanding and safe use of the modern computational finite element design tools*'.

The course follows a multi-media structure and comprises of the following elements:

- **Video**. The main video (50 minutes) introduces the finite element techniques as used in the design process. It demonstrates the many steps, assumptions and engineering judgments neces sary to create an appropriate computational model. Lessons are drawn from the case study of a Lola Indy racing car wheel hub (illustrated in Fig. 1.) subjected to severe cornering loads in the Indianapolis 500 event.

The second tape (20 minutes) introduces the basic mathematics of the finite element method using an axially loaded simple bar as an example. Aspects of modelling and meshing are also discussed.

- **Written Texts**. These cover the essential theory and computational procedures.
- **Computer Aided Learning (CAL) Material**. Interactive tutorial software packages designed for use on low grade PC's. Those modules cover theory and examples for two dimensional quasi harmonic (heat conduction, porous media flow, etc.) and elastic stress analysis,
- **ELFEN - Introductory Commercial FE Software.** A PC based finite element system, operated under Windows 95 or NT, introduces 'real world' code for two and three dimensional analysis and includes examples.
- **Course Guide and Notes.** An overview of all the material in the course and a plan of study.

The most novel feature of the course is the computer aided learning software that was developed and its structure and functionality is briefly described below.

Computer Aided Learning Modules for FE Education and Training. One of the CAL modules developed for the Open University course was programme QUASI aimed at the interactive solution of engineering problems governed by the quasi-harmonic equation. This was considered to be the most appropriate vehicle for introduction to the finite element solution of continuum problems in view of its wide spread engineering applicability and that only one degree of freedom exists at each nodal point. Physical problems governed by the quasi-harmonic equation include heat conduction, gas diffusion, porous media flow, magnetostatics, torsion of prismatic sections and Reynolds film lubrication.

The primary objective was to produce an introduction to the mathematical and engineering aspects of the finite element method and to permit the interactive solution of a variety of engineering problems on commonly available low cost machines. Important features of the software are that it permits students/engineers to study at their own pace and also allows instructors to select particular topics for individual courses. The code is written in C and a Windows environment implemented through use of a Miocrosoft Windows Software Development Kit (SDK Version 3.1). The module has the following features:

- Operates within a Windows environment.
- A fully interactive operational mode using both mouse and keyboard.
- Contains a progressive instructional sequence from basic theory, through tutorial examples to student exercises.
- An interactive student exercises section which contains a comprehensive checking facility to guide students through the path necessary for a correct solution.

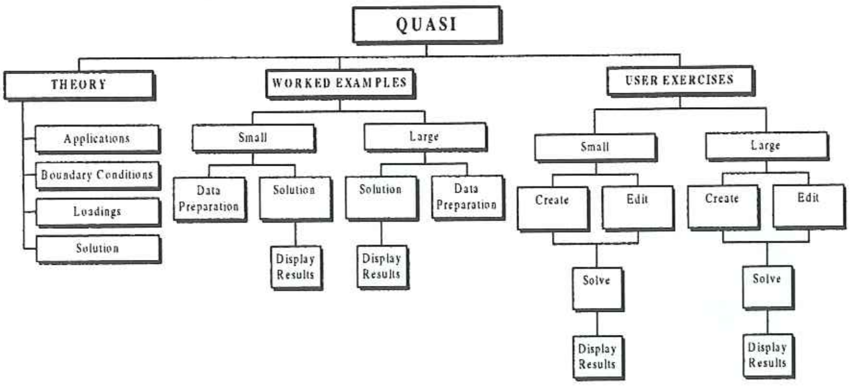
QUASI has been designed to allow the student to interact with the software to gain a firm understanding of the steps required to perform a finite element analysis. Problem types are divided into small and large, with more detailed on-screen information being provided for small examples, which better suits a beginner pursuing a low level study.

The structure of programme QUASI is shown in Figure 2 in which the following three main features are indicated:

- **Theory.** This provides an on-screen summary of the essential theoretical expressions involved in quasi-harmonic analysis. The governing equation and appropriate boundary conditions are first provided, before the discretised form of the problem is introduced and the resulting element stiffness matrices and force vectors are summarised.
- **Worked Examples**. A set of library examples is provided, both large and small, aimed at establishing the user's confidence and improving understanding of the method. A progressive instructional step-by-step sequence takes the student through the solution procedure, commencing from the evaluation of the stiffness and force terms for each element, followed by the global assembly process and equation solution and ending with the recovery of element quantities.
- **User Exercises**. This section of the code allows the user to interactively create a new problem or to modify an existing library example and pursue the solution at various levels of skill, ranging from beginner to advanced level. The skill level chosen determines the degree of guidance and help offered. The programme monitors the student's progress and ensures that correct results are achieved before allowing progression to the next stage of solution.

The progress achieved to date represents only some initial requirements of an interactive distance learning facility for both finite element education and training. Clearly extension of the functionality of the package in terms of both 3D and shell problems and the consideration of nonlinear and/or dynamic responses is necessary, as are improvements in the level of interactive help provided. Nevertheless, the package has already proved to be an extremely valuable complementary tool for finite element teaching and professional training. Future enhancements and further development are currently being planned. •

Structure of Programme QUASI



Central European and Polish Update

by
M. Kleiber
Chairman of the Central European Association of Comptational Mechanics
and
A. Garstecki
Chairman of the Polish Association of Computational Mechanics

"... an efficient platform for friendly contacts and common initiatives... "

The Central European Association for Computational Mechanics (CEACM) was founded at a meeting held in Leipzig on March 25, 1992. Originally the region of activities of CEACM was stretched to Austria, CSRD, Hungary and Poland. It was extended at a meeting held in Dresden on April 15, 1993, during the subsequent conference of GAMM. Presently the region of activity of CEACM consists of the following Central European countries: Austria, Crotia, Czec Republic, Hungary, Poland, Slovak Republic and Slovenia.

The statute and objectives of CEACM are coherent with those of the IACM but with emphasis on fostering the interchange of ideas among its members in the region. CEACM has given impact to local initiatives in the Central European countries to found national chapters of IACM and it has represented their opinions at the level of IACM.

CEACM promoted, fostered and coordinated various activities in the field of computational mechanics undertaken in EC countries, in particular organization of courses and conferences.

Presently, CEACM has approximately 350 members. The last meeting of CEACM was in Pozan on May 5, 1997. "Computer Assisted Mechanics and Engineering Sciences" (CAMES) was an official publication of CEACM and was first published in 1994. Details may be found at: http://www.ippt.gov.pl/~zkulpa/CAMES
This international scientific journal is published jointly by the Institute of Fundamental Technological Research and PWN Polish Scientific Publishers in Warsaw, Poland (ed. M. Kleiber, ass.ed. H.A. Mang.)

The first chairman of CEACM was H.A. Mang from 1992 to 1995. All the national chapters of CEACM (PACM among them) are grateful to Prof. Mang and other Austrian colleagues for their friendly assistance at the early stages of activities in the national level.

The Assembly of Delegates of CEACM, which met in Warsaw during the 'Lightweight Structures' conference in September 1995, elected the Executive Board of CEACM for the next four year term. Elected chairman is M. Kleiber, vice chairman is V. Kommpis and secretary is T. Lodygowski.

M. Kleiber - Chairman of CEACM and A. Garstecki - Chairman of PACM

The Polish Association for Computational Mechanics (PACM) was created due to an initiative of L. Demkowicz, M. Kleiber, T. Liszka, J. Orkisz and Z. Waszczyszyn and the first General Assembly took place on May 16, 1991. PACM was founded as a national chapter of IACM, accepted the Statute and elected L. Demkowicz as the first chairman. The regular membership of PACM was opened to all those whose work or other activities were associated with computational mechanics. 72 persons declared their wish to be members of PACM.

It is worth mentioning that this event was preceded by two year discussions of profits and obligations for the Polish community of mechanitions following from the creation of the Polish chapter of IACM. There were private exchange of opinions and public discussions on the occasions of conferences, where the above listed colleagues advocated the foundation of PACM and presented with great engagement the activities of IACM. Fortunately, we were optimists and PACM was founded.

"... each member of PACM has the feeling that they are real members of IACM as the living organization..."

Presently PACM has 120 regular members and three honoury members: Zb. Kaczkowski (Warsaw), H. Mang (Vienna) and O.C. Zienkiewicz (Swansea). PACM has proved to be an efficient platform for friendly contacts and common initiatives with colleagues from IACM representing all countries. The first self-evident result is the promotion of the ideas of IACM and spreading of information on conferences and other events by the way of regular distribution of the IACM-expressions among all members of PACM. We have taken the chance to cooperate in all forms of organizational activities within the IACM, i.e. putting forward nomination for boards, participation of our representatives in the organization of IACM Congress and other conferences, etc. We strongly hope that each member of PACM has the feeling that they are real members of IACM as the living organization, where friendly personal relations and passion towards computational mechanics are the first principles. If PACM has contributed to it, then it was worth founding.

Reading this, you may have the impression that our effort was focused on implanting the ideas of the IACM in Poland. This is only partly true. PACM has carried out a number of its own projects as well. Among them are:

- the organization of three international conferences on Computer Methods in Mechanics (PCCMM, Kielce 1993, Warszawa-Zegrza 1995 and Poznan 1997)
- the organization of international courses on *'New Computing Technologies'* (1995) & Supercomputers in Mechanics (1997).
- the co-organization of the following courses:
  - Mesh Adaptivity Methods in FEM, Poznan, October 1992
  - Boundry Element Methods - Theory and Implementation into Education, Poznan October 1994
  - Realiability Based Design, Poznan, October 1996.
- best paper competition by a young author at PCCMM, Warszawa-Zegrze 1995, Opznan 1997 conference
- publishing the information bulletin of PACM
- publishing the home page of PACM (http://www.put.poznan.pl/hypertext/put/IKB/pacm.htm).

PACM is affiliated with the Central European Association for Computational Mechanics (CEACM), European Council of Computational Mechanics (ECCM), International Association for Computational Mechanics (IACM) and with the European Community on Computational Methods in Applied Sciences (ECCOMAS).

The new executive committee of PACM was elected in May 1997 with the elected chairman as M. Witkowski, vice-chairman as T. Burczynski and secretary as R. Gajewski. •

The balance of motivation and achievement

Each human being is unique. There are no two alike. That is why each one has their own identity, a particular way of thinking and feeling; their own personality.

It is true that a person is influenced by the environment which surrounds us, i.e. family, school, means of communication etc, but a persons mental and emotional health is just as important as his physical health. A person who enjoys good mental and emotional health, is able to approach new situations with confidence, no matter what other influences they may receive.

When choosing a career and a profession, there are different opinions about how a person should decide your future. Some say 'think about your greatest passion'. Some say 'think about your future and economic position'. And others say 'try to find the balance between both'. The truth is that no matter what people say, you are the only one able to make those final decisions, as you are the one having to face the consequences. All of these processes constitute a part the matureness and autonomy you have developed that will enable you to make these decisions on your own, using all your knowledge and wisdom.

And in this stage of life, when a human being is motivated to continue preparing themself, portraying self-confidence, with enough self-esteem to accomplish all the goals they have set for themself, and the constant desire to increase their value and position, we find some of the greatest reasons for human activity. •

Maria Guadalupe Gutierrez Sola
Psychologist

"Of course there is no formula for success except perhaps an unconditional acceptance of life and what it brings"

Arthur Rubinstein

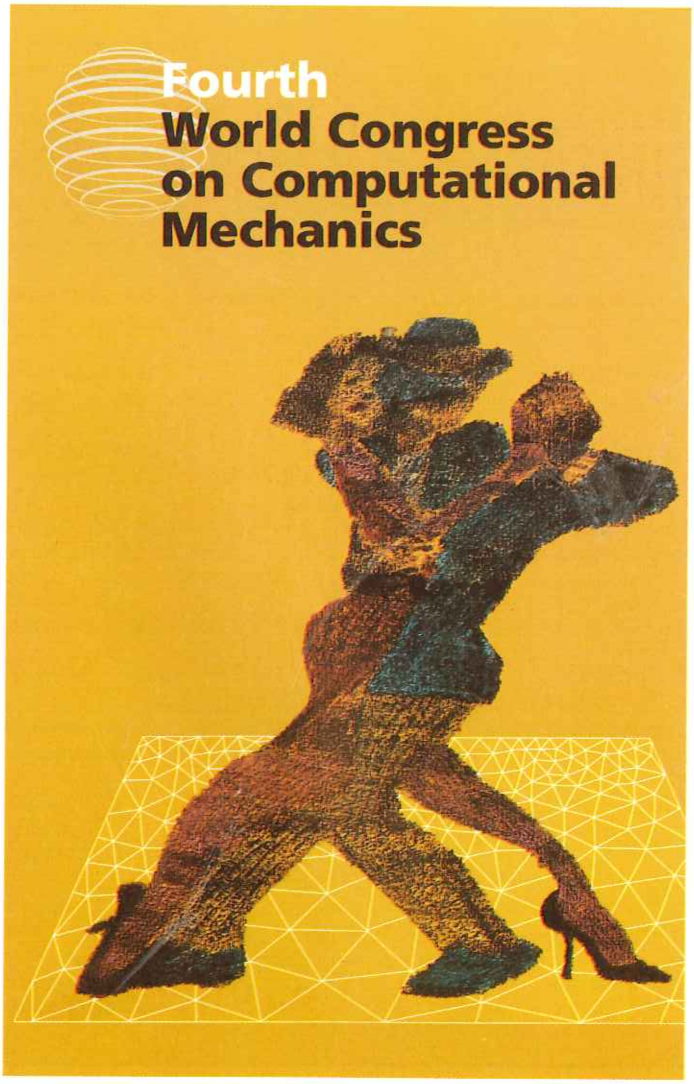
"The immature mind hops from one thing to another; the mature mind seeks to follow through"

Harry A. Overstreet

Argentinian Computational Mechanics Community

by
E. Dvorkin
Centro de Investigaciones Industriales FUDETEC
Argentina

Argentina will, in 1998, host the Fourth World Congress of Computational Mechanics in **Buenos Aires** on **29 June to 2 July**. We therefore believe that it will be useful for the IACM members to picture the Computational Mechanics activities in our country.



IV IACM World Congress on Computational Mechanics

Historical background - The first activities in the field of Computational Mechanics can be traced to the Instituto de Cálculo (Institute for Scientific Computation) at the Science School of the University of Buenos Aires. This Institute was created in 1962 and its first director was Dr. Manuel Sadosky.

It is interesting to remember that the first computer used at an Argentine University, a Mercury Ferrante, was located at this Instituto de Cálculo.

Some of the fields that were developed in those pioneering years at the Instituto de Cálculo were: Computational Continuum Mechanics, Hydraulic Simulations, Macro-economics Models, Meteorology, etc.

In 1966 a military dictatorship intervened the University of Buenos Aires and many of its Professors and Researchers resigned in dis-agreement with the lack of academic and political freedom. The activity at the Instituto the Cálculo was therefore stopped (it was only re-initiated in 1988). Most of Instituteís researchers emigrated to Latin American countries, the U.S. and Europe.

In Argentina in the last 15 years, the activity in the field of Computational Mechanics experi-enced a very rapid growth. The Argentinian Computational Mechanics community nowadays has an active participation in the international arena.

National, Latin American and international conferences periodically take place in Argentina, organized under the umbrella of the Argentinian Association of Computational Mechanics (AMCA).

The Argentine Computational Mechanics community - In what follows we present a listing of the main research groups that are active in Argentina (I do not claim it to be a complete list and I do apologize to any group that, due to my lack of memory, was not included).

City	Institution	Group Director
Bahía Blanca	Instituto de Mecánica Aplicada (CONICET)	Dr. Patricio Laura *(Ph.D., Catholic Univ. of Washington, U.S.A.)*
Bariloche	Comisión Nacional de Energía Atúmica	Dr. Marcelo Venere *(Dr. in Nuclear Engng., Inst. Balseiro, Univ. de Cuyo, Argentina)*
Buenos Aires	Centro de Investigaciones Industriales (FUDETEC)	Dr. Eduardo N. Dvorkin *(Ph.D., M.I.T., U.S.A.)*
Buenos Aires	Ente Nacional Regulador Nuclear (ENREN)	Ing. Juan Carlos Ferreri *(Eng.,Univ. Nacional de La Plata, Argentina)*
Buenos Aires	Instituto de Cálculo, Facultad de Ciencias Exactas y Naturales, Univ. de Buenos Aires	Dr. Pablo Jacovkis *(Dr. in Math., Univ. de Buenos Aires, Argentina)*
Buenos Aires	Depto. de Computación, Facultad de Ciencias Exactas y Naturales, Univ. de Buenos Aires (CONICET)	Dr. Guillermo Marshall *(Ph.D., T.U.Delft, The Netherlands)*
Buenos Aires	Instituto Nacional del Agua y del Ambiente	Dr. Angel Menéndez *(Ph.D., The Univ. of Iowa, U.S.A.)*
Buenos Aires	Lab. de Mec·nica Computacional, Depto. de Física, Facultad de Ingeniería, Univ. de Buenos Aires	Dr. Gustavo Sánchez Sarmiento *(Dr. in Nuclear Engng., Inst. Balseiro, Univ. de Cuyo, Argentina)*
Buenos Aires	Grupo de Simulaciún Numérica de Resevorios, Lab. de Ingeniería de Reservorios, Faultad de Ingeniería, Univ. de Buenos Aires	Dr. Gabriela Savioli *(Dr. in Math., Univ. de Buenos Aires, Argentina)*
Campana	Centro de Investigaciones Industriales (FUDETEC)	Dr. Alberto Pignotti *(Dr. in Physics, Univ. de Buenos Aires, Argentina)*
Córdoba	Univ. Nacional de Cúrdoba	Dr. Luis Godoy, *(Ph.D. Univ. of London, U.K.)* Dr. Carlos Prato, *(Ph.D.,M.I.T., U.S.A.)*
La Plata	Centro de Investigación y Desarrollo en Criotecnología de Alimentos	Dr. Rodolfo Mascheroni *(Dr. Univ. Nacional de La Plata, Argentina)*
Mar del Plata	Facultad de Ingeniería, Univ. Nacional de Mar del Plata	Dr. Enrique Pardo *(Dr. in Mat. Sc., Univ.Nacional de Mar del Plata, Argentina)*
Mendoza	Inst. de Ciencias Básicas, Univ. Nacional de Cuyo	Dr. Carlos Garcìa Garino *(Dr. in Engng., Politech. Univ. of Catalunya, Spain)*
Rosario	Univ. Austral	Dr. Domingo Tarzia *(Dr. 3eme. Cycle Math. et Habilit., Univ. de Paris 6, France)*
Santa Fe	INTEC-(Univ. Nacional del Litoral-CONICET)	Dr. Julio Deiber *(Ph.D., Princeton Univ., U.S.A.)*
Santa Fe	INTEC-(Univ. Nacional del Litoral-CONICET)	Dr. Sergio Idelsohn *(Ph.D., Univ. of Liege, Belgium)*
Santa Fe	INTEC-(Univ. Nacional del Litoral-CONICET)	Dr. Fernando Saita *(Ph.D., Univ. of Minnesota, U.S.A.)*
Tucumán	Univ. Nacional de Tucumán	Dr. Guillermo Etse *(Dr.-Ing., Univ. Karlsruhe, Germany)*

Principal Researchers	Research fields	Fax / E-mail
Dr. L. Ercoli,	Mechanical vibrations, Elastic stability, Heat transfer, Thermo-elasticity, Applied bioengineering	54-91-88-3933 ima@criba.edu.ar
Dr. Fernando BasombrÌo, Dr. Gustavo Buscaglia, Dr. Enzo Dari, Dr. Sergio Felicelli, Dr. Claudio Padra, Dr. Fernando Quintana	Finite element mesh generation, CFD, Solid mechanics, Finite element modeling of diffusion problems	54-944-45299 venere@cab.cnea.edu.ar
Dr. Marcela Goldschmit	Finite element formulations, Metal forming, Turbulence models, Plasticity and viscoplasticity, Industrial applications	54-1-310-1000 dvk@fudfem.org.ar
Dr. Eduardo García	Thermo-hydraulics of nuclear installations, CFD	54-1-480-0160 jferreri@cae.enren.gov.ar
Marisa Bauzá,M.Sc., Dr. Susana Blanco Dr. María Figliola, Dr. Osvaldo Rosso	Hydrodynamics, River hydraulics, Hydrology, Numerical simulation of oil reservoirs	54-1-782-0620 jacovkis@dc.uba.ar
Dr. Fernando Molina Dr. Dino Otero	Complex systems, Deposition patterns in electrochemical problems	54-1-783-0729 marshall@cnea.edu.ar
	Surface and underground hydrodynamics, Sediment transport and erosion/sedimentation, Contaminants transport and transformation	54-1-480-0459 menendez@satlink.com
Dr. Claudio Jouglard	Comput. modeling of industrial processes, Numerical methods, Heat transfer, Stress analysis, Expert systems,	54-1-326-2424 gssarmi@aleph.fi.uba.ar
Ing. Mirtha Susana Bidner (Lab Director)	Numerical simulation of oil and gas reservoirs	54-1-780-0145 gsavioli@di.fcen.uba
	Heat transfer, Modeling of industrial furnaces, Modeling of electromagnetic problems, Non-destructive testing	54-489-27928 rpapi@criba.edu.ar
Dr. Alejandro Brewer, Dr. Fernando Flores Dr. José Stuardi, Julio Massa, M.Sc.	Structural stability, Dynamics, Plasticity	54-51-690047 lgodoy@com.uncor.edu.ar
Dr. Viviana Salvadori	Heat and mass transfer in food processing and conservation	54-21-249287 mcanon@isis.unlp.edu.ar
Dr. Eduardo Brizuela	Fracture, Reactive flows, Boundary elements, Meshless methods	54-23-81-0046 epardo@bart.mdp.edu.ar
Dr. Anibal Mirasso, Silvia Raichman, Dr. Virginia Vera	Solid mechanics, Plasticity, Metal forming, Structural stability, Simulation of ultrasonic testing	54-61-494084 cgarcia@pascal.uncu.edu.ar
Dr. Lucio Berrone Dr. Cristina Turner	Free boundary problems for the heat-diffusion equation, Stefan problem, Phase change problems, Root growth, Variational inequalities, Numerical analysis, Finite element method, Error bounds	54-41-810505 tarzia@uaufce.edu.ar
Dr. Raúl Bortolozzi	Fluid flow and energy transfer in porus media, Rheology and viscoelastic material processing Finite differences	54-42-556673 treoflu@arcride.edu.ar
Dr. Alberto Cardona, Dr. Norberto Nigro Victorio Sonzogni, M.Sc., Dr. Mario Storti	CFD, Mechanisms, Heat transfer	54-42-550944 rngtm@arcride.edu.ar
Dr. Carlos Corvalán, Dr. José Di Paolo Dr. María Giavedoni	Interface phenomena, Flows with gas-liquid interface, Surfactants, Elasto-hydrodynamic processes	54-42-550944 madelia@arcride.edu.ar
Dr. Bibiana Luccioni Dr. D. Ambrosini	Plasticity, Viscoplasticity, Damage-Plasticity, Localisation, Structural stability	54-81-364087 cetse@herrera.unt.edu.ar

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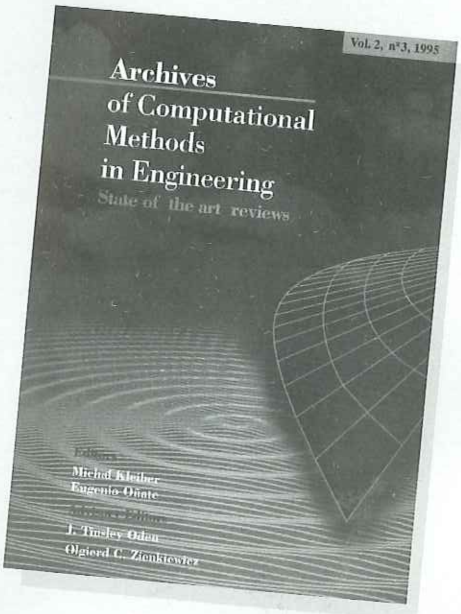

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iacm
Symposia

IACM Special Interest Conferences and IACM Symposia

At the last meeting of the Executive Council of IACM, held on January 15, 1997 at Austin, Texas, the International Conference on Numerical Methods in Industrial Forming Processes (NUMIFORM) was accepted as an IACM Special Interest Conference. This is now the third meeting of this class to the conferences on Computational Plasticity (COMPLAS) and Finite Element in Fluids (FEMIF). The last COMPLAS V conference was held on 17 - 20 March in Barcelona, Spain and was attended by some 300 delegates (see note on page 29). The next FEMIF will take place in Tucson, Arizona on 5 - 8 January 1998 and will be dedicated to Prof. R.H. Gallagher. NUMIFORM - VI will take place at Twente University in Holland on 22 - 25 June 1998 i.e. just a few days prior to the IACM World Congress in Buenos Aires. A good opportunity for a round the world trip for many IACM members!

At the above mentioned Austin meeting, the IACM Executive Council also decided to promote and support the organisation of IACM Symposia. These could be arranged jointly with other organisations such as is regularly done with IUTAM (see note below), or else they can have an identity of their own. Further details on the format of the IACM Symposia are under discussion and will be announced shortly. •

E. Oñate
IACM Secretary and Tresurer

IUTAM/IACM Simposia

IACM is an Affiliate of IUTAM, the International Union for Theoretical and Applied Mechanics. This affiliation provides an important connection of the computational mechanics community with broader nationally-supported scientific organizations under the auspices of ICSU, the International Council of Scientific Unions. IACM also participates with IUTAM through the Working Party on Computational Mechanics, through which IACM organizes symposia and conferences on specialized topics on computational mechanics. The IACM members of the IUTAM Working Party in Computational Mechanics are Professors E. Arantes e Oliveira (Portugal), P. Ladeveze (France), T. Belytschko (U.S.A.), J.T. Oden (U.S.A.) and H. Mang (Austria). Several workshops, symposia and conferences sessions have been organized by this group in recent months.

The IACM members of the IUTAM Working party met in Austin, Texas on January 15, 1997 to finalize proposals for several symposia, workshops and mini-symposia under the joint sponsorship of IUTAM and IACM. The proposed IUTAM/IACM symposia are listed as follows:

June 1997 — **Symposium on Discretization Methods in Solid Mechanics**
IACM symposium organized by Prof. H. Mang.
Vienna, Austria

27 - 31 July 1997 — **IUTAM Symposium on Computational Methods for Unbounded Domains**
Organized by Prof. T. Geers and co-sponsored by the IACM as an activity of the Working Party and to provide financial support as well.
Boulder, Colorado, USA

4 - 7 August 1997 — **The Sixth International Symposium on Education and Practice of Computational Methods in Engineering Science**
Organized by Prof. Arantes e Oliveira who is also co-chairman of the meeting.
Guangzhou, China

6 - 8 August 1997 — **Mini-symposium on Adaptive Hierarchical Modelling in Computational Mechanics**
Organized by Prof. E. Stein of Hannover and is part of the USACM Congress in San Francisco.
San Francisco, California, USA

17 - 19 Sept. 1997 — **Conference on New Advances in Adaptive Computational Methods in Mechanics**
Third meeting in a series on Reliability in Computational Mechanics organized by Prof P. Ledevez.
Paris, France •

J.T. Odem
Texas Institute for Computational and Applied Mathematics (TICAM)

'Message from the President'

J.N. Reddy
USACM President

Extracts from USACM Bulletin Vol.9 No.2 October 1996

Mechanics, in its broadest sense, is a discipline that is concerned with a fundamental understanding of natural phenomena, while a computational method is a numerical technique used to compute or solve equations. Mathematical models to simulate natural phenomena have been studied for centuries, but until the advent of modern computational methods and computers, the use of realistic mathematical models stood outside the reach of the scientific and engineering research. Since the middle of the century, advances in computational methods and computing devices have facilitated the development of more accurate modelling of physical phenomena. Today, mathematical models used to study the mechanics of solids and fluids, electromagnetism, heat transfer, plasma physics, and other scientific disciplines take into account all the necessary features of the system, and they can be evaluated through computational methods. The discipline concerned with the application of computational methods and devices in the numerical simulation of physical phenomena is called computational mechanics. In the last four decades the discipline has emerged as an important area of education, research and application throughout the world.

The first attempt to bring together this community was undertaken by three leading scientists R.H. Gallagher, J.T. Oden and O.C. Zienkiewicz, who called a meeting to form a group of International Centres of Computational Mechanics. This led to the founding of the International Association of Computational Mechanics (IACM) and the establishment of a Founding Council and a Constitution.

Twenty-one prominent U.S. scientists in computational mechanics met on December 18, 1987 in Boston where the ASME Winter Annual Meeting was held, to discuss the formation of the U.S. Association for Computational Mechanics (USACM). After some discussion, they agreed a general format and plan for establishing the USACM and an executive committee was elected with J.T. Oden as the first president.

The members of the USACM are instrumental in establishing a standing Subcommittee on Computational Mechanics of the U.S. National Committee on Theoretical and Applied Mechanics (USNC/TAM). The subcommittee prepared a national Research Council (NRC) publication entitled Research Directions in Computational Mechanics which discussed the key role of computational mechanics in today's technology, and emphasises its critical role in manufacturing, space exploration, defence, environmental concerns and in fundamental scientific research. It also established the role of computational mechanics in the new agency-wide research initiative on High Performance Computing and Communication, and describes how computational mechanics impacts solutions of the Grand Challenge Problems. A collection of 14 appendices which give technical summary accounts of key areas of future research in computational mechanics are included in the report.

The 14 areas are as follows: 1. adaptive methods and error estimation, 2. prototype test simulation, 3. parallel computation, 4. artificial intelligence in mathematical modelling, 5. environmental contamination and geomechanical simulation, 6. materials research: numerical modelling of new materials, 7. structures and structural dynamics, 8. nonlinear equations and bifurcation, 9. uncertainty and stochastic processes in mechanics, 10. chemically reacting flows and combustion, 11. numerical modelling of turbulence, 12. general computational fluid dynamics, 13. non-linear dynamics of multiparticle systems, and 14. manufacturing process, design and development.

In reviewing the past accomplishments of the USACM in national and international areas, one should get the feeling that the association is on the right course. •

book report

Advanced Design of Concrete Structures

K. Gilltoft, B. Engström, L.O. Nilsson, N.E. Wiberg (Eds.)
1997, US$ 60, CIMNE Barcelona..

This publication forms the proceedings of the Symposium on Advanced Design of Concrete Structures to be held in Göteborg in June 1997. In modern and future design of concrete structures, a total view of all influences during design, construction and operation is strongly needed. The different papers emphase the need to combine material knowledge and advanced methods of analysis with aspects concerning construction, operation and maintenance of concrete structures to a generalized design philosophy.

Computational Science for the 21st Century

M.O. Bristeau, G. Etgen, W. Fitzgibbon, J.L. Lions, J. Périaux, M.F. Wheeler (Eds.)
800 pages, April 1997, UK£ 95.00, John Wiley & Sons Ltd.

The goals of Computational Science are to develop and analyze sophisticated mathematical models in order to simulate and control processes of increasing complexity, while optimizing computer resources in order to solve large problems. The goals can be reached using theoretical and algorithmic tools from the fields of partial differential equations, control theory, optimization theory, intelligent software development, computer architecture and parallel distributed computation. This book presents the state-of-the-art in Computational Science, ranging from theoretical and numerical topics to practical implementations.

Domain Decomposition Methods in Science and Engineering

P. Bjorstad, M. Espeda & D. Keyes (Eds.)
750 pages, June 1997, John Wiley & Sons Ltd..

Domain decomposition is a computing strategy suitable for high performance computer systems and applied to a broad class of large scale mathematical-physical problems in engineering and sciences. This book includes topics ranging from basic theoretical research to industrial application, industrial implementations in large scale codes and parallel algorithms and recent research results from top rank scientists. This edition presents the papers of the high level scientific conference held in Bergen, Norway.

book report

Computational Plasticity

D.R.J.Owen, E. Oñate and F. Hinton (Eds.)
Two volumes, 2300 pages, 1997, US$ 170,
CIMNE Barcelona.

This two part book contains over 230 papers presented at the Fifth International Conference on Computational Plasticity (COMPLAS V) held in Barcelona, March 1997. The papers are divided into eighteen sections which fall into three main areas of interest: (i) Advances in constitutive models involving both rate dependent and rate independent plasticity under infinitesimal and finite strain condition. (ii) Algorithmic developments and their computer implementation. (iii) The application of computational plasticity models to practical engineering problems.

Thermal Design of Heat Exchangers

E. Smith (Ed.)
418 pages, March 1997, UK£ 37.50,
John Wiley & Sons Ltd.

Heat exchangers play an important role in nuclear industries, power generation, aerospace and ground handling equipment, cryogenics (very low temperatures), chemical industries etc. Three sets of partial differential equations for both contra-flow and cross-flow are established and form the basis from which a range of methods of direct-sizing and stepwise rating may proceed. Transient methods are covered, including the Method of Characteristics and the Single-blow method of testing is treated. Numerous aspects of low and high temperature design are discussed and extensive references to the literature are provided.

Recent Developments in Computational and Applied Mechanics

A book in Honour of J.B. Martin

B.D. Reddy (Ed.)
412 pages, 1997, US$ 60,
CIMNE Barcelona.

This book has been edited on the occasion of the sixtieth birthday of Prof. John B. Martin. The book contains original contributions from eminent scientists on current developments in non linear finite element analysis of solids and structures, particularly in regard to plasticity. The content of the book provides a perspective of the state of the art in computational structural mechanics at the turn of the century.

iacm news

Germany

Prof. René de Borst of Delft University of Technology, The Netherlands, was elected as recipient of the 1996 Max Planck Research Award for International Cooperation. The award was presented on 3 December 1996 in Bonn.

USA

Prof. J.N. Reddy became the fifth president of the U.S. Association for Computational Mechanics (USACM), beginning September 1, 1997. Dr Reddy is the inaugural holder of the *Oscar S. Wyatt Endowed Chair* in Mechanical Engineering at Texas A & M University, College Station, Texas.

The 1997 Melvin R. Lohmann Medal from Oklahoma State University, Stillwater, Oklahoma recipient will be Dr J.N. Reddy. This medal honours a graduate of the College of Engineering, Architecture and Technology who has made "outstanding technical or managerial contributions to his or her profession and/or contributions to the education of engineers, architects or technologists that merit the highest recognitions". Dr Reddy was also the first recipient of this award in 1991.

Argentina

In October 1996 the Argentine National Academy of Exact Physical and Natural Sciences incorporated Dr. Eduardo N. Dvorkin (Centre for industrial Research, FUNDETEC) as an Academy Fellow. At the presentation Dr. Dvorkin lectured on "Computational Mechanics: Theoretical Developments and Industrial Applications".

In November 1996 the Argentine National Academy of Science awarded the "Ingeniero Enrique Villarreal" prize for contributions to the field of Structural Engineering to Prof. Guillerno Etse (University of Tucumán).

ICES97 - Costa Rica

The following awards were given out at the ICES97 conference in Costa Rica:

- ICES Medal to Prof. T. Belytschko of Northwestern University, U.S.A.,
- Washizu Medal to Prof. T. Nishioka of Kobe University of Mercantile Marine, Japan,
- Eric Reissner Medal to Prof. E. Oñate of CIMNE, Barcelona, Spain,
- Pian Medal to Dr. G. Shi of the National University of Singapore.

$$\frac{1\not{6}}{\not{6}4} = \frac{1}{4}$$

Prof. Brains has discovered an exciting mathematical phenomena concerning fractions with digits under 100.
If he cancels identical digits above and below the line, the fraction is still correct.
Can you find three other fractions of which this is true?

Answers on page 30

*"What is defeat?
Nothing but education, nothing but the first step towards something better."*

Wendell Phillips

"If it does not look easy, it is that we have not tried hard enough"

Fred Astaire

conference notices

NSCM X
10th Nordic Seminar on Computational Mechanics

The anniversary 10th Nordic Seminar on Computational Mechanics (NSCM X) will take place in **Tallinn, Estonia** on **October 24 - 25, 1997**. The Nordic Association of Computational Mechanics (NoACM) was created in Göteborg at its first seminar in 1988. The founding countries were Denmark, Finland, Iceland, Norway and Sweden. In 1991, the Baltic states Estonia, Latvia and Lithuania joined NoACM. One of the main goals of NoACM is to create a forum for meeting and discussion, especially for young PhD students, to get training in presentation of their research work at an early stage and to create an invaluable personal network early in life.

Main invited key-note invited will be Prof E. Stein, Hanover, Germany (the president of the newly created European Committee of Computational Mechanics ECCM) and Prof. E. Oñate, Barcelona, Spain (Secretary of IACM and ECCM). Invited speakers from NoACM countries include Profs. M. Bendsoe, A. Salupere, J. Paavola, H. Pettola, L. Buligins, R. Barauskas, S. Remseth and M. Klisinski.

For further information please contact
Prof. J. Metsaveer on: Tel: (37) 2 6 202 551,
Fax: (37) 2 6 202 550, (37) 2 6 202 020
Email: jmetsa@edu.ttu.ee, jmetsa@cc.ttu.ee
Web site: http://www.ttu.ee/nsem •

Fourth U.S. National Congress on Computational Mechanics

The fourth U.S. National Congress on Computational Mechanics is the official congress of the U.S. Association for Computational Mechanics (USACM) and will be held on **August 6 - 8, 1997**, at the Hyatt Regency in Embarcadero Centre, **San Francisco, California**.

This conference will provide a forum to communicate ideas and new developments on a wide range of topics associated with computational mechanics and its application to critical problems in science and engineering. There are 5 key-note presentations, 98 technical sessions with over 450 papers, and a post conference short course.

Conference information can be found on the conference web page located at :
http://www.scorec.rpi.edu/usnccm/usnccm.html

For those wishing additional information and unable to contact the web page, contact:
Mark S. Shephard,
Scientific Computational Research Centre,
7011 CII Building,
Rensselaer Polytechnic Institute Troy,
NY 12180-3590
Voice: (1) 518 - 276 6795
Fax: (1) 518 - 276 4886
Conference Email: usnccm@scorec.rpi.edu •

NUMIFORM'98
Sixth International Conference on Numerical Methods in Industrial Forming Processes

An IACM Special Interest Conference

The Sixth International Conference on Numerical Methods in Industrial Forming Processes (NUMIFORM'98) will bring together researchers and practitioners in the field of numerical simulation of forming processes used in industry. It provides a forum for discussion of the current state of the art in numerical methods (hybrid methods, inverse methods, parallel computing, explicit/implicit integration, solution methods, meshing, optimization, Eulerian/Lagrangian formulation, contact algorithms) mathematical modelling (constitutive equations, evolving microstructure, phase changes, damage, contact and friction, thermomechanical coupling, free surfaces, steady state problems, residual stresses, chemical reactions)and industrial applications (bulk forming, sheet forming, casting, polymer processing, powder forming, machining, joining thermal & chemical processing, surface treatment, food processing) .

It will be held on campus of the **University of Twente**, located between the cities of Enschude and Hengelo in the eastern part of **The Netherlands** on **June 22 - 25, 1998**.

Abstracts on topics related to the theme of the Conference are invited by August 31, 1997 and should be limited to 500 words, plus figures and references.

For technical questions please contact:
Prof Han Huétink, NUMIFORM '98
University of Twentee, WB-N136
P.O. Box 217, 7500 AE ENSCHEDE
The Netherlands
Tel: (31) 53 489 2576 Fax: (31) 53 489 3900
e-mail: J.Huetink@wb.utwente.nl
or visit the home page on:
http://www.numiform98.wb.utwente.nl

ECCOMAS
III European Congress on Computational Methods in Applied Science

ECCOMAS III will take place in **Barcelona** during **September 2000**. This event follows the two previous meetings held in Brussels (1992) and Paris (1996). The Paris meeting was attended by some 700 participants.

These conferences are promoted by the European Committee on Computational Methods in Applied Science (ECCOMAS), grouping all IACM affiliated organisations in Europe. The Barcelona meeting in the year 2000 will be organised by the Spanish Association for Numerical Methods in Engineering (SEMNI).

Further details can be obtained from:
SEMNI in Barcelona, Spain
Fax: (34) 3 - 401 65 17
Email: semni@etseccpb.upc.es •

debrief

IACMM
Israel Association for Computational Methods in Mechanics

An official meeting of the Israel Association for Computational Methods in Mechanics (IACMM), a member of IACM, was held on **10 October, 1996** in **Tel Aviv**, **Israel**. The symposium was organized at Tel Aviv University with the support of the Iby and Aladar Fleischman Faculty of Engineering.

Over 50 engineers and scientists participated, The symposium included a keynote lecture by S. Abarbanel on high-order methods, an invited lecture by D. Givoli on finite element methods for crystal growth and two lecture sessions which emphasized industrial applications. In addition, the participants toured the Computational Fluid Dynamics Laboratory and the Fracture Mechanics Laboratory at the Faculty of Engineering of Tel Aviv University. An exhibit of commercial software tools for engineering analysis was held in conjunction with the symposium.

The next symposium of the Israel Association for Computational Methods in Mechanics will be held on 16 April, 1997 at the Technicon-Israel Institute of Technology in Haifa, Israel.

For further information please visit the IACMM web site:
http://www.eng.tau.ac.il/~harari/IACMM/iacmm.html •

Foundation and Activities of ECCM
The European Council of Computational Mechanics

ECCM is the coordinating & steering organisation for all European Association affiliated to IACM.

After preliminary meetings of representatives from European Associations for Computational Mechanics, the official foundation of ECCM took place on **18th March 1997** in **Barcelona** during the COMPLAS V conference. In total 23 European countries are represented by ECCM so far and the foundation of further European associations is in progress.

The constitution of ECCM was passed in Barcelona and the following essential paragraph 1.3 reads: *Object and Activities* The objective of the Council is to promote, foster, organise and coordinate various activities concerning Computational Mechanics on the continent of Europe & to represent European interests in Computational Mechanics as an affiliate of IACM. The council shall serve as a formal vehicle for overseeing and coordinating conferences, colloquia, symposia & other meetings. It shall also promote research, commercial & academic activities in the general area of computational mechanics that takes place in Europe. The functions will be undertaken on behalf of the IACM.

ECCM shall provide European representatives in the planning and hosting of International IACM-Congresses and shall periodically organise 'European Conferences on Computational Mechanics'. The first ECCM'99 on Solids, Structures and Coupled Problems will be held from 31 August to 3 September 1999 in Munich, Germany. The Chairman on the Organising Committee will be Prof. W. Wunderlich.

Present members of the Managing Board are: E. Stein (Hannover) Chairman, E. Oñate (Barcelona) , H. Mang (Vienna), P. Ladeveze (Cachan) and M. Papadrakakis (Athens).

According to the new decisions of the ECCOMAS Executive Board on April 28, 1997 in Hamburg, the relations and responsibilities of ECCM and ECCOMAS for specific tasks in Europe have to the discussed and negotiated in the near future. Independently from formal aspects and responsibilities, ECCM should proceed to strengthen the European cooperation in Computational Mechanics to the benefit of a strong interaction of science and technology. •

E. Stein
University of Hannover, Germany

Representatives of the European IACM Organisation at the ECCM Barcelona meeting. From left to right: C. Mota-Soares (PSTACM, Lisbon), B. Schrefer (GIMC, Padova), W, Wunderlick (GACM, Munich), E. Stein (GACM, Hannover), H. Mang (CEACM, Vienna), M. Kleiber (PACM, Warsaw), R. De Borst (Delft), J. Orkisz (PACM, Warsaw), N. Bicanic (ACME, Glasgow), R. Owen (ACME, Swansea), N.E. Wiberg (NoACM, Gotebörg), M. Papadrkakis (GRACM, Athens), E. Oñate (SEMNI, Barcelona), P Ladeveze (CRMA, Paris).

iacm awards

The IACM Award for Computational Mechanics

This award will be given for contributions to traditional areas, such as computational structural mechanics and computational fluid dynamics, but also be given to recognized contributions outside these specific areas. For example, the Award may be given in recognition of accomplishments in software development, scientific computing, research contributions in computational electromagnetics, semi-conductor device simulation, biomechanics or other areas not traditionally embraced by computational structural mechanics and fluid dynamics but which have general applicability to computational mechanics.

The IACM award for Young Investigators in Computational Mechanics

This award recognises outstanding accomplishments, particularly outstanding published papers, by researchers aged 40 or younger. Eligibility requires that the nominee not turn 41 in the year the award is presented.

The IACM Fellows Award

This award recognises individuals with a distinguished record of research, accomplishment and publication in areas of computational mechanics and demonstrated support of the IACM through membership and participation in the Association, its meetings and activities. All recipients shall be members in good standing of IACM and multiple awards may be given at four year intervals.

The IACM Congress Medal

This is the highest award given by the IACM. It honours individuals who have made outstanding, sustained contributions in the fields of computational mechanics generally over periods representing substantial portions of their professional careers. The medal is normally awarded every four years, at the time of the World Congress of the Association. Past recipients are R.H. Gallagher, J.H. Argyris, O.C. Zienkiewicz, R.W. Clough and J.T. Oden.

Guidelines and Call for Nominations

All members of IACM in good standing, i.e. who have paid their annual dues. etc., are invited to submit nominations to the Awards Committee Chairman: Prof. T.J.R. Hughes, Division of Mechanics and Computation, Department of Mechanical Engineering, Stanford University, Stanford, CA 94305-4040, U.S.A. Nominators may nominate no more than one individual for an award during the four-year interval and self-nominations are not accepted. Nominators are invited to submit a maximum of one page with a combined nominating statement/c.v.vita in support of the nominee.

The deadline for nominations is December 31, 1997. •

Post Doctoral Research Assistant Position

Adaptive Delamination of Composites

Department of Aeronautics
Imperial College of Science, Technology & Medicine

This project is sponsored by the European Union and involves a consortium of Industry, Research Establishments, and Academia. It will last for 27 - 30 months and will start in September 1997. It is aimed at a post-doctoral Research Assistant.

Experience in FE modelling and development is vital for this project, which aims to predict the initiation and propagation of delamination between layers of laminated plies. Novel ways of predicting will be evaluated, using a scheme which refines and changes the mesh at the (curved) delamination front. Impact damage will be modelled and verified by testing on curved panels. Explicit (FE77) and implicit (LUSAS) codes will be used and compared with each other and with tests. The testing programme will be less than 20% of the total project, and the remaining FE development will be roughly divided between one third on the development of a transition interface element aimed at adaptive delamination, implicit FE work and explicit FE work.

The salary, including London Allowance, will be £18,129 gross p.a. (This roughly equates to £12,800 net i.e. after deductions).

The work will be supervised by Professors G.A.O. Davies, M.A. Crisfield and Mr. D. Hitchings. Interested applicants please send a C.V. plus 3 referees to Prof. M. Crisfield, Department of Aeronautics, Imperial College, Prince Consort Road, London, SW7 2BY.

Fax: (44) 171 594 5078, Email: m.crisfield@ic.ac.uk •

Answers from page 27

$$\frac{26}{65} = \frac{2}{5} \quad \frac{19}{95} = \frac{1}{5} \quad \frac{49}{98} = \frac{4}{8}$$

conference diary planner

2 - 4 July 1997
V International Conference on Applications of High-Performance Computers in Engineering
Venue: Santiago de Compostela, Spain
Contact: Lynn Morton, Tel: (44) 1703 293 223.

6 - 8 August 1997
The Fourth U.S. National Congress on Computational Mechanics
Venue: Hyatt Regency in Embarcadero Centre, San Francisco, California, USA
Contact: M.S. Shephard. Tel:(1) 518 - 276 6795, Fax: (1) 518 - 276 4886, Email: usnccm@scorec.rpi.edu

19 - 20 August 1997
The Mouchel Contenary Conference on Innovation in Civil & Structural Engineering
Venue: Cambridge, United Kingdom
Contact: B.H.V. Topping, Fax: (44) 131 451 3129

8 - 10 September 1997
Computer Aided Optimum Design of Structures
Venue: Rome, Italy
Contact: Liz Kerr, (44) 1703 293 223

17 - 19 September 1997
Efficient and Reliable Continuum Finite Elements for Linear and Nonlinear Analysis
Venue: Bad Herrenalb, Karlsruhe, Germany
Contact: K. Schweizerhof, Tel: (49) 721 608 2070, Fax: (49) 721 608 2071

18 - 20 September 1997
2nd Congress of Croatian Society of Mechanics
Venue: Hotel Kaktus, Supetar, on the Island of Brac, Croatian Adriatic, Croatia.
Contact: Prof. J. Biondic, Tel: (385) 1 61 68 250, Fax: (385) 1 61 56 940, Email: jurica.soric@fsb.hr

22 - 27 September 1997
Annual Conference of the International Association for Mathematical Geology
Venue: Barcelona, Spain.
Contact: CIMNE Secretariat, Tel: (34) 3 - 401 6037 Fax: (34) 3 - 401 6517, Email: cimne@etseccpb.upc.es

1 - 3 October 1997
II International Workshop on Factory Communication Systems
Venue: Barcelona, Spain.
Contact: Barbara Schmitt, Tel: (93) 401 6037, Fax: (34) 3 - 401 6517, Email: semni@etseccpb.upc.es

20 - 22 October 1997
V Encuentro Nacional Mecánica Computacinal
Venue: Guimarães, Portugal.
Contact: Conference Secretary, Tel: (35) 1 53 510 2000

24 - 25 October 1997
NSCM X - 10th Nordic Seminar on Computational Mechanics
Venue: Tallinn, Estonia.
Contact: Prof. J. Metsaveer, Tel: (37) 2 6 202 551 Fax: (37) 2 6 202 550 or 020, Email: jmetsa@edu.ttu.ee

2 - 7 November 1997
IX International Conference of the International Association for Computer Methods and Advances in Geomechanics
Venue: Wuhan, China.
Contact: Prof. J. Yuan, The Chinese Academy of Science. Tel: (86) 27 - 788 1776

5 - 8 January 1998
FEMIF '98 - 10th International Conference on Finite Elements in Fluids
An IACM Special Interest Conference
Venue: University of Arizona, Tuscon, U.S.A..
Contact: Prof. R. Gallagher. Tel: (1) 315 - 268 6444, Email: dick5762@aol.com

12 - 15 January 1998
SACAM '98 - Second South African Conference on Applied Mechanics
Venue: University of Cape Town, South Africa.
Contact: Prof.B.D. Reddy. Tel: (27) 21 650 2332, Fax: (27) 21 685 2281, Email: sacam98@engfac.uct.ac.za

31 March - 3 April 1998
EURO-C 1998 - Computational Modelling of Concrete Structures
Venue: Hotel Salzburger hod, Badgastein, Austria.
Contact: Prof. N. Bicanic. Tel: (44) 141 330 5200, Fax: (44) 141 330 4557, Email: n.bicanic@civil.gla.ac.uk

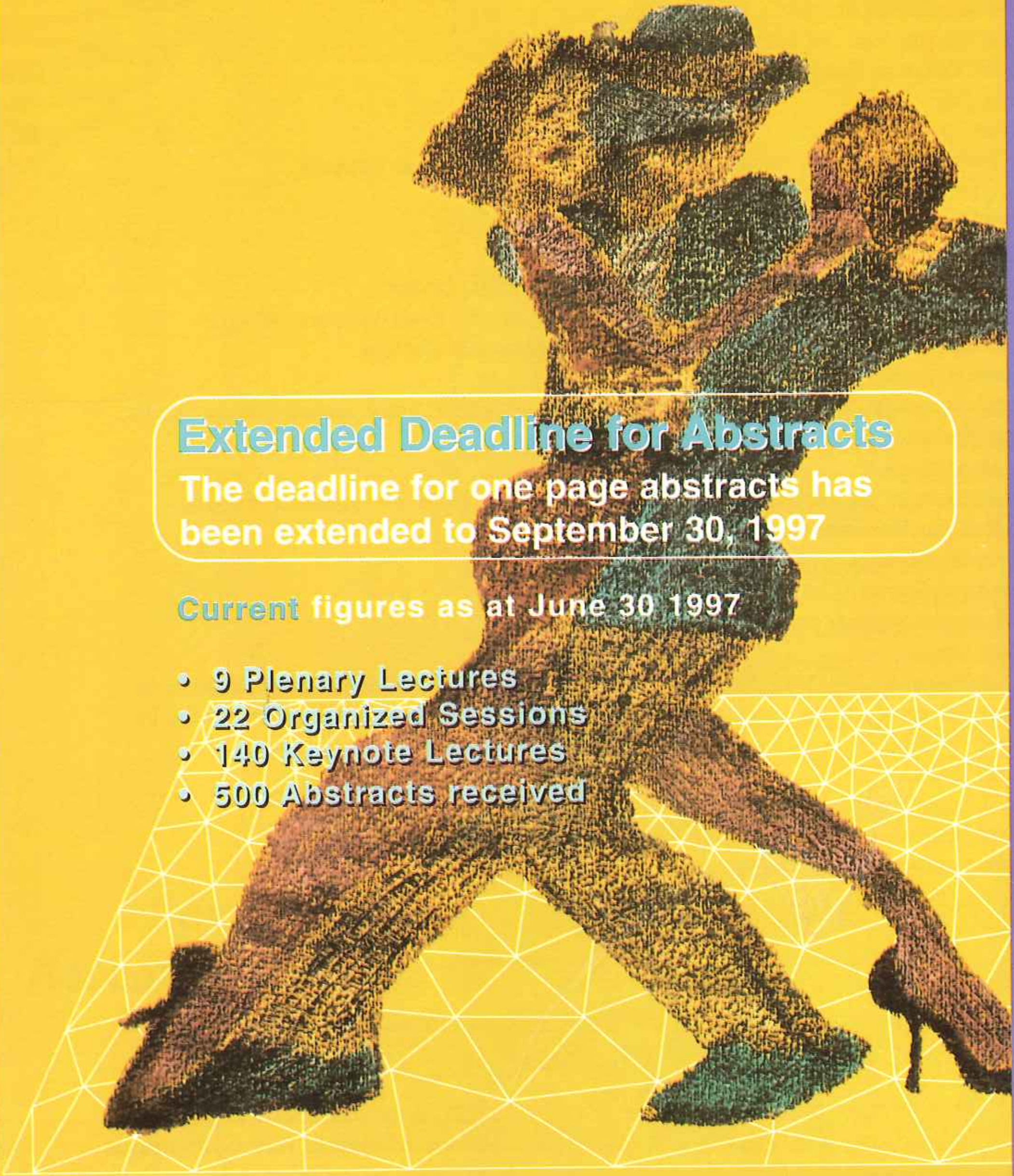
22 - 25 June 1998
NUMIFORM '98 - The 6th International Conference on Numerical Methods in Industrial Forming Processes
An IACM Special Interest Conference
Venue: Department of Mechanical Engineering, University of Twente, Enschede, The Netherlands.
Contact: Prof. H. Huétink. Tel: (31) 53 489 2576, Email: J.Huetink@wb.utwente.nl

29 June - 2 July 1998
IACM - Fourth World Congress on Computational Mechanics
Venue: Buenos Aires, Argentina.
Contact: IACM Secretariat. Tel: (34) 3 401 6036. Fax: (34) 3 - 401 6517, Email: iacm@etseccpb.upc.es

31 August - 3 September 1999
ECCM '99 - European Conference on Computational Mechanics
Solids, Structures and Coupled Problems
Venue: Munich, Germany
Contact: Prof. W. Wunderlich Tel: (49) 89 - 289 224 22, Fax: (49) 89 - 289 224 21

2000
ECCOMAS 2000
Venue: Barcelona, Spain
Contact: Barbara Schmitt, Tel: (34) 3 - 401 6037, Fax: (34) 3 - 401 6517, Email: semni@etseccpb.upc.es

Fourth World Congress on Computational Mechanics



Extended Deadline for Abstracts

The deadline for one page abstracts has been extended to September 30, 1997

Current figures as at June 30 1997

- 9 Plenary Lectures
- 22 Organized Sessions
- 140 Keynote Lectures
- 500 Abstracts received

For further information contact:

Spanish Association for Numerical Methods in Engineering (SEMNI)

Edificio C-1
Campus Norte UPC
Gran Capitan s/n
08034, Barcelona
Spain
Tel: (34) 3 - 205 70 16
Fax: (34) 3 - 401 65 17
Email: iacm@etseccpb.upc.es

Argentina Association for Computational Mechanics (AMCA)

Güemes 3450
3000 Sante Fe
Argentina
Tel: (54) 42 - 55 66 73
Fax:: (54) 42 - 55 09 44
Email: rngtm@arcride.edu.ar
HTTP://cimne.upc.es/cimne/congring.htn

International Association for Computational Mechanics

IACM Secretariat
Edificio C1
Campus Norte UPC
Gran Capitán s/n
08034 Barcelona
Spain
Tel: (34) 3 - 401 7441
Fax: (34) 3 - 401 6517
Email: iacm@etseccpb.upc.es