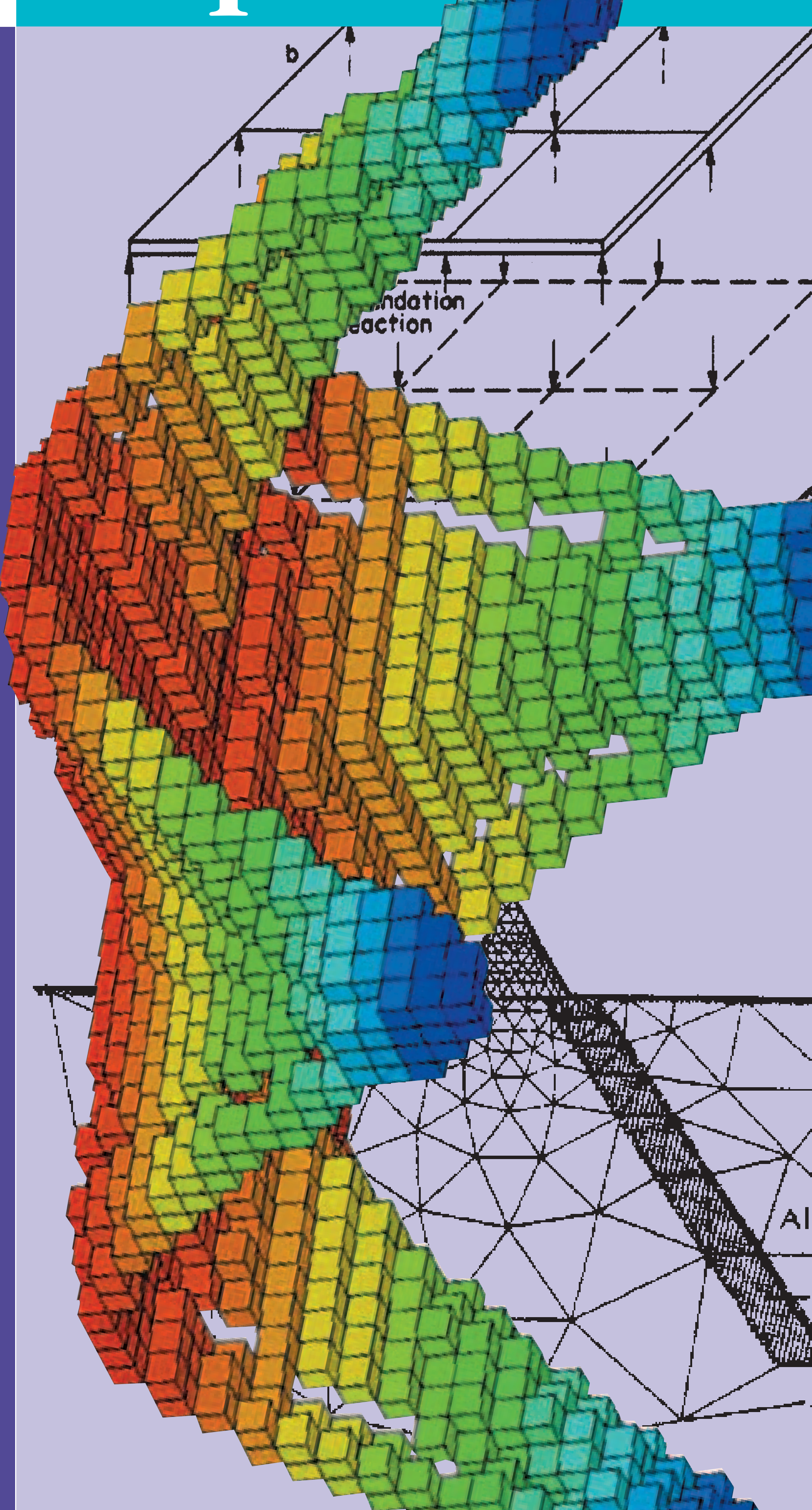
iacm **expressions**



Bulletin for
The International Association for Computational Mechanics

Nº 18
October 2005

IACM Executive Council

President: **E.Oñate** Spain
Past Presidents: **T.J.R. Hughes** U.S.A, **J.T. Oden** U.S.A., **A. Samuelsson**† Sweden, **O.C. Zienkiewicz** U.K.
Vice President (Americas): **T. Belytschko** U.S.A
Vice President (Asia-Australia): **S. Valliappan** Australia
Vice President (Europe-Africa): **H. Mang** Austria
Secretary General: **S. Idelsohn** Argentina
Members: **A. Jameson** U.S.A., **M. Kleiber** Poland, **W.K. Liu** U.S.A., **J. Periaux** France, **B. Schrefler** Italy, **G. Yagawa** Japan, **M.W. Yuan** China
Corresponding Members: **E.R. Arantes e Oliveira** Portugal, **C.K. Choi** Korea, **R. Ohayon** France, **R. Owen** U.K., **M. Papadrakakis** Greece, **E. Ramm** Germany, **T. Tezduyar** U.S.A.
Honorary Members: **Y.K. Cheung**, China, **R. Dautray** France, **T. Kawai** Japan, **E. Stein** Germany, **W. Wunderlich** Germany, **W. Zhong** China

IACM General Council

O. Allix France
T. Arakawa Japan
D. Aubry France
G. Ayala-Milian Mexico
I. Babuska U.S.A.
G. Baker Australia
P. Bar-Yoseph Israel
F. Basombrio Argentina
K. J. Bathe U.S.A.
J-L. Batoz France
T. Belytschko U.S.A.
P. Bergan Norway
T. Bickel U.S.A.
M. Borri Italy
T. Burczynski Poland
M. Casteleiro Spain
M. Morandi Cecchi Italy
M. Cerrolaza Venezuela
J. S. Chen U.S.A.
C. K. Choi Korea
J. Crempien-Laborie Chile
E. de Arantes e Oliveira Portugal
R. de Borst Netherlands
L. Demkowicz Poland
M. Doblaré Spain
E. Dvorkin Argentina
G. Etse Argentina
R. Ewing U.S.A.
C. Farhat U.S.A.
C. Felippa U.S.A.
J. Fish U.S.A.
J. Flaherty U.S.A.
K. Fuji Japan
M. Geradin Belgium
M. Gilchrist Ireland
D. Givoli Israel
J. M. Goicolea Spain
I. Herrera Mexico
R. Himeno Japan
A. Huerta Spain
T. Hughes U.S.A.
G. Hulbert U.S.A.
S. Idelsohn Argentina
K. Ishii Japan
C. Johnson Sweden
T. Kanok-Nukulchai Thailand
K. Kashiyama Japan
J. T. Katsikadelis Greece
M. Kawahara Japan
M. Kleiber Poland
V. Kompis Slovakia
P. Ladevèze France
G. R. Liu Singapore
W. K. Liu U.S.A.
P. Lyra Brasil
H. Mang Austria
K. Morgan U.K.
C. Mota Soares Portugal
K. Nakahashi Japan
Y. Nakasone Japan
H. Nogushi Japan
A. Noor U.S.A.
J. T. Oden U.S.A.
R. Ohayon France
Y. Ohnishi Japan
E. Oñate Spain
J. Orkisz Poland
R. Owen U.K.
M. Papadrakakis Greece
U. Perego Italy
E. Ramm Germany
E. Rank Germany
B. D. Reddy S. Africa
J. N. Reddy U.S.A.
E. Sacco Italy
K. Sato Japan
B. Schrefler Italy
M. Shephard U.S.A.
P. Steinmann Germany
B. Szabo U.S.A.
H. Takeda Japan
N. Takeuchi Japan
T. Taniguchi Japan
R. Taylor U.S.A.
J. A. Teixeira de Freitas Portugal
T. Tezduyar U.S.A.
A. Tezuka Japan
S. Valliappan Australia
N. Vrankovic Croatia
W. Wall Germany
T. Watanabe Japan
J. Whiteman U.K.
N.-E. Wiberg Sweden
B. Wohlmuth Germany
P. Wriggers Germany
T. Yabe Japan
G. Yagawa Japan
S. Yoshimura Japan
S-K. Youn Korea
M. Yuan China
K. Yuge Japan
H. Zhang China
Y. Zheng China

Honorary Members:

E. Alarcon Spain, **J. F. Besseling** Netherlands, **R. Dautray** France, **C.S. Desai** U.S.A., **S.J. Fenves** U.S.A., **R. Glowinski** U.S.A. **P.K. Larsen** Norway, **A.R. Mitchell** U.K. , **J. Périaux** France, **T.H.H. Pian** U.S.A. , **O. Pironneau** France, **K.S. Pister** U.S.A. , **L.-X. Qian** P. R. China **G. Strang** U.S.A. , **C.W. Towbridge** U. K. , **E.L. Wilson** U.S.A. , **Y. Yamada** Japan , **Y. Yamamoto** Japan , **W. Zhong** China, **O. C. Zienkiewicz** U.K.

IACM Affiliated Organisations

Listed in order of affiliation

U.S.A.	**U.S. Association for Computational Mechanics (USACM)**
Argentina	**Asociacion Argentina de Mecanica Computacional (AMCA)**
PR China	**The Chinese Association of Computational Mechanics**
Italy	**Gruppo Italiano di Meccanica Computazionale (GIMC)**
Denmark, Estonia, Finland, Iceland, Latvia, Lithuania, Norway, Sweden	**The Nordic Association for Computational Mechanics (NoACM)**
Japan	**The Japan Society for Computational Engineering and Science (JSCES)**
Spain	**Sociedad Española de Métodos Numéricos en Ingeniería (SEMNI)**
Germany	**German Association of Computational Mechanics (GACM)**
France	**Computational Structural Mechanics Association (CSMA)**
U.K.	**Association for Computer Methods in Engineering (ACME)**
Greece	**The Greek Association of Computational Mechanics (GRACM)**
Austria, Croatia, Hungary, Poland, Slovenia, The Czech Republic, Slovakia	**The Central-European Association for Computational Mechanics (CEACM)**
Poland	**Polish Association for Computational Mechanics**
Bulgaria	**The Bulgarian Association of Computational Mechanics (BACM)**
Chile	**Asociacion Chilene de Mecanica Computacional (SCMA)**
Israel	**The Israel Association of Computational Methods in Mechanics (IACMM)**
Portugal	**The Portuguese Society of Theoretical, Applied and Computational Mechanics**
Australia	**Australian Association of Computational Mechanics**
S. Africa	**South African Association for Theoretical and Applied Mechanics (SAAM)**
Turkey	**Turkish Committee on Computational Mechanics**
Brazil	**Brazillian Association for Computational Methods in Engineering (ABMEC)**
Venezuela	**Sociedad Venezolana de Métodos Numéricos en Ingeníera**
Romania	**Romanian Association for Computational Mechanics**
Mexico	**Sociedad Mexicana de Métodos Numéricos en Ingeniería**
Ireland	**Irish Society of Scientific and Engineering Computations (ISSEC)**
Korea	**Korean Association on Computational Mechanics (KACM)**
Thailand	**Thailand Society for Computational Mechanics (TSCM)**
Singapore	**Association for Computational Mechanics, Singapore (SACM)**
India	**Indian Association for Computational Mechanics**
Japan	**Japanese Association for Computational Mechanics (JACM)**
Netherlands	**Netherlands Mechanics Committee (NMC)**
Malaysia	**Malaysian Association for Computational Mechanics (MACM)**

IACM Membership

Fee

The annual fee for direct individual membership of IACM is 25 US dollars.
For affiliated organisations the membership fee is reduced to 10 dollars for the first fifty members, 7 dollars for the next one hundred and fifty members and 5 dollars for any member exceeding two hundred. The Bulletin and a discount on IACM supported activities (congress, seminars, etc.) are some of the benefits of the membership. For further details contact IACM Secretariat.

IACM Expressions

Published by
The International Association for Computational Mechanics (IACM)

Editorial Address
IACM Secretariat, Edificio C1, Campus Norte UPC, Gran Capitán s/n, 08034 Barcelona, Spain. Tel: (34) 93 - 401 7441, Fax: (34) 93 - 401 6517,
Email: iacm@cimne.upc.edu ***Web***: www.iacm.info

IACM members are invited to send their contributions to the editors. Views expressed in the contributed articles are not necessarily those of the IACM.

contents

editorial

The role of computational mechanics in problems related with the integrity of infrastructures and safety of people is increasing dramatically. Computational methods have been traditionally used as necessary tools for the better design of products and processes understood in the broad sense. Here “products” include for instance buildings, dams, vehicles, ships, airplanes, as well as all the more classical outcomes of industry. Processes, on the other hand, encompass all the manufacturing and construction activities, among others.

The modern concept of “design for life” introduces the need to assess the durability of a product under service conditions (i.e. loads, environment, etc.). A durable product is in many cases essential to preserve the security of human beings. Accurate prediction of product life can not be however detached from a detailed study of the manufacturing and maintenance phases. For example, the life of a casted part strongly depends on the residual stresses and the material defects induced during the casting manufacturing process.

The novelty in recent times are the circumstances under which product life is to be considered. The increased probability of hazards (both of natural and human-induced types) has introduced the urgent necessity of studying the integrity of “products” under a diversity of risk conditions.

The study of an oil tank ship in a rough sea, the failure analysis of a landscape , a highway or a building area under a severe earthquake, a tornado or a tsunami and the assesment of fire on forests and rural environments are just a few examples of problems which unfortunately are becoming a common reality in our times. Not to mention the study of the impact of human-induced endangers on our everyday life, the importance of which needs not to be stressed here.

Many consultancy firms are deeply involved in the so called forensic-type engineering activities. This requires the use of advanced quantitative models to reproduce fortuitous events in an effort to assess and explain the reasons, effects and actions to be taken.

Strange as it may seem, computational mechanics can play an important role in the prediction and analysis of hazards of all kinds. Some examples are presented in articles of this issue of Expressions, and surely publications in this field will be more frequent in the near future. Indeed we should invest our best efforts to contribute with new ideas and computational methods in order to diminish the risk and effects of hazards in our communities.

A change of subject. The date of 7th World Conference on Computational Mechanics to be held in the city of Los Angeles (USA) on 16-22 July 2006 is approaching fast. Over 150 organised minisymposia are already scheduled. Please put WCCM 2006 in your agenda.

I am also pleased to inform you that in 2006, we plan to celebrate the 25th anniversary of the IACM. Time flies.

Eugenio Oñate
IACM President

Moving Particle Semi-Implicit (MPS) Method
- A Particle Method for Fluid and Solid Dynamics -

by
Seiichi Koshizuka
The University of Tokyo
Japan

Abstract

Particle methods draw the attention for their advantages of Lagrangian and meshless formulation. Large motion of free surfaces is tracked without numerical diffusion. Fluid disintegration and merging can be analyzed without mesh tangling. The particle methods are also fitted to large deformation and fracture of solid materials. Moving Particle Semi-implicit (MPS) method is one of the particle methods. Particle interaction models are prepared with respect to differential operators. Governing equations are discretized to particle dynamics by substituting the particle interaction models. Calculation examples for ship engineering, micro flow and solid dynamics are provided.

Introduction

Computational fluid dynamics (CFD) using particles was studied in the Los Alamos National Laboratory in parallel with mesh methods in 60's [1]. However, mesh methods, such as the finite volume and finite element methods, are widely used now. Plenty of commercial codes have been developed and applied to practical problems in industry.

Practical problems are often represented by multi-physics involving fluid dynamics, heat transfer, mass transfer, interaction with structure, chemical reaction, etc. We need to analyze large motion of interfaces. If the mesh is moved to follow the interface, mesh distortion breaks down the calculation. If a quantity representing the fluid fraction is distributed on a fixed mesh, numerical diffusion makes the interfaces unclear. These difficulties are essentially attributed to the mesh. Particle methods are free from these difficulties; mesh distortion never occurs as well as numerical diffusion disappears because of fully Lagrangian description.

"...MPS formulation for elastic analysis satisfies the principle of virtual work, and total energy conservation is achieved by employing an explicit symplectic scheme as the time integration."

Smoothed Particle Hydrodynamics (SPH) was proposed for compressible fluid dynamics [2]. SPH has mainly been used in astrophysics. Moving Particle Semi-implicit (MPS) method was developed for incompressible fluid dynamics [3]. A semi-implicit algorithm is used to incorporate the incompressibility constraint. The MPS method has been applied to free surface flows and multi-physics problems: for example, wave breaking [4], sloshing [5], shipping water [6], micro flow [7] and solid dynamics [8].

MPS method

The point of particle methods or meshless methods is to discretize continuous media without the mesh. In the MPS method, particle interaction models are prepared with respect to differential operators such as gradient, divergence, and Laplacian. For example, gradient is simply defined between two neighboring particles. At the particle position, the gradient operator is represented by the weighted average among the combinations with the neighboring particles. The neighbor is limited by the weight function to reduce the computation time. If we substitute the particle interaction models for differential operators in the governing equations, then we will have discretized equations for numerical analysis.

The fluid density is proportional to a particle number density. Incompressibility is expressed by the particle number density being constant. This condition is implicitly combined with the pressure gradient term in the momentum conservation equation, and then we have a Poisson equation of pressure of which the source term is represented by the particle number density.

The wall boundary is represented by fixed particles. Free surfaces are recognized by the decrease of the particle number density because there are no particles outside the free surfaces. We do not need to draw the contour of the free surfaces. Fluid fragmentation as well as large deformation of the free surfaces can be analyzed with this simple boundary condition.

Solidification and melting are modeled by immobilizing and re-mobilizing the particles, respectively. The immobilized particles behave as the wall particles. Thus, transition of the flow channel geometry is considered by this simple model. The surface tension model is based on the distribution of neighboring fluid particles. We do not need to draw the contour of the interface.

When elastic solids are analyzed, the degrees of freedom of rotating motion are added to each particle. Deformation is obtained by subtracting the rigid rotating motion from the relative displacement. Strain and stress components are evaluated between two neighboring particles. It is shown that the MPS formulation for elastic analysis satisfies the principle of virtual work, and total energy conservation is achieved by employing an explicit symplectic scheme as the time integration.

Application examples

Shipping water

When ships are navigating in heavy seas, the water level exceeds the bow height and water rushes on the deck to damage the equipment. This phenomenon is called shipping water. Ships may sink if hatch covers on the deck are broken and water enters into the cargo holds. Shipping water has mainly been studied by experiments. Simple mathematical models have been used to estimate the load on the deck. Numerical analysis is preferable but it is difficult because the free surface is extremely deformed.

The MPS method is used to analyze the shipping water [6]. The calculation condition is the same as the experiment which was carried out by Tanizawa et al. [9]. A semicircle step is located in a two-dimensional wave tank where regular waves are generated. In the calculation, one linear wave is generated in front of the step in the initial condition to save the memory. The total number of particles is 367,038. The calculation result is shown in *Figure 1*. The wave impinges on the step and water rushes up on the step from the semicircle edge. Water is focused on the center of the semicircle.

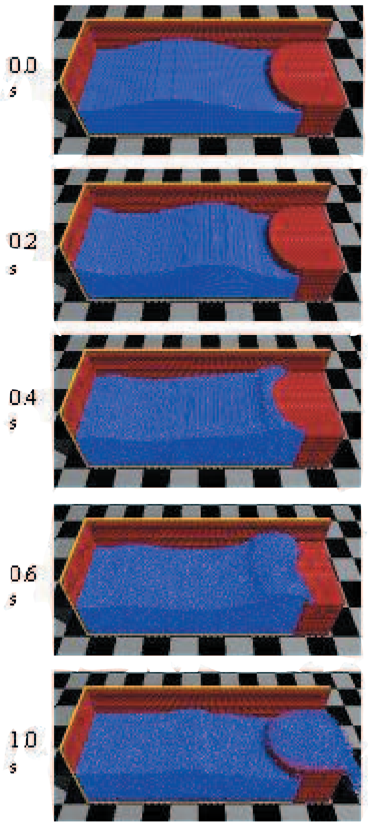


Figure 1:
Shipping water behavior on a semicircle step

The focusing was also found in the experiment. It is shown that three-dimensional behaviour of shipping water is simulated by the MPS method.

Figure 2 shows the comparison of the time integration of the deck pressure at the center of the semicircle step. The agreement is good though the slope is a little lower in the calculation. The time integration of pressure is important information for the structural design of the hatch covers.

Figure 2:
Time integration of pressure at the center of the semicircle step.

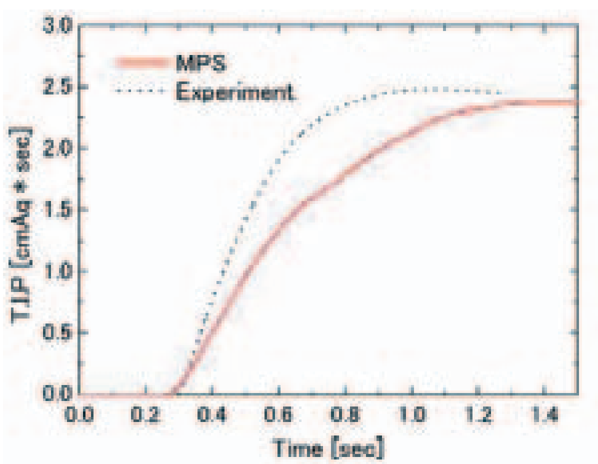


Figure 3:
Photo-realistic computer graphics of shipping water.

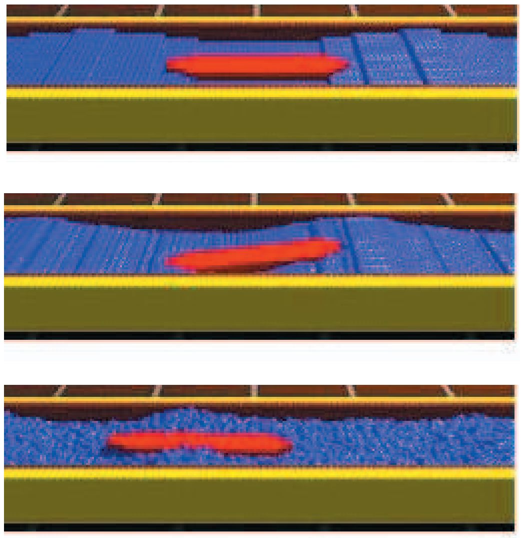
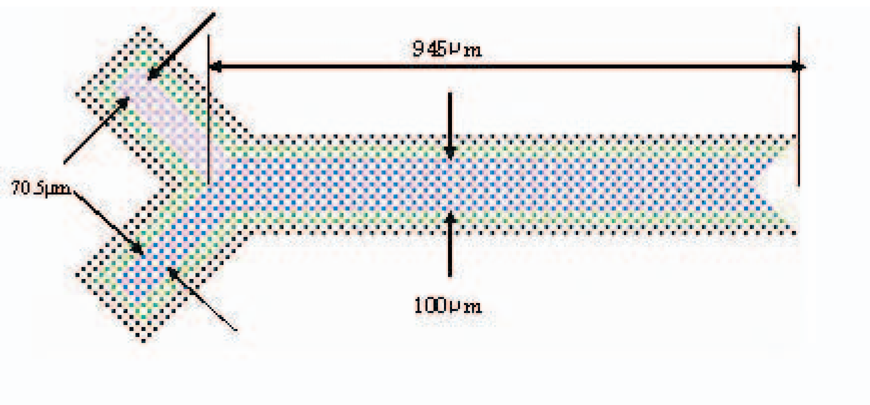


Figure 4:
Interaction between a ship and waves.

Photo-realistic pictures are made from the calculation result *(figure.3)*. Water is drawn as a transparent material and ray tracing is performed on the free surface. We are developing a technique to draw photo-realistic pictures by computer graphics based on the particle simulation. This technique is useful for ship handing simulators. Stormy sea can be drawn if the MPS method is used in the simulators.

Three-dimensional motion of a rigid body is non-linear, so that perturbation theory, which has been used for the ship motion model, cannot be used for large motion. The ship motion is modeled by quaternion and Euler equations to use in the MPS method. Interaction between ships and waves is calculated by this ship motion model and the MPS method as shown in *figure 4*. We can see large-amplitude pitching motion in the figure.

Figure 5:
Micro channel for micro droplet generation.



Micro flow

Micro Total Analysis System (μTAS) is based on micro-device technologies. Micro-scale pumps, valves, channels, etc. are combined to realize a chemical plant on a chip. Various applications to biological processes are being studied as well. Micro flow has specific characteristics which are different from macro-scale fluid dynamics: relatively large viscosity, surface tension and electric force. Interaction with structure is often necessary to consider. We need to analyze such multi-physics in micro flow. Since the MPS method is useful for multi-phase flow and fluid-structure interaction with large deformation of interfaces, it is expected to apply to micro flow [7].

Micro-scale droplets are generated by a simple connection of two channels. Water and organic fluids are supplied from different inlets. The calculation geometry is shown in *figure 5*. The organic solvent is butyl acetate. The calculation is two-dimensional. New particles are generated at the inlets and the outside particles are removed at the outlet. In this calculation, surface tension is so large to determine the stable time step. Thus, the surface tension term is calculated separately with a smaller time step.

Figure 6 shows one case of water flow V_0 = 0.008333m/s and organic flow V_w = 0.005000m/s. The same size droplets are generated sequentially at the junction. The calculated droplet size, pitch and frequency agree well with the experimental data [10].

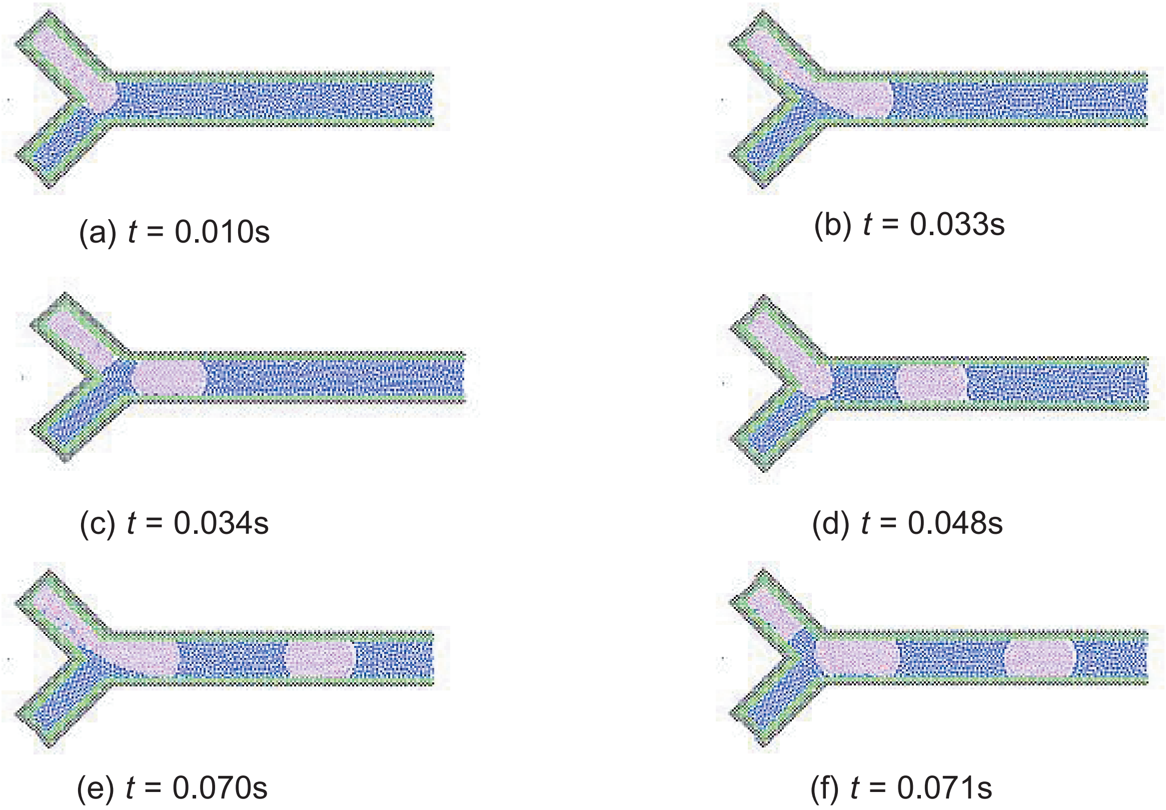


Figure 6:
Two-dimensional calculation of micro droplet generation (V_0=0.008333m/s, V_w=0.005000m/s).

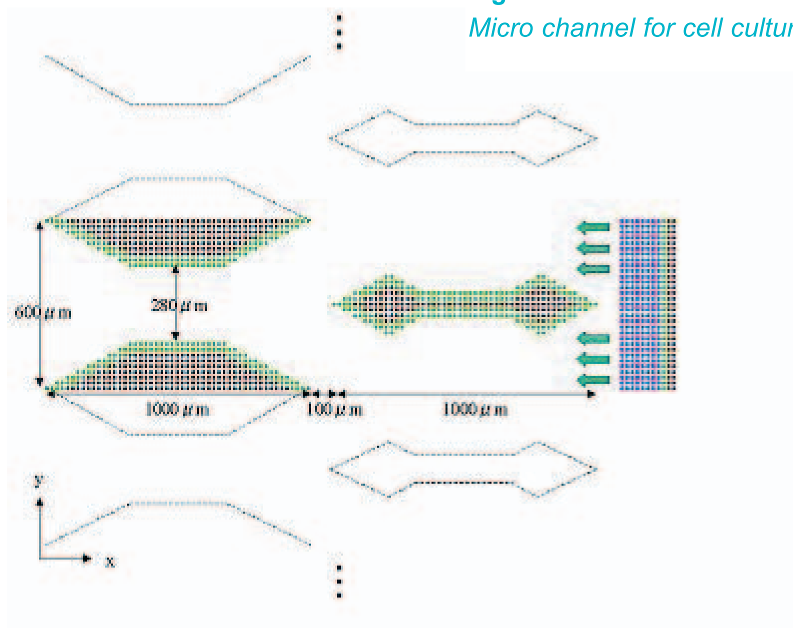
Micro channels are expected for cell culture. A part of such a micro channel for liver cell culture is calculated by the MPS method (*figure 7*). Cell adhesion and detachment are modeled by immobilizing and re-mobilizing particles, respectively. In this model, the fluid particles of which the velocity is below a critical value are fixed. The flow channel geometry is changed by the fixed fluid particles.

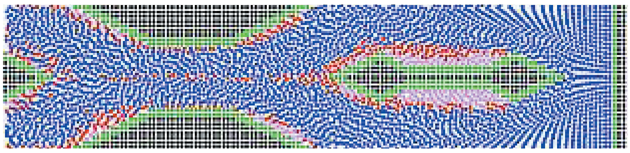
Figure 8 shows the calculation result. When the adhesion is weak *(figure 8 (a))*, the cells are fixed where the flow is stagnant. When the adhesion is strong *(figure 8 (b))*, the flow channel is blocked by the immobilized particles. In the experiment [11, 12], the cell aggregation occurred at the same position as the calculation.

Solid dynamics
Structural analysis is carried out by using the MPS method [8]. *Figure 9* shows the large deformation of jelly. Photographs were taken by a high speed video camera *(figure 9 (a))*. Two-dimensional elastic analysis with Young's modulus of 105 Pa and density of 103 kg/m3 is shown in *figure 9 (b)*. Photo-realistic computer graphics is shown in *figure 9 (c)*. We can see good agreement between the calculation result and the photographs.

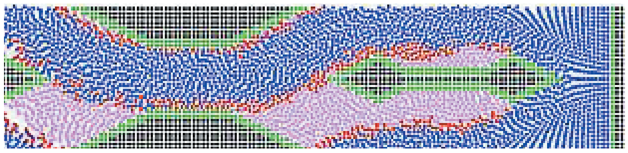
Muscle contraction is simulated in three dimensions *(figure 10).* The constitutive equation of the muscle is nonlinear and nonuniform [13]. We can see the muscle motion is well represented by the MPS method.

Figure 7:
Micro channel for cell culture





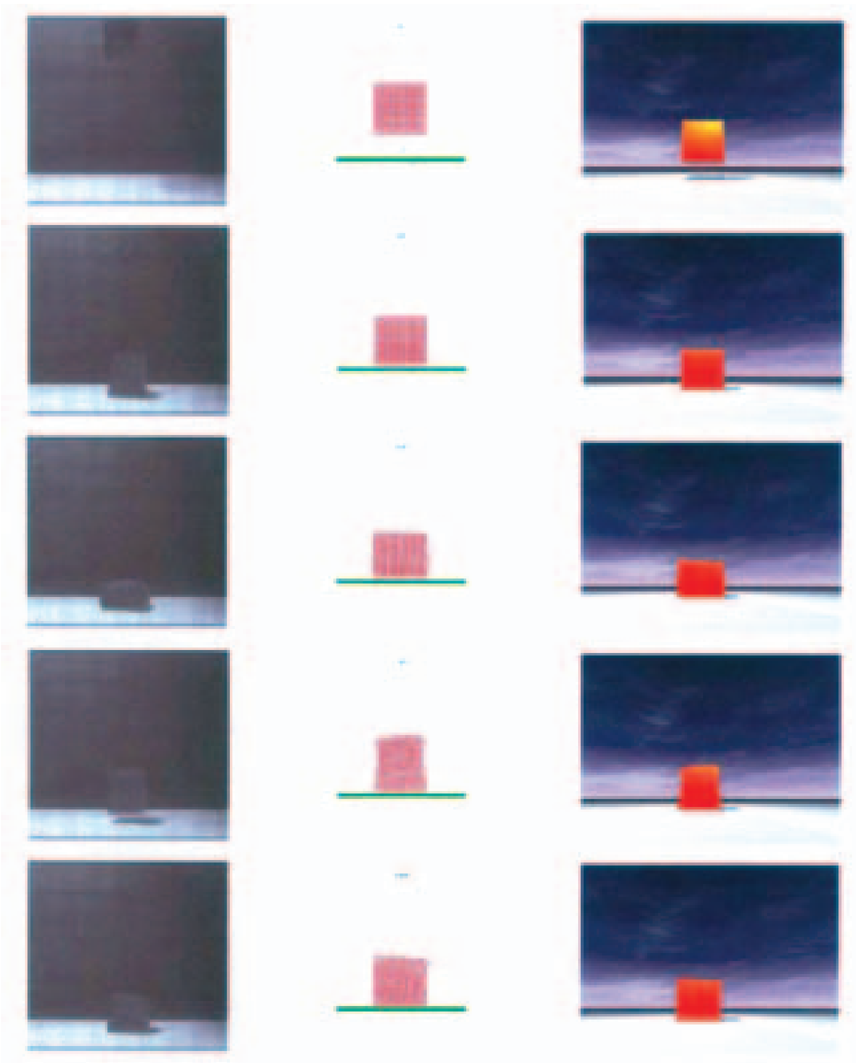
(a) *weak adhesion*



(b) *strong adhesion*

Figure 8:
Cell adhesion and channel blockage (pink: immobilized particles, red: re-mobilized particles).

Figure 9:
Large deformation of jelly as a soft elastic material ($E=10^5$ Pa, $\rho=10^3$ kg/m^3).



(a) *photographs* (b) *simulation* (c) *computer graphics*

The MPS method is fitted to biological materials which are relatively softer and more fragile than the conventional materials for buildings, bridges, ships, etc. Besides, it is also expected to apply to fluid-structure interaction which appears in biological problems: blood flow with blood vessel deformation, red blood cell deformation in the blood vessel, virtual surgery, etc.

Concluding Remarks

The MPS method is one of the particle methods which can be used for both fluid and solid dynamics. The MPS method is useful in large deformation of interfaces because of Lagrangian and meshless formulation. In this article, application examples are provided. Shipping water behaviour on the ship deck is analyzed and compared with the experimental data. Complex motion of the free surface is successfully calculated. Interaction between a ship and waves is also modeled by particles. In micro flows, the MPS method is applied to a micro droplet generation process and cell culture in micro channels. Structural analyses of soft materials are carried out. Large deformations of jelly and muscle are shown. The MPS method is fitted to biological problems involving soft and fragile materials.

References:

[1] **Harlow, F. H.**, *PIC and Its Progeny*, Comput. Phys. Comm. 48; 1-10, (1988).

[2] **Lucy, L. B.**, *A Numerical Approach to the Testing of the Fission Hypothesis*, Astronomical J. 82, 1013-1024 (1977).

[3] **Koshizuka, S. and Oka, Y.**, *Moving-Particle Semi-implicit Method for Fragmentation of Incompressible Fluid*, Nucl. Sci. Eng. 123, 421-434 (1996).

[4] **Koshizuka, S., Nobe, A. and Oka Y.**, *Numerical Analysis of Breaking Waves Using the Moving Particle Semi-implicit Method*, Int. J. Numer. Meth. Fluids 26, 751-769 (1998).

[5] **Chikazawa, T., Koshizuka, S. and Oka, Y.**, *Numerical Analysis of Sloshing with Large Deformation of Elastic Walls and Free Surfaces Using MPS Method*, Trans. Japan Soc. Mechanical Engineers (B) 65, 2954-2960 (1999).

[6] **Shibata, K., Koshizuka, S., Oka, Y. and Tanizawa, K.**, *A Three-dimensional Numerical Analysis Code for Shipping Water on Deck Using a Particle Method*, Proc. 2004 ASME Heat Transfer/Fluid Engineering Summer Conf., Charlotte, July 11-15, 2004, HT-FED04-56477

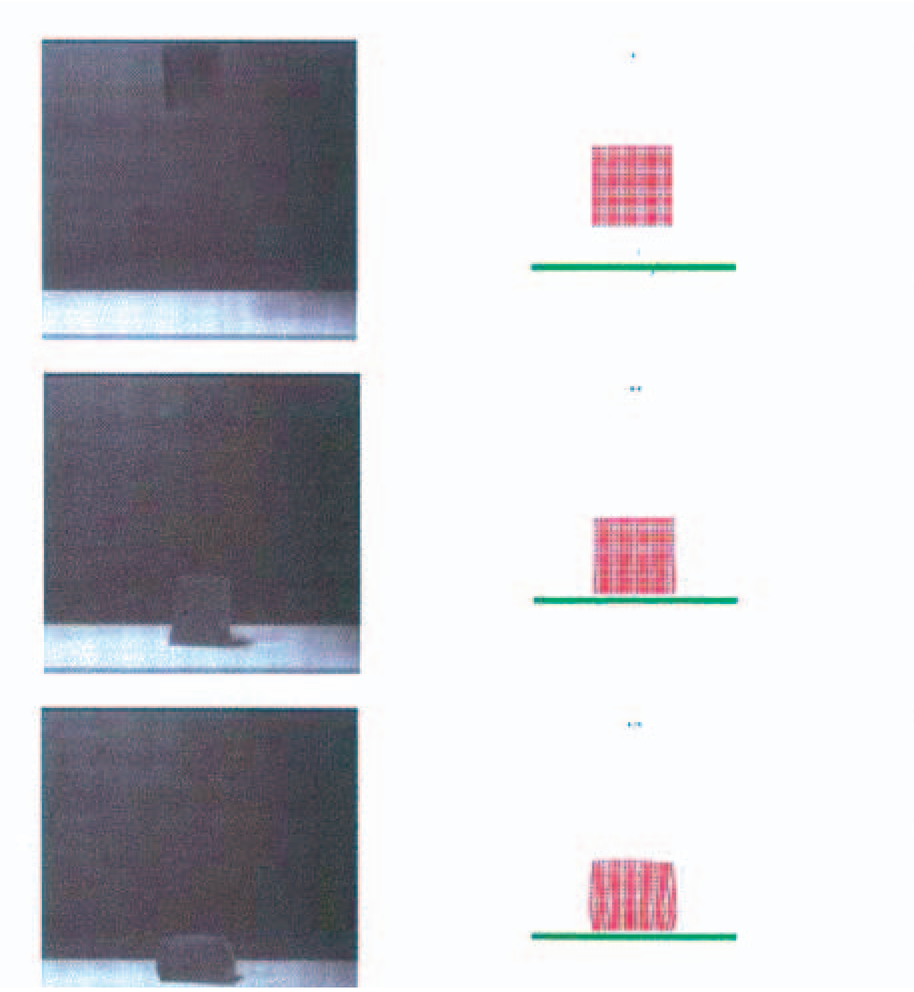


Figure 10:
Particle simulation of muscle contraction

[7] **Koshizuka, S., Suzuki, Y., Koishikawa, M. and Sato, T.**, *Development of a Multi-physics Simulator for Micro-flow Analysis using a Particle Method*, J. Soc. Chemistry and Micro-Nano Systems 3, 8-12 (2004).

[8] **Koshizuka, S., Song, M. S., and Oka, Y.**, *A Particle Method for Three-dimensional Elastic Analysis*, Proc. 6th World Cong. Computational Mechanics (WCCM VI), Beijing, September 5-10, 2004.

[9] **Tanizawa, K., Sawada, H., Tsujimoto, M. and Koshizuka, S.**, *Experimental and Numerical Study of Shipping Water Impact on Running Ship Foredeck in Regular Head Sea*, Hydrodynamics VI - Theory and Applications, Proc. 6th Int. Conf. on Hydrodynamics, Perth, November 24-26, 2004, p.125-134.

[10] **Go, J.S., Jeong, E.H., Kim, K.C., Yoon, S.Y. and Shoji, S.**, *In-plane digital sorting of flow-through droplet phase microfluids*, Proc. 7th Int. Conf. Miniaturized Chemical and Biological Analysis Systems, Squaw Valley, October 5-9, 2003, p.1275-1278.

[11] **Leclerc, E., Sakai, Y. and Fujii, T.**, *Three-dimensional PDMS microstructure for 3T3-L1 fibroblast and HEP G2 cells perfusion culture*, Micro Total Analysis Systems 2002, 2, 826-828 (2002).

[12] **Leclerc, E., Sakai, Y. and Fujii, T.**, *Cell culture in 3-dimensioal microfluidic structure of PDMS (polydimethylsiloxane)*, Biomedical Microdevices 5:2, 109-114 (2003).

[13] **Teran, J., Blemker, S., Hing, Ng Thow Hing, V. and Fedkiw, R.**, *Finite Volume Methods for the Simulation of Skeletal Muscle, Eurographics/SIGGRAPH Symposium on Computer Animation* (2003).

"... MPS method is fitted to biological materials which are relatively softer and more fragile than the conventional materials for buildings, bridges, ships, etc."

Computational Mechanics and Security

by
Rainald Löhner
School of Computational Science and Informatics
George Mason University
Fairfax
U.S.A.

The longing for security is an intrinsically human desire. Faced with an uncertain, chaotic world (the fact that chaos and life are intimately linked was one of the great discoveries of the 20th century), we have tried to prevent accidents, prepare for eventualities, and quantify risk. Financial pressures (mass production, leveraging, minimization of fixed costs) and convenience (communication, closeness, the vitality of urban life) have led to centers of production and civilization where accidents or intentional destruction can have devastating effects.

around the world in the last century. The quantification of risk and the design of buildings, facilities or products to offer a minimal amount of security offers a rich field of endeavour for computational mechanics. One should realize from the outset, though, that simulations of this kind will, in most cases, fall outside standard design principles and assumptions. If we consider, as an example, large office buildings or offshore platforms, any design for operating conditions will require the materials to behave elastically. Explosions, tsunamis and freak waves will lead to large plastic deformations, cracking, spalation, and other nonlinear phenomena, all of which may occur under very high strainrates.

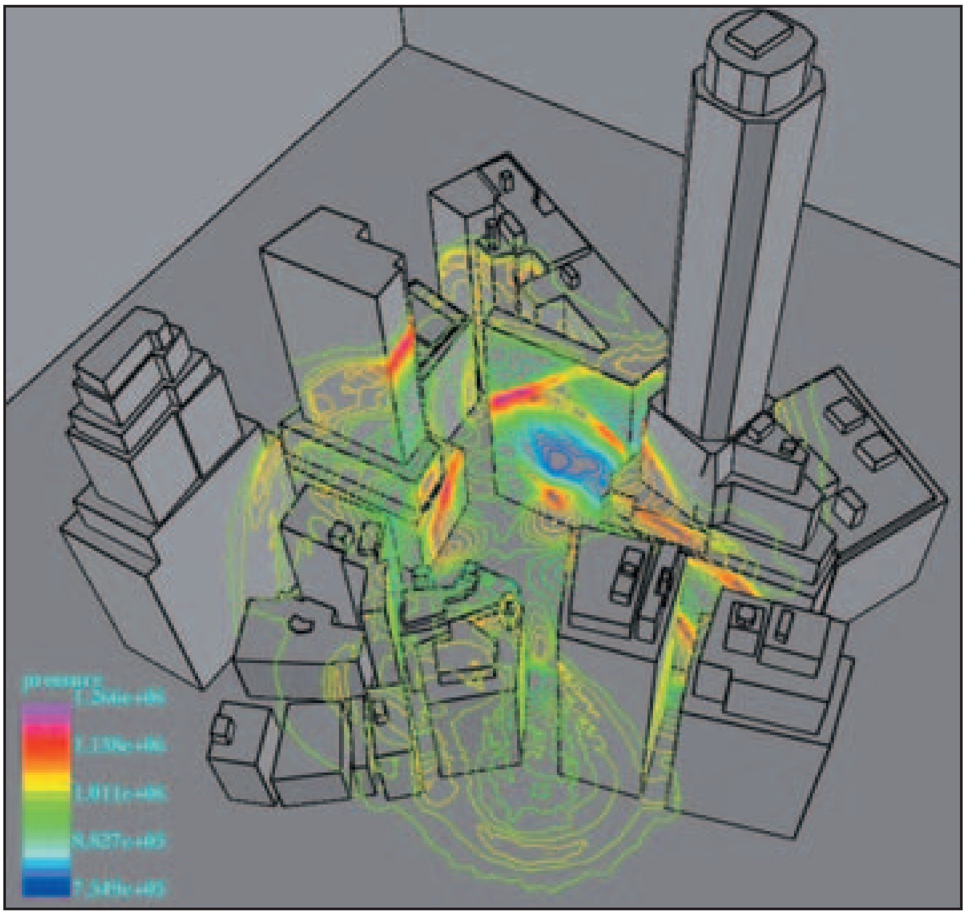


Figure 1: *Blast In Inner City Plaza: This figure shows a typical damage prediction run [4]. The blast was initiated from a 1- D HE run and then interpolated to the 3-D mesh. Window breakage was then assessed from pressure and impulse data obtained. Note the shock diffraction, focusing and shadowing effects typical of the complex geometries encountered in inner city settings.*

Good examples for this tendency are nuclear power plants, refineries, chemical production plants, supertankers, offshore platforms, financial centers, convention centers, stadiums, airports, and the megacities that have appeared

Moreover, the deformations of the structure are typically such that the flowfield is affected by it, thereby changing the loads, implying that a fully coupled simulation is required in most cases.

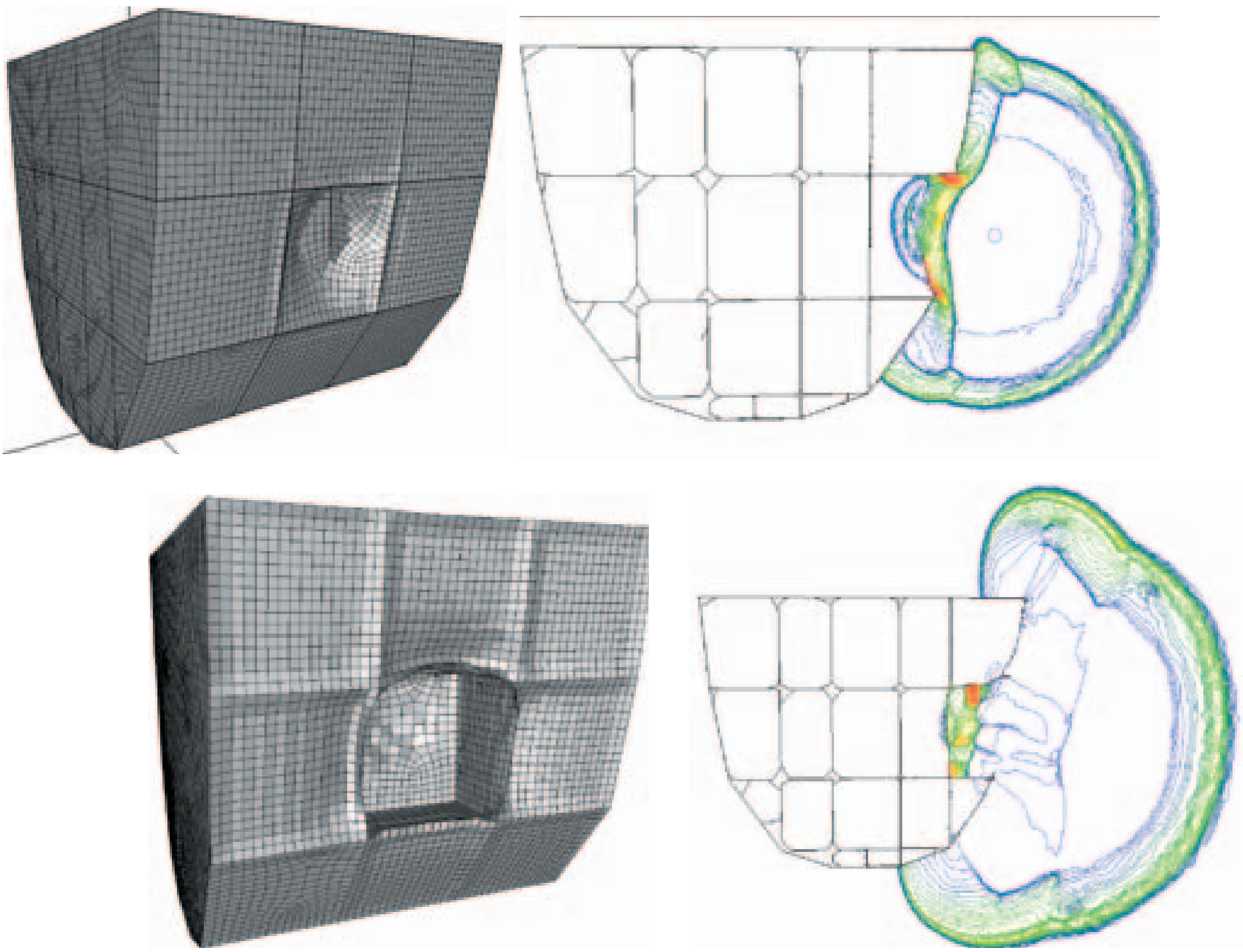
Given the small size of this 'security marked' as compared to the standard 'product development marked', as well as the legal consequences that may ensue if a certified building or product fails, it is not surprising that only a few, highly specialised software packages have been developed, largely under the tutelage of government organizations.

It is fair to state that until a decade ago, most of the runs aimed at quantifying risk under severe conditions were largely based on simple, semi-empirical codes that summarized the findings of lengthy series of experiments.

Enabling technologies that have allowed large-scale, first principle calculations in this field include:

For Pre-Processing: the widespread use of CAD (important for the many details required in highly nonlinear simulations), the use of remote sensing data (e.g. satellite images for civil engineering response simulations [think of a city center]), powerful graphics cards that allow tens of millions of triangles to be displayed in real time [think of a complete airport], and automatic gridding tools that allow high quality meshing in near real-time;

Figure 2:
Blast Interaction With a Generic Ship Hull: For this fully coupled CFD/CSD run [5], the structure was modeled with quadrilateral shell elements, the fluid as a mixture of high explosive and air, and mesh embedding was employed. The structural elements were assumed to fail once the average strain in an element exceeded 60%. As the shell elements failed, the fluid domain underwent topological changes. The figures show the structure as well as the pressure contours in a cut plane at two times during the run. The influence of bulkheads on surface velocity can clearly be discerned. Note also the failure of the structure, and the invasion of high pressure into the chamber.



“Even though considerable advances have been made during the last decade, . . . we have barely started on what is likely to be an arduous road until a comprehensive capability is at hand for the ‘security market’.”

For Fluid Dynamics [think loading of structures], which usually takes 95% of the CPU for typical first-principle, coupled runs: high-order, monotonicity preserving schemes for shocks, detonation modeling, adaptive refinement and parallel computing;

For Structural Mechanics [think response of structures], which usually takes 5% of the CPU for typical first-principle, coupled runs: large deformation FEM formulation, good low-order shell elements, l-point integration and hourglass control, the development of many new material models, fast contact algorithms and parallel computing;

For Post- Processing: powerful graphics cards, distributed visualization that allows geo-graphically separated people to participate in the discussion of results, and the merging of virtual reality and physical models (very important for decision-makers who may not understand a typical surface pressure or stress plot, but easily grasp the effects of an explosion when presented with a charred surface).

Even though considerable advances have been made during the last decade, and many spectacular simulations have been validated against experiments, we have barely started on what is likely to be an arduous road until a comprehensive capability is at hand for the ‘security market. Fertile areas of research that may be envisioned at this point include:

For Pre-Processing: fast, error-free input of very large datasets [think complete oil refinery, offshore platform, airport or financial center with all required details], the simultaneous input from many modalities: CAD, satellite data, field survey, blueprints, etc., fast CAD to mesh (remember that the structural definition requires a high level of details), the possible abstraction of structures, and minimal user input for many (e.g. stochastic) runs;

For Fluid Dynamics: the accurate characterization of high explosives, detonation and ignition (chemistry, stiff source terms, time scales), shock propagation through different phases (gas, liquid, solid, porous media), as well as shock diffraction and focusing for complex geometries;

For Structural Dynamics: the modeling of discontinua such as concrete (FEM, DPM, PFEM 7), accurate prediction of breakage, cracking, spalation (all of which are, in principle, chaotic processes), characterization of glass, characterization of soft, non-standard materials (walls, dividers, etc.) and stochastic analysis of highly nonlinear materials;

For Post-Processing: any post-event collaterals (such as tire, gas, water, electricity, dispersion, etc.), distributed data acquisition and plotting, the reduction of data for decision makers, the seamless transition from data to information to intelligence to decision, as well as the link to data banks.

An important impulse to further research and development in the general area of security may come via legislation. Three examples (of many possible) come to mind here.

The first regards explosions. The current worldwide political climate has led to an increased threat of bombs in open societies. Moreover, the amount of explosives used in large-scale terrorist attacks has increased drastically over the last two decades. This has recently led to new building regulations for a large class of buildings (DoD buildings with more than 30 people on active duty). These regulations specifically consider the mitigation of explosive threats as a certification criterion. While civil engineers always had to consider the loads due to gravity, weather, machinery and occupants, explosive loading was largely ignored.

The second example is that of freak waves. Recent satellite surveys have found that the probability of these monster waves is much higher than previously anticipated. This will, undoubtedly, lead to new building regulations for offshore platforms and ships.

The third example is that of tsunamis. It is surprising that very few, if any, building regulations exist for buildings near coasts that are regularly exposed to tsunamis. On average, the Pacific ocean will witness a major tsunami once a decade, and a devastating tsunami once a century. It is possible to design buildings and coastal towns to survive tsunamis. Some countries are considering or have already adopted legislation to consider tsunamis in the certification of new buildings in coastal areas.

In the same way that a ‘crash market’ was created by legislating minimum security standards of cars, the ‘security market’ will develop rapidly once these new regulations take effect. ●

References:
There are too many good references in this evolving field to be included here, and any short list will undoubtedly do a gross injustice to the work of others. The interested reader may wish to start the search from the first 3 references.

[1] Proc. *1st Int. Conf: on Design and Analysis of Protective Structures Against Impact/Impulsive/Shock Loading* (DAPSIL), JSCE, Tokyo (2003).

[2] **P. Bergan, J. Garcia, E. Oñate and T. Kvamsdal** eds. -*Computational Methods in Marine Engineering*; CIMNE (2005).

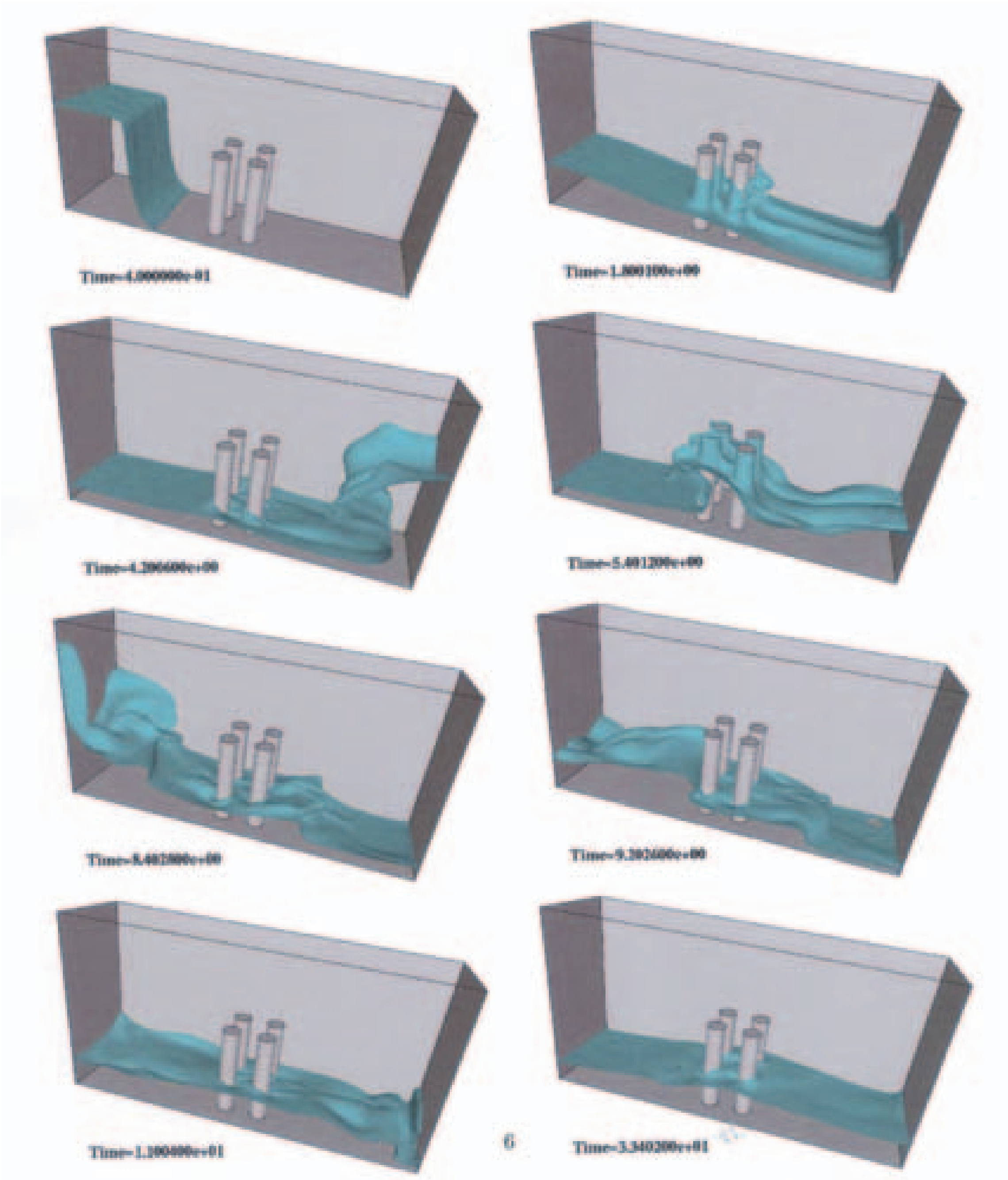
[3] **J. Czujko** -*Design of Offshore Facilities to Resist Gas Explosion Hazard;* Engineering Handbook, CoorOcean (2001).

[4] **F. Togashi, R. Löhner, J.D. Baum, H. Luo and S. Jeong** -*Comparison of Search Algorithms for Assessing Airblast Effects*; AIAA-05-4985 (2005).

[5] **R. Löhner, J. Cebral, C. Yang, J.D. Baum, E. Mestreau, C. Charman and D. Pelessone** -*Large-Scale Fluid-Structure Interaction Simulations*; Computing in Science and Engineering (CiSE) May/June'04, 27-37 (2004).

[6] **C. Yang, R. Löhner and S.C. Yim** -*Development of a CFD Simulation Method for Extreme Wave and Structure Interactions*; Proc. 24th Int. Conf. on Offshore Mech. and Arctic Eng. , OMAE2005-67422, Halkidiki, Greece, June (2005).

Figure 3:
3D Dam-Break Wave Interacting: with Four Circular Cylinders. This example shows the impact of large waves with a generic offshore platform [6]. The figure shows a sequence of snapshots of the free surface in time.



Large Membrane Structures for Scientific Remote Sensing & Space Exploration

by
Alexander Tessler
NASA Langley Research Center
U.S.A.

As part of the NASA Floyd L.Thompson Fellowship, the author spent four months in the beginning of 2005 at the International Center for Numerical Methods in Engineering (CIMNE) in Barcelona, Spain. During this visit, he had many opportunities to discuss the new NASA Space Exploration Program with graduate students and faculty at CIMNE, and worked closely with several researchers focusing on the modeling and analysis of thin-film membranes. Here, a brief overview of the space exploration technologies that use very large structural membranes is presented, together with some comments related to computational mechanics issues for simulating the response of large membrane structures.

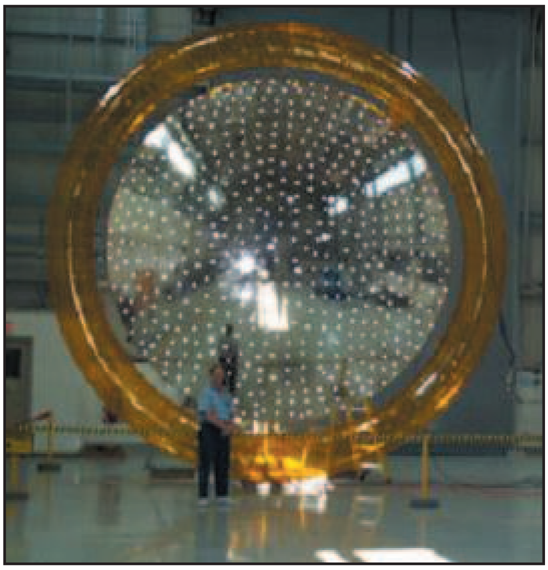


Figure 1:
Inflatable antenna.

Space Exploration Technologies

In support of the new initiative for space exploration unveiled by President George W. Bush in 2004, NASA centers are facing the challenges to provide the exploration program with the best technologies in the areas of materials, structures, propulsion, radiation shielding, automation, and systems analysis. Some of the most exciting space technologies being explored are large structural membranes designed for scientific remote sensing and space exploration. These include deployable/assembled in-space gossamer structures such as large aperture inflatable antennas, sun shields, telescopes, inflatable habitats, and solar sails *(figures 1-4)* [1,2]. The materials considered are ultra-lightweight polymer films that combine enhanced characteristics of space environmental durability, tear resistance, and self-healing. To enable in-space deployment, inflatable/rigidizable columns are designed for constructing lightweight built-up structures. The synergy of nontraditional testing techniques, advanced analytical and computational methods, and modern supercomputing is required for designing these novel space structures *(figures 5-7)*. In the remainder of this paper, the focus is on solar sails and issues related to their successful modeling and simulation.

" A solar sail would gain momentum from incidence of sunlight photons that bounce off of its highly reflective surface, producing a constant acceleration . . . "

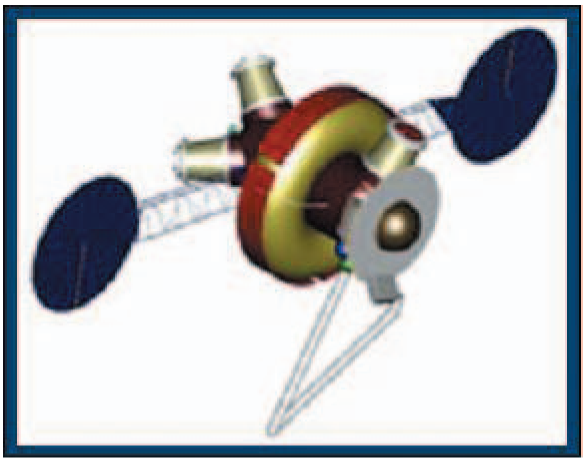


Figure 2:
Inflatable habitat.

Solar Sails

Johannes Kepler, the great astronomer and mathematician, envisioned the idea of solar sailing for interstellar space travel in the beginning of the 17th century. Some 300 years later, the Russian engineer-scientist, Fridrikh Arturovich Tsander, wrote in 1924, "For flight in interplanetary space I am working on the idea of flying, using tremendous mirrors of very thin sheets, capable of achieving favorable results. The interplanetary ships to be sent to other planets should be equipped with large mirrors almost one kilometer in area; the interplanetary stations should also have mirrors, but even larger. The light is collected by these mirrors and sent to the mirror of the interplanetary spaceship in flight. The low pressure of light over the tremendous distances of travel will result in tremendous flight speeds, thereby shortening flight duration. (Refer to F. A. Tsander lectures on the website of the Planetary Society [3]).

NASA's solar sail activities date back to the 1970s, when a Halley comet rendezvous opportunity was being planned with the use of a solar-sail propelled spacecraft; the opportunity, however, was never undertaken. For a fascinating historical review on the subject, see Louis Friedman's chapter in [3]. With the advent of new ultra-lightweight, temperature-resistant thin-film materials, the design and construction of practical solar sails are now more feasible than ever before. Over the past several years, NASA's Space Propulsion Technology Project has produced important solar sail technologies that could be ready to launch on a science mission within a couple of years.

Independently, the former NASA manager, Louis Friedman, is leading a privately funded, US-Russian non-government organization, the Planetary Society, whose recent project ***Cosmos** 1* was concerned with launching the first-ever solar sail on June 21, 2005. The mission of ***Cosmos 1***, a 100 kg spacecraft, was to circle the Earth at an ever-increasing orbit with the help of its 30-meter petal-shaped solar sail made of 5-micron-thin aluminized Mylar. Regrettably, the Volna booster rocket that carried the spacecraft misfired and crashed less than two minutes after its launch from a Russian nuclear submarine in the Barents Sea.

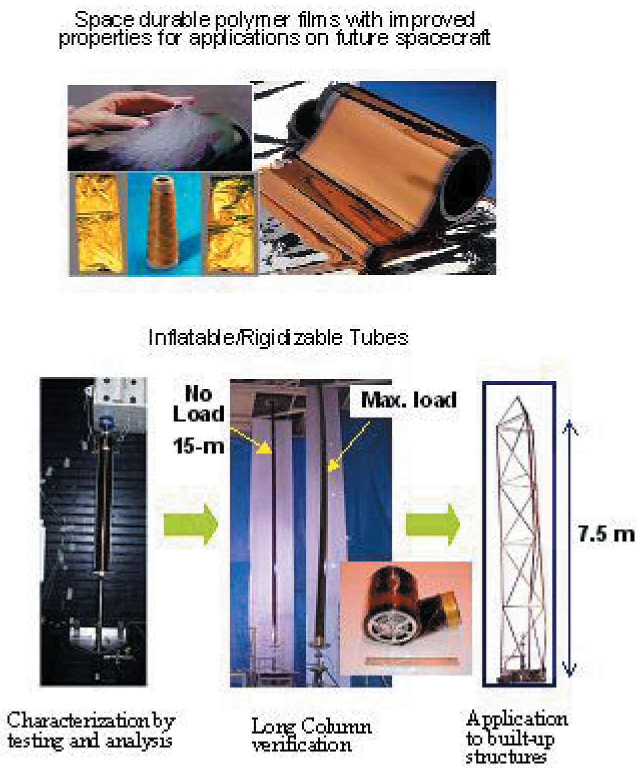
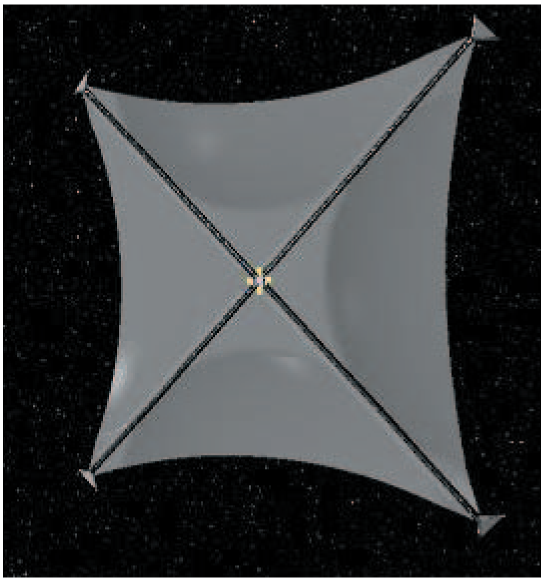


Figure 3:
Thin film and rigidizable materials technology.

A solar sail spacecraft, whose sail is made of large thin-film sheets, is propelled through space entirely by sunlight pressure. Alternative sources of beamed energy, such as microwave or laser beams supplied from another spacecraft or a satellite, could provide a secondary power source. The basic notion of solar pressure comes from James Maxwell's description of light as a packet of energy acting as a tiny particle called a photon. A solar sail would gain momentum from incidence of sunlight photons that bounce off of its highly reflective surface, producing a constant acceleration of the spacecraft. Since the momentum carried by an individual photon (and transferred to the sail) is very tiny, a solar sail needs a large, highly reflective surface area and a low mass, so that sufficient acceleration can be achieved. Because of their large size – potentially spanning several hundred meters – and operation in a weightless space environment, solar sails cannot be adequately tested in a laboratory, thus necessitating application of reliable, high-fidelity computational methods to design such structures using "virtual" testing.

Figure 4:
Solar sail designed of thin-film membrane with four supporting booms.



Simulating Structural Wrinkles

Once launched into an earth orbit by a rocket or a space shuttle, the sails are deployed by an inflatable boom system. The deployment results in the small tensile forces that stretch the sail. Thus, a several micron-thin membrane would undergo predominately tensile membrane deformations.

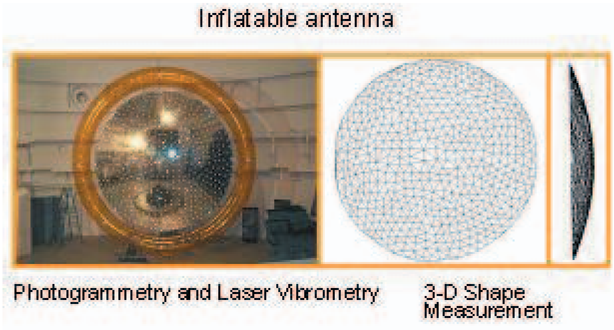
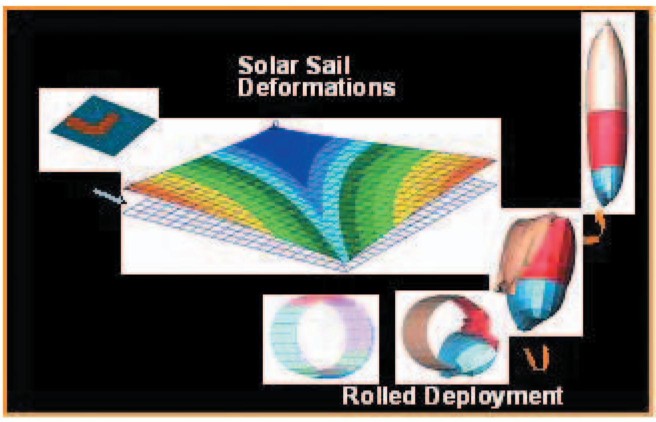


Figure 5: Experimental methods for large inflatable membranes.

Although tensile membrane stresses are dominant, there also exist rather low compressive and bending stresses that tend to wrinkle the material, producing geometrically large out-of-plane displacements or what is known as structural wrinkles. The presence of structural wrinkles is undesirable. The wrinkles may detrimentally affect the stability, maneuverability, and reflectivity characteristics of a solar sail. Moreover, relatively high thermal stresses can develop near the stress concentration regions from which such wrinkles generally emanate, thus potentially causing the material to tear. Note that the vast majority of the mechanics efforts have been based on purely membrane analyses in which compressive stresses are eliminated by way of modifying the material constitutive relations, and the bending deformations are excluded altogether (e.g., refer to the early tension-field theories in [4-5], and a recent review in [6]).

Figure 6: Computational mechanics methods for simulating solar sail deformations and rolled deployment of inflatable columns (LS-DYNA and ABAQUS Implicit and Explicit).



Whereas such analyses are generally capable of determining wrinkled regions and the wrinkle directions, they cannot produce the actual shapes and amplitudes of wrinkles. Recently, there has been an increased effort toward the high-fidelity modeling of structural wrinkles by means of shell-based finite element analysis (e.g., [6-12]).

To predict wrinkling deformations in their complete topological form, both membrane and bending deformations must be considered, as is commonly realized in a shell model. Furthermore, geometrically nonlinear kinematics incorporating large displacements and rotations must be included. When modeling a perfectly flat membrane, the onset of wrinkling can be initiated by slightly perturbing the shell geometry in the thickness (transverse) direction. This will bring about the essential membrane-to-bending coupling in the response even when exclusively membrane loading is applied. A simple and unbiased means of achieving this is by using pseudorandom, small out-of-plane geometric imperfections imposed at the nodes [6-8]. Other perturbed conditions can also be successful, for example, by imposing small transverse forces/pressures, or by starting out with a set of buckling mode shapes. In all of these schemes, the perturbed geometric or load conditions must be small, in relation to the membrane thickness, so as to retain the basic features of the original problem. In *figure 8* are depicted a set of experimentally observed and computationally obtained wrinkled patterns (using ABAQUS [13]) for a thin membrane loaded in shear [6]. In the analysis, the membrane is assumed to be linearly elastic and is initially unstressed. The experimentally observed and computationally predicted wrinkling patterns compare well qualitatively even though the actual geometric and stress imperfections that occur naturally in the experiment were not included in the finite element model.

Similar results have recently been obtained using rotation-free shell elements [14]. These new shell elements, employing only three translation degrees-of-freedom per node, offer the advantage of reducing the number of degrees-of-freedom by a factor of two, as compared to the traditional shell elements that have six degrees-of-freedom per node [15].

For thin membranes exhibiting high stress concentrations, due to the specific geometric features and/or loading conditions, the finite element simulations of structural wrinkles have been less successful, even with the best nonlinear finite element codes and advanced shell element technology. A number of recent efforts have focused on the problem of a square membrane subject to tensile forces at the four corners [6-12] *(figure 9)*. The presence of stress concentration tends to suppress the formation of wrinkles in a model. By removing sharp corner regions from the model, and by prescribing distributed tractions instead of concentrated loads, the deleterious effects of stress concentration are alleviated. Consequently, reasonably accurate simulations of wrinkles can be obtained as evidenced by the results in *figure 9*. The computational model is able to predict four wrinkles radiating from the truncated corner regions, closely correlating with those in the experiment. The analysis also predicts that curling occurs at the free edges (slack region) as observed in the experiment, although the experiment shows somewhat greater wrinkle amplitudes. Considering the many simplifying assumptions in the computational model, i.e., disregarding the actual imperfections, corner boundary conditions, and inherent asymmetry of the experimental setup, the comparison with the experiment can only be judged as successful from the qualitative point of view. On the other hand, it is noted that the computational results are very sensitive to the kinematic boundary conditions, mesh refinement, and element technology. For example, additional mesh refinement in the regions of applied loading can actually cause the wrinkling pattern to disappear altogether.

Concluding Remarks

Whereas some success in the high-fidelity predictions of the formation and growth of wrinkles has been achieved – particularly when modeling relatively uniform equilibrium states – the problems exhibiting high stress concentrations have been particularly difficult to solve even with the best nonlinear finite element codes and advanced shell element technology. Therefore, this latter class of problems remains to be a major challenge and requires an improved understanding of the phenomenon of structural wrinkling in the presence of stress concentration.

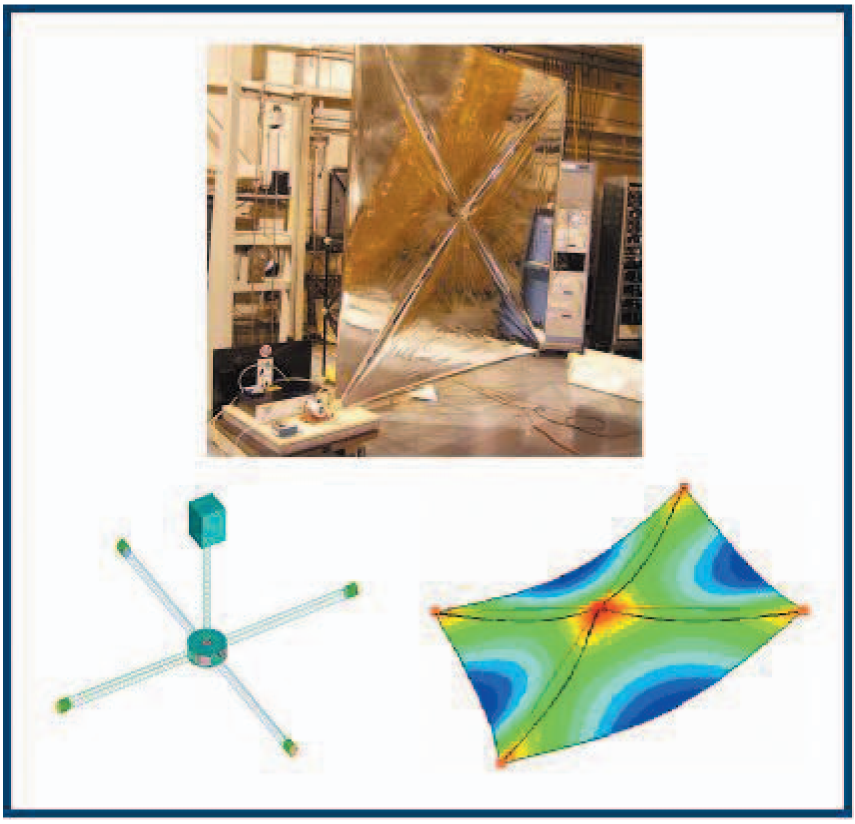


Figure 7:
Testing and analysis of sub-scale solar sail.

Acknowledgements

The author is indebted to the NASA Floyd L. Thompson Fellowship that made his visit to CIMNE possible. He would also like to thank Professor Eugenio Oñate and his research team, Fernando Flores and Gerardo Valdes, for the fruitful technical interactions and discussions. Finally, the author would like to thank the many excellent technical contributions of NASA researchers and contractors whose work on membrane structures was highlighted in this paper. ●

Figure 8:
Wrinkling deformations of square (229mm x 229mm), 0.0762 mm-thin Mylar film subjected to prescribed displacement along top edge and clamped along bottom edge: (a) Experiment (Photogrammetry) [11], and (b) Nonlinear FEM shell analysis using S4R5 elements in ABAQUS [6]).

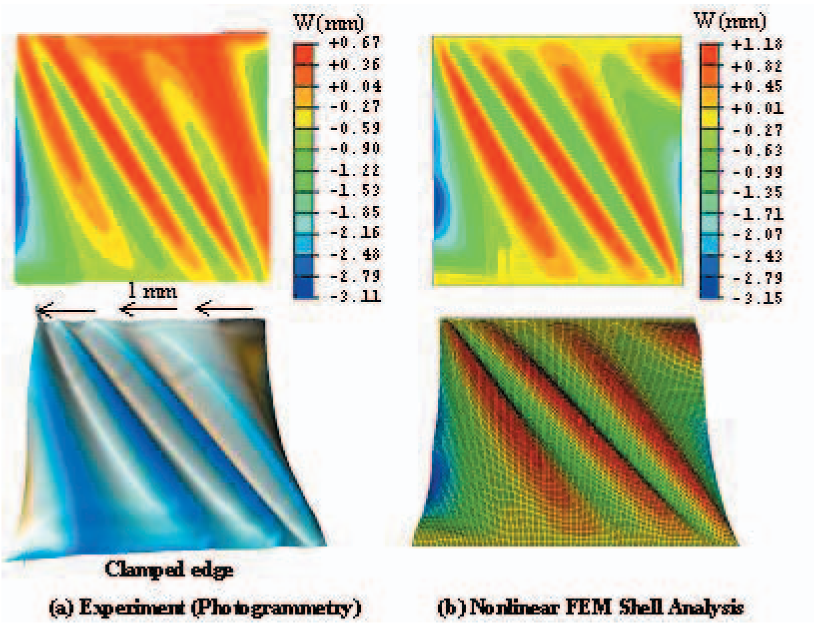
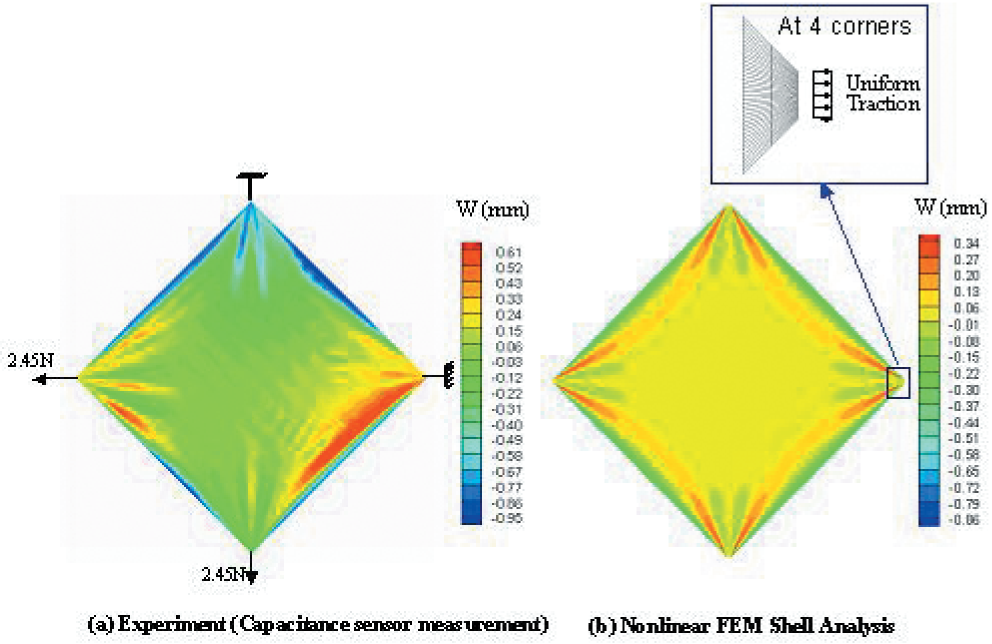


Figure 9: *Wrinkling deformations of square (500mm x 500mm) 0.0254mm-thin KAPTON film loaded in tension by corner tractions (a) Experiment (Capacitance sensor measurement) [12], and (b) Nonlinear FEM shell analysis using S4R5 elements in ABAQUS [6]).*



"... this ... problem remains to be a major challenge and requires an improved understanding of the phenomenon of structural wrinkling in the presence of stress concentration."

References

1. **Belvin, W. K.**, *"Advances in Structures for Large Space Systems,"* 45th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, Palm Springs, California, AIAA-2004-5898, 2004.
2. **Murphy, D, Trautt, T., McEachen, M. , Eskenazi, M., Messner, D., Laue, G., and Gierow, P.**, *"Progress and Plans for System Demonstration of a Scalable Square Solar Sail,"* 14th AAS/AIAA Space Flight Mechanics Conference, Maui, Hawaii, 2004.
3. *The Planetary Society website:* http://www.planetary.org/.
4. **Reissner, E.**, *"On Tension Field Theory."* Proceedings of the 5th Int'l Congr. Appl. Mech., 88–92, 1938.
5. **Stein, M., and Hedgepeth, J. M.**, *"Analysis of Partly Wrinkled Membranes,"* NASA TN D-813, 1961.
6. **Tessler, A, Sleight, D. and Wang, J**, *"Effective Modeling and Nonlinear Shell Analysis of Thin Membranes Exhibiting Structural Wrinkling,"* Journal of Spacecraft and Rockets, AIAA, vol. 42, no. 2, 287-298, 2005.
7. **Tessler, A, Sleight, D.**, *"Toward Effective Shell Modeling of Wrinkled Thin-Film Membranes Exhibiting Stress Concentrations,"* 45th AIAA/ASME/ASCE/AHS/ ASC Structures, Structural Dynamics and Materials Conference, Palm Springs, California, AIAA-2004-1739, 2004.
8. **Wang, J., Chen, T., Sleight, D., and Tessler, A.**, *"Simulating Nonlinear Deformations of Solar Sail Membranes Using Explicit Time Integration,"* 45th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, Palm Springs, California, AIAA-2004-1580, 2004.
9. **Wong, Y.W. Wong, Pellegrino, S., and Park, K. C.**, *"Prediction of Wrinkle Amplitudes in Square Solar Sails,"* 44th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference and Exhibit, Norfolk, Virginia, AIAA-2003-1982, 2003.
10. **Su, X., Abdi, F., and Blandino, J. R.**, *"Wrinkling Analysis of A Kapton Square Membrane under Tensile Loading,"* 44th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference and Exhibit, Norfolk, Virginia, AIAA-2003-1985, 2003.
11. **Leifer, J., Black, J. T., Belvin, K. W. and Behun, V.**, *"Evaluation of Shear Compliant Boarders for Wrinkle Reduction in Thin Film Membrane Structures,"* 44th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, Norfolk, Virginia, April 2003.
12. **Blandino J.R., Johnston, J.D., and Dharamsi U.K.**, *"Corner Wrinkling of a Square Membrane due to Symmetric Mechanical Loads,"* Journal of Spacecraft and Rockets, vol. 35, no. 9, Sept/Oct 2002.
13. *ABAQUS/Standard User's Manual,* Version 6.3.1, Hibbitt, Karlsson, and Sorensen, Inc., Pawtucket, RI, 2002.
14. **Oñate, E., Tessler, A., Flores, F., and Valdes, G.**, *"Modeling and Analyses of Wrinkled Thin Membranes using Rotation-Free Shell Elements,"* Private Communications, 2005.
15. **Oñate, E., and Flores, F.**, *"Advances in the Formulation of the Rotation-Free Basic Shell Triangle,"* Comput. Methods Appl. Mech. Engrg., vol. 194, 2406-2443, 2005.

Alf Samuelsson
(1929-2005)

Professor Alf Samuelsson from Chalmers University, Göteborg, Sweden died on the 3rd of June 2005 at the age of 75 after a lengthy illness.

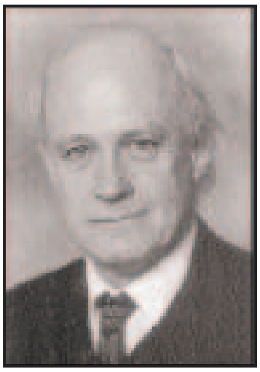
Professor Samuelsson was an engineer with Professor Sven-Olof Asplund's Construction Company from 1952 to the time he joined Chalmers University in September 1954. In 1963 he completed his doctoral thesis with Professor Asplund on the subject of analysis of framed structures by use of algebraic topology. He was much beloved by students, colleagues and co-workers and was known as "Alf" by all. Through Alf's foresight and deep knowledge in many fields he created a strong group in Computational Mechanics at Chalmers University which he led until his retirement in July 1994. Under his leadership the Department of Structural Mechanics flourished and has been widely recognized for its many scientific contributions. Alf supervised a large number of doctoral students of which nine have become professors. Alf was for many years the Dean of Research at Chalmers and has contributed much to the University's development.

After his retirement Alf visited the Department almost every day still enjoying working and interacting with students and colleagues. He worked for Chalmers to the very end even giving his last lectures in February this year. He was always revered by his students. Above all Alf was a warm hearted person with great humour and lived his personal motto "Every day is a good day". Within the Department his good company and jovial manner will be missed, especially at coffee break time where he loved relating jokes and historical stories. Through his interest in history Alf, together with his daughter Ulla, wrote a book on the early history of Chalmers with a second volume due out this autumn describing the years after Chalmers was given full university status.

In 1995 Alf was awarded the Chalmers Medal in appreciation of his many contributions and years of dedicated service.

Alf was elected to the Swedish Royal Academy of Science in recognition of his significant influence on the development and dissemination of Computational Mechanics in Sweden.

Alf also was strongly engaged in the international scientific world where he maintained an extensive international network. He was one of the founders of the International Association of Computational Mechanics (IACM). His contributions and dedication were essential in developing IACM as a worldwide organization. He was first the General Secretary and later President of IACM during the period 1994-1998 and has collaborated with this organization ever since.



On behalf of all Alf's friends, colleagues and students we express our great sorrow and sympathy to his wife Margareta and their daughter Ulla.

Nils-Erik Wiberg
(Alf's first Ph.D. student)
Eugenio Oñate
Olgierd Zienkiewicz
Robert Taylor

Research in Computational Mechanics with Professor O.C. Zienkiewicz during the Pioneering Days (1962-1967)

by
Y.K. Cheung

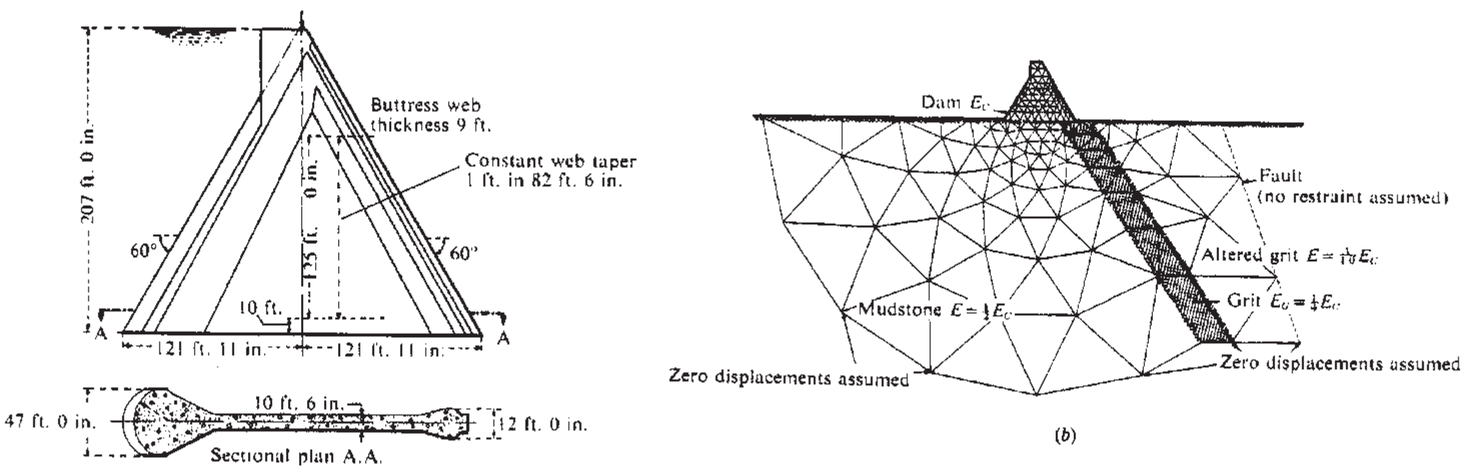
Winner of 2004 IACM Award

I was born and brought up in Hong Kong. In 1954 I went back to China to study Structural Engineering in the South China Institute of Technology and worked as a structural designer for three years.

In October 1961 I went to Swansea to attend an interview for a Master's course of study. Professor Zienkiewicz and Professor Davies were present at the interview, which lasted from 9 a.m. to 5 p.m., with an hour off for lunch. Essentially, they were trying to find out whether I, a graduate from a newly established Chinese university, would be suitable to undertake graduate study in Swansea, and whether I could cope with the English language. Therefore I had to describe in detail what I knew, subject by subject. They were pleasantly surprised by my description of the Galerkin Method and Kantorovich Method in Mathematics, of the Zemochkin Method of analyzing a beam on elastic half plane/space. Professor Zienkiewicz was particularly impressed when I told him that the Zemochkin Method could be applied to the analysis of lintel beams, and that in contrast to the commonly accepted loading pattern caused by the arching action of the bricks, the Zemochkin Method produced a much smaller loading by virtue of taking into account the composite action between the bricks and the lintel beam. After the interview Professor Zienkiewicz informed me that he would be prepared to recommend me for a 2 year Ph.D. course of study in spite of my unrecognized degree.

During the next couple of months I studied and worked hard to come up with a thesis title. Then one day, Professor Zienkiewicz said to me *"My friend, Professor Ray Clough, told me that the Finite Element Method is a good thing. We both don't know anything about it. Let's try"*. Being a good disciple, I agreed on the spot, in spite of the fact that there were only several references on that topic in early 1962. Whether I made the right decision on that occasion was far from clear at that time. On the one hand Professor Zienkiewicz was in those days an expert in finite difference method and relaxation method, and if I took that route I could be assured of a Ph.D. On the other hand it is probably not wise to go down a well-trodden path, and one should try to innovate at every opportunity and work out something fundamental and meaningful. Anyway things turned out extremely well from that fateful day to the present.

Figure 1:
Stress analysis of a buttress dam. Plane stress condition assumed in a dam and plane strain in foundation.
Left: *The buttress section analysed.* ***Right:*** *Extent of foundation considered and division into finite elements*



At this juncture something should be said about computers. There is no doubt that the development of FEM, and computational mechanics in general, owed much to the presence of the electronic computer which came on the scene in the middle of the last century. It can also be said that the two areas developed hand in hand, with the progress of one pushing the other forward, and vice versa. It is in such a situation that I found myself when the University College of Swansea purchased a small IBM1620 computer (small by computing power with only 2K word memory, but huge by dimension since it occupied a big room). since there was no one in the Department who knew anything about computer programming, I had to learn Fortran II from scratch and I became the so-called "expert" programmer in the Department.

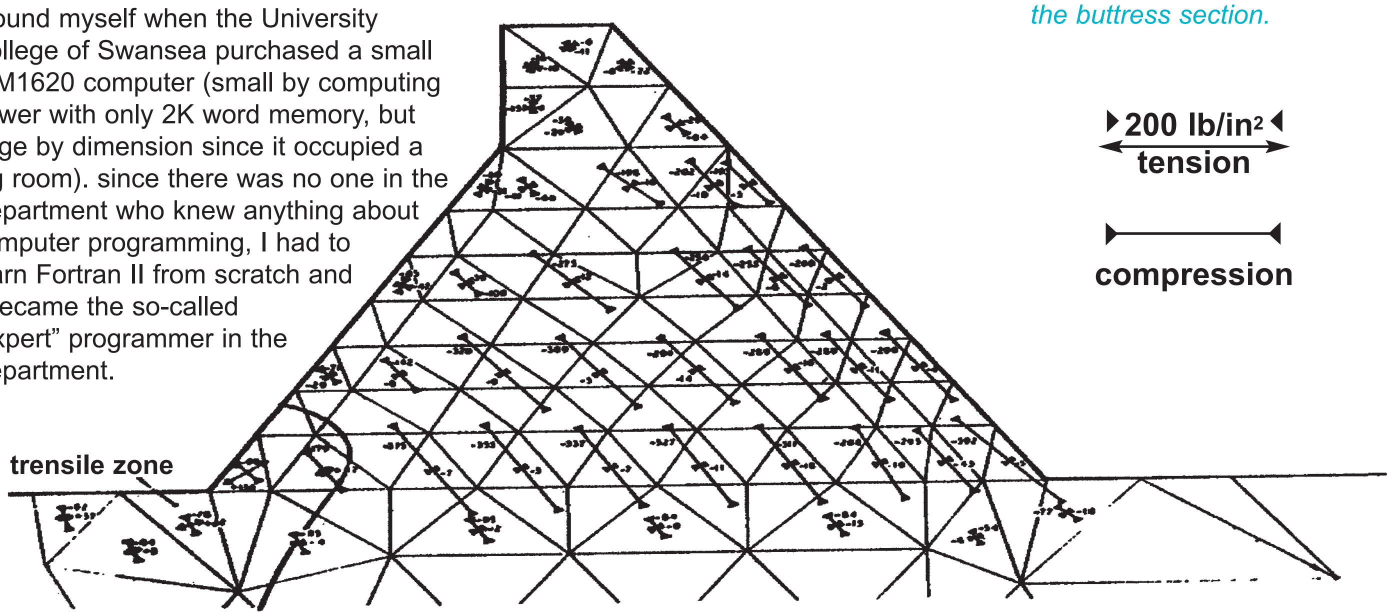


Figure 2:
Directions and magnitudes of the principal stresses in the buttress section.

Although I was still a research student, I was asked by Professor Zienkiewicz to give a computer programming course to the Part I students. A challenge which I took up and I believed my performance was quite satisfactory.

Apart from extensive usage of the IBM1620 for small problems, I had the good fortune of securing, through the recommendation of my mentor and supervisor, two hours of free time on the main frame IBM7090 in London. All the larger problems in my thesis were computed on the 7090, and literally every second of computer time counted. In order not to waste my small allocation, all the programmes and data were checked several times before any job was submitted. I set out to write my first programme suite on the solution of plane stress/strain problems but got stuck because no suitable solver was available. Professor Zienkiewicz found a good band matrix solver when he went to a conference in the States but had to come back empty-handed because of financial problem. In the end I managed to write my own solver using a tridiagonalisation technique. The programme suite was published in the first FEM book by Zienkiewicz and Cheung in 1967, and I believe that literally hundreds of researchers learned to write FEM programme based on that piece of work.

The publication of the text was an exciting experience. The editors of McGraw Hill were enthusiastic about our work, and they were happy that the book became a classic, selling over 20,000 copies of the English Edition and being translated into Japanese, Russian, Chinese and other languages.

The programme suite was used to analyse a real dam on elastic foundation, the Clywedog Buttress Dam in Wales (*figure 1*).

In those days the engineers would treat such a dam as a variable thickness, variable height cantilever beam on a rigid foundation. The FEM results showed that the vertical stress distribution was very different from the stress distribution of a beam, and the elastic foundation did affect the stress distribution near the base of the dam (*figure 2*). The engineers then asked for proof that the FEM results were indeed accurate. At that time we were not able to show them any mathematical proof of convergence, however they were satisfied when we showed them that at a number of sections we can always obtain equilibrium, i.e. $\Sigma X=0, \Sigma K=0$ and $\Sigma M=0$.

"... Ray Clough told me that the Finite Element Method is a good thing. We both don't know anything about it. Let's try ..."

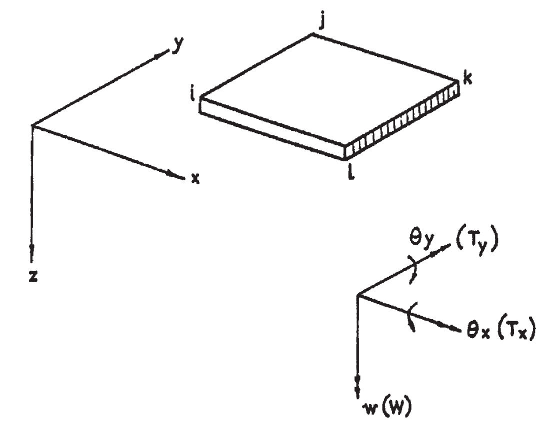
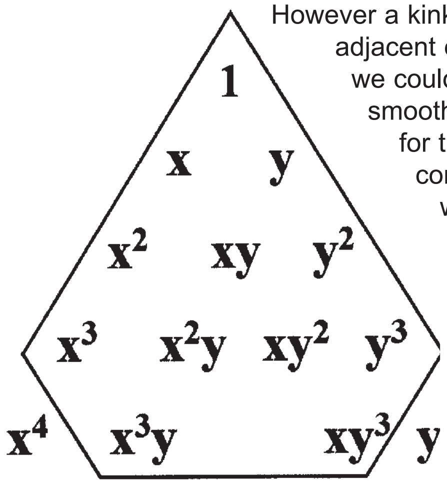


Figure 3:
Rectangular bending element.



Pascal Triangle

25 years later, Professor Zienkiewicz and myself received a Mature Structures Award from the Concrete Society for our pioneering work in the use of FEM in dam design. The first element I formulated was a 12 DOF rectangular bending element *(figure 3)*, which I thought would be a simpler problem to work on because of its regular shape.

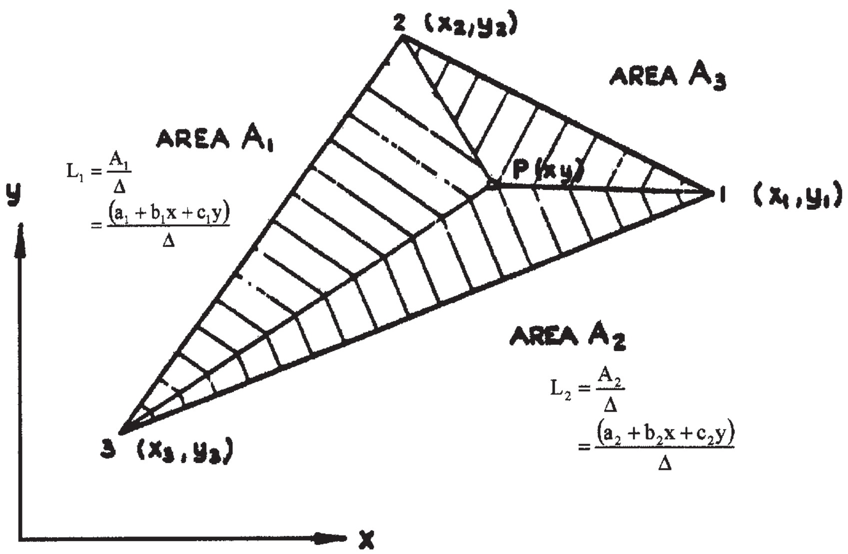
If we examined the Pascal triangle, we found that a polynomial expression consisting of 1, x, y, x^2, xy, y^2, x^3, x^2y, xy^2, y^3, x^3y, xy^3 would have been the right displacement function because we had a cubic curve along each edge, and a cubic curve is uniquely controlled by the 4 nodal parameters at the two ends.

However a kink still existed between 2 adjacent elements, and therefore we couldn't obtain a completely smooth displacement function for the whole plate. One consequence was that there wouldn't be monotonic convergence of results when we kept on increasing the number of elements for modelling the structure. Paradoxically the nonconforming 12 DOF rectangular bending element very often yielded better results than the conforming 16 DOF rectangular bending element. This was because displacement type elements were always too stiff, and the slits which exist would make the plate more flexible. In other words, the two opposite effects tended to cancel each other and therefore produce values which were closer to the exact solution for the same mesh division. The paper was awarded a Telford Premium by The Institution of Civil Engineers of U.K.

My next task from Professor Zienkiewicz was to formulate a more versatile bending element, a triangular element which could be used to analyse plates of any shape. That time we were unable to use the Pascal triangle, but Professor Zienkiewicz came up with a set of displacement functions using area coordinates which has the property of being unity at the vertex in question and zero along the opposite edge of the triangle *(figure 4)*. We expanded the product of the area coordinates into polynomial terms and integrated such polynomials over the triangular area. The work was quite tedious and we were very pleased when we found the equation for the integration of area coordinate expressions *(figure 5)*

An important piece of work after the publication of the rectangular plate element was the analysis of a rectangular plate on elastic half-space. The Russian and the Chinese researchers were at that time able to analyse a beam on elastic half space, using a flexibility approach and with the flexibility coefficients calculated by the Boussinesq equation. With the plate problem I decided to use the

Figure 4:
Triangular bending element and area coordinates



$$\int L_1^a L_2^b L_3^c dA = \frac{a!b!c!A}{(a+b+c+2)!}$$

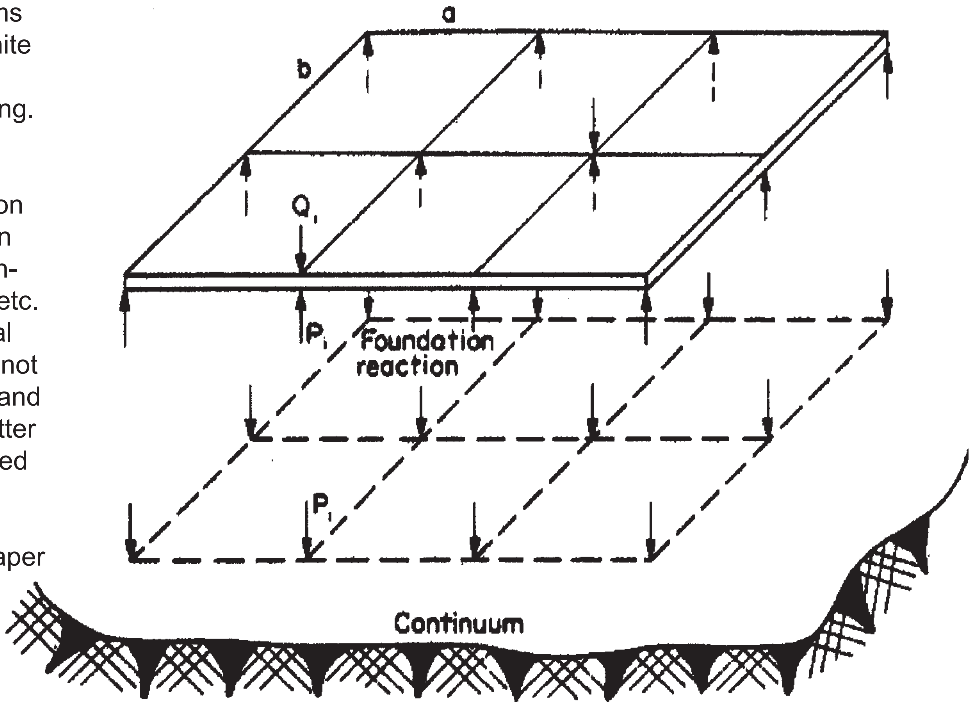
stiffness approach by assembling the stiffness matrices of all the plate elements, and for the foundation part I hit upon a rather novel idea of computing the stiffness matrix of the foundation by inverting the flexibility matrix formed from the Boussinesq equation. Adding the two matrices together would give us the stiffness matrix of the plate on elastic half space.

The next development which was to have a profound impact in later years on analysis of non-structural problems was the publication of the paper "Finite Elements in the Solution of Field Problems" by Zienkiewicz and Cheung. In this paper we established the capability of FEM as an excellent scheme for solving Laplace's equation and Poisson's equation which govern such problems as seepage, heat conduction, torsion, electrical potential, etc. The paper was submitted to a journal but, unfortunately, the reviewers did not see much merit in the new method, and they concluded that FEM was no better than FDM. The paper was not rejected but we were asked to make many modifications, which Professor Zienkiewicz refused to make. The paper was then submitted to the Engineer and has to date enjoyed over 120 citations.

It should be mentioned that our subsequent papers distinctly showed that FEM can indeed solved problems which are difficult or impossible to deal with by FDM.

I moved from Swansea to Calgary in 1967, thus ended our period of close collaboration with rewarding results. However, we remain in close contact with each other all the time up to the present. ●

Figure 5:
A plate and its foundations



References

1. **Zienkiewicz, O.C. and Cheung, Y.K.**, *Finite Element Methods in Structural and Continuum Mechanics*, McGraw-Hill Co., New York, 1967.
2. **Zienkiewicz, O.C. and Cheung, Y.K.**, "*Buttress Dam on Complex Rock Foundations*", Water Power, May 1964.
3. **Zienkiewicz, O.C. and Cheung, Y.K.**, *"The Finite Element Method for Analysis of Elastic Isotropic and Orthotropic Slabs"*, Proc., Institution of Civil Engineers, Vol. 28, pp. 471-480, August 1964.
4. **Zienkiewicz, O.C. and Cheung, Y.K**, *"Finite Element Method of Analysis for Arch Dam Shells and Comparison with Finite Difference Procedures*", Theory of Arch Dams, Editor: Rydzewski, Pergamon Press, 1965.
5. **Cheung, Y.K. and Zienkiewicz, O.C.**, *"Plates and Tanks on Elastic Foundations - An Application of Finite Element Method*, International Journal of Solids Structures, Vol. 1, pp. 451-461, 1965.
6. **Zienkiewicz, O.C. and Cheung, Y.K.**, *"Stresses in Buttress Dams",* Water Power, Vol. 17, February 1965.
7. **Zienkiewicz, O.C. and Cheung, Y.K.**, *"Finite Elements in the Solution of Field Problems"*, The Engineer, September, 1965.
8. **Bazeley, G.P., Cheung, Y.K., Irons, B.M. and Zienkiewicz, O.C.**, *"Triangular Elements in Plate Bending - Conforming and Nonconforming Solutions"*, Proc. Conference on Matrix Methods in Structural Mechanics, Air Force Inst. of Tech., Ohio, October, 1965.
9. **Zienkiewicz, O.C., Cheung, Y.K. and Stagg, K.G.**, *"Stresses in Anisotropic Media with Particular Reference to Problems in Rock Mechanics",* Journal of Strain Analysis, Vol. 1, No. 2, pp. 172-182, 1965.
10. **Zienkiewicz, O.C., Mayer, P. and Cheung, Y.K.**, *"Solution of Anisotropic Seepage by Finite Elements",* Journal of the Engineering Mechanics Division, Proc. ASCE, February, pp. 111-120, 1966.
11. **Zienkiewicz, O.C. and Cheung, Y.K.**, "*Plate and Shell Problems, Finite Element Displacement Approach"*, Proceedings of the Symposium on the Use of Electronic Digital Computers in Structural Engineering, University of Newcastle-upon-Tyne, July 1966.
12. **Zienkiewicz, O.C. and Cheung, Y.K.**, *"Application of the Finite Element Method to Problems of Rock Mechanics",* Proc. of the Int. Congress on Rock Mechanics, National Laboratory of Civil Engineering, Lisbon, Portugal, September 1966.
13. **Zienkiewicz, O.C., Cheung, Y.K., Ribeiro, A.A., Azevedo, M.C., Ferreira, M.J.E. and Pedro. J.O**., *"Comparison of Analytical and Experimental Results in the Design of a Hollow Gravity Dam"*, Proc. 9th Int. Congress on Large Dams, Istanbul, 1967.
14. **Zienkiewicz, O.C., Watson, M. and Cheung, Y.K.,** *"Stress Analysis by the Finite Element Method – Thermal Effects",* Proc. of Conference on Prestressed Concrete Pressure Vessels, Institution of Civil Engineers, London, March 1967.
15. **Zienkiewicz, O.C. and Cheung, Y.K.**, *"Stresses in Shafts",* The Engineer, November 1967.
16. **Cheung, Y.K., King, I.P. and Zienkiewicz, O.C.,** *"Slab Bridges with Arbitrary Shape and Support Conditions, A General Method of Analysis Based on Finite Elements",* Proc., Institution of Civil Engineers, Vol. 40, May, 1968.

Ship Hydrodynamics

A Challenge for Computational Mechanics

by
Eugenio Oñate
Julio García
Sergio R. Idelsohn
CIMNE, Barcelona
Spain

and

Rainald Löhner
George Mason University
USA

The water resistance for a ship in motion determines the required engine power and thereby the fuel consumption. Accurate prediction and minimization of the hydrodynamic forces is therefore an important issue in ship hull design. Further, excitation of a wave pattern by ship motion may also limit the speed in the vicinity of the shore for environmental reasons.

The prediction of the wave pattern and the wave resistance of a ship has challenged mathematicians and hydrodynamicists for over a century. The Boundary Element Method (BEM), termed by hydrodynamicists as Panel Method, is the basis of many computational algorithms developed mainly in the period 1960-1980. Here the flow problem is solved using a simple potential model.

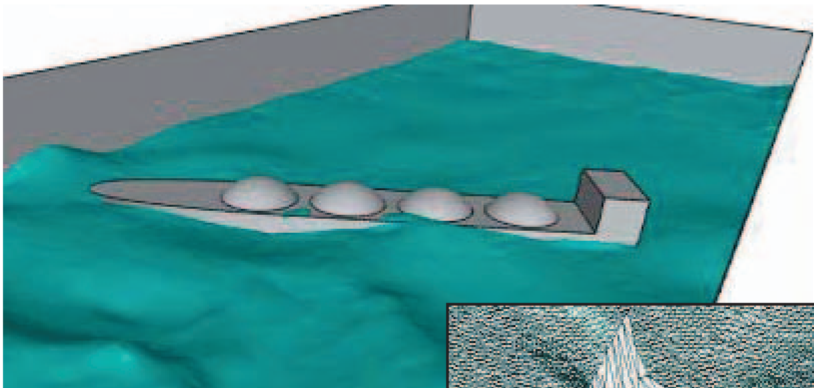


Figure 1:
Hydrodynamic analysis of a container ship on rough seas. ALE/FEM Analysis

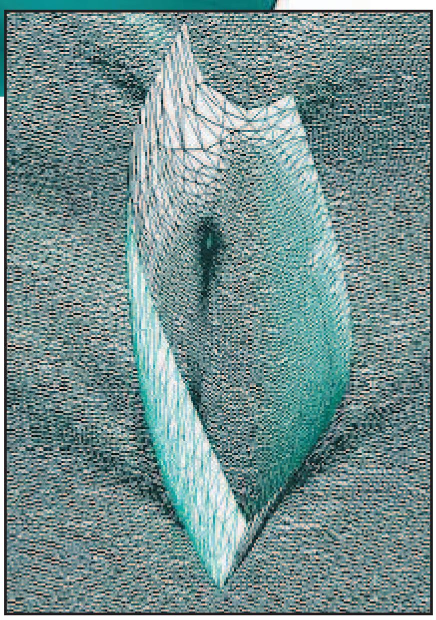


Figure 2:
American Cup sailing boat Bravo España. Surface mesh for ship and hull

In addition to the developments in potential flow panel methods for practical ship hydrodynamics analysis, much research in the second half of the twentieth century was oriented towards the introduction of viscosity in the CFD analysis. In the 1960's the viscous flow research was mainly focused in 2D boundary layer theory and by the end of the decade several methods for arbitrary pressure gradients were available. This research continued to solve the 3D case during the following decade. Applications to some well specified test cases were reported and numerical and experimental results compared acceptable well for most part of the boundary layer along the hull, while wrong results were obtained near the stern. This prompted additional research and by the end of the 1980's a number of numerical procedures for solving the full viscous flow equation accounting for simple turbulence modes based on Reynolds averaged Navier-Stokes (RANS) equations were available.

Independently of the flow equations used, the free-surface boundary condition has been solved in different manners. The exact free surface condition is nonlinear and several linearizations have been proposed. Some of them use a fixed domain and others a moving one. An alternative is to solve the full nonlinear free surface equation on a reference surface which does not necessarily coincides with the free surface itself. In this way the updating of the surface mesh is minimized and sometimes is not even necessary.

The solution of the free-surface equation in a bounded domain requires a radiation condition to eliminate spurious waves. A way to introduce this condition was proposed at the end of 1977 by Dawson [1] who used a finite difference (FD) formula based in four upwind points to evaluate the first space derivatives appearing in the free-surface equation. This method became very popular and this is probably the main reason why a large majority of codes predicting the wave resistance of ships use FD methods on structured meshes.

Indeed the 1990's were a decade of considerable progress in CFD methods for ship hydrodynamics. The most important breakthrough was perhaps the coupled solution of the free-surface equation with the fluid flow equations. The coupled equations are formulated in an arbitrary Lagrangian-Eulerian (ALE) description allowing the independent motion of the mesh nodes from that of the fluid particles. The typical numerical difficulties encountered are the unsta-bilities induced by the convective terms and the limits in the approximation of the velocities and pressure variables introduced by the incompressibility constraint. These problems have been overcome using stabilized numerical schemes and a number of viscous and inviscid solutions for the surface ship wave problem using stabilized finite element (FEM) and finite volume methods and codes with non structured grids have been reported [2-9].

The solution of the coupled free-surface problem is highly non linear due to the presence of the unknown velocities in the free surface equation and also because the free-surface position de- fining the new boundary conditions is also unknown. Most iterative schemes for the non linear surface wave problem solve for the new free-surface height, for fixed values of the velocity field compu-ted from the fluid solver in a previous iteration within each time increment. At this stage two procedures are possible, either the position of the free-surface is updated after each iteration and this becomes the new reference surface, or else an equivalent pressure is applied at the current reference surface as a boundary condition in the next flow iteration. The first option might require the regeneration of a new mesh, where as the second one is less accurate but computationaly cheaper. A compromise between the two alternatives is usually chosen in practice [3].

An alternative method to treat the free-surface equation is based in voume of fluid or level set techniques. The free-surface position is defined in both methods as the interface between two fluids interacting with each other, where the efect of one fluid on the other is very small (i.e. the water and the surrounding air). An interface function is transported with the fluid velocity using a time dependent advection equation [4].

Figure 3:
American Cup sailing boat. Pressure contours on hull and appendages.

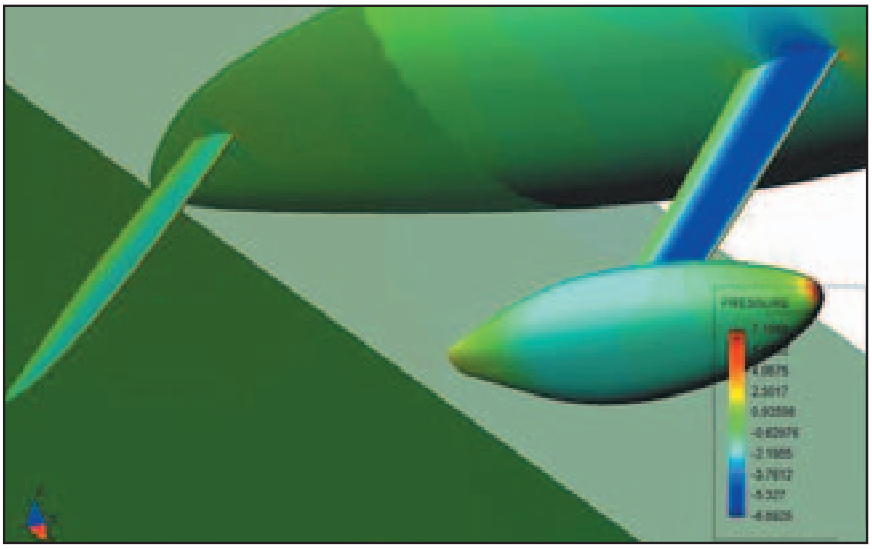
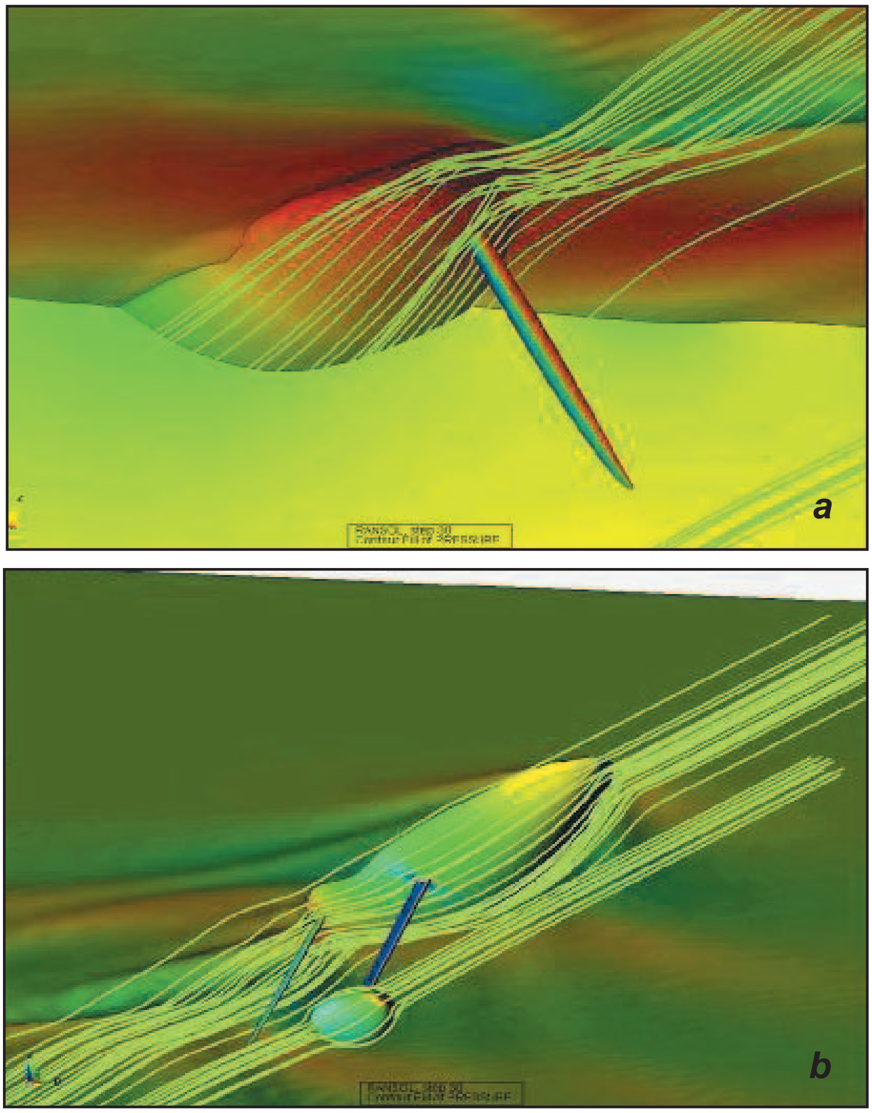


Figure 4: *(a and b) American Cup sailing boat. Streamlines*



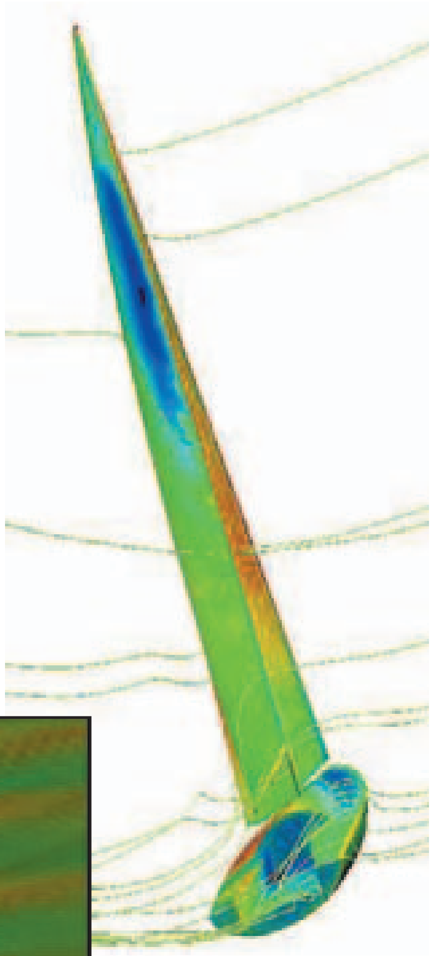


figure 5:
Aerodynamic study of a sail boat.

A particular class of ship hydrodynamic problems require the modelling of breaking waves or the prediction of water inside the hull (green water) due to large amplitude waves typical of sea keeping problems. Here Lagrangian flow methods such as the Particle Finite Element Method (PFEM) [9--11] where the motion of each flow particle is individually tracked are a very effective (and relatively simple) procedure for modelling the flow of fluid particles undergoing severe distorsions such as water jets, high amplitude waves, breaking waves, water splashing, filling of cavities, etc. The Lagrangian flow equations are obtained by noting that the velocity of the mesh nodes and that of the fluid particles are the same. Hence the convective terms vanish in the momentum equations, while the rest of the fluid flow equations remain unchanged. The motion of the free surface is followed naturally by computing the displacement of (all) the fluid particles at each time step. The frequent regeneration of the mesh is mandatory.

The Lagrangian formulation is very suitable for ship hydrodynamic problems where the ship undergoes large motions. An advantage of the Lagrangian formulation is that both the ship and the fluid motion are defined in the same frame of reference.

The current challenges in CFD research for ship hydrodynamics focus in the development of robust and computationaly efficient numerical methods able to capture the different scales involved in the analysis of practical situations. Wave resistance coefficients for modern ship design involving complex shapes are needed for a wide range of speeds and here the accurate prediction of the wave pattern and the hull pressure distribution at low and high speeds are major challenges. Great difficulties exist in the computation of the viscous resistance which requires very fine grids in the vicinity of the hull, resulting in overall meshes typically involving several million elements. Other relevant problems

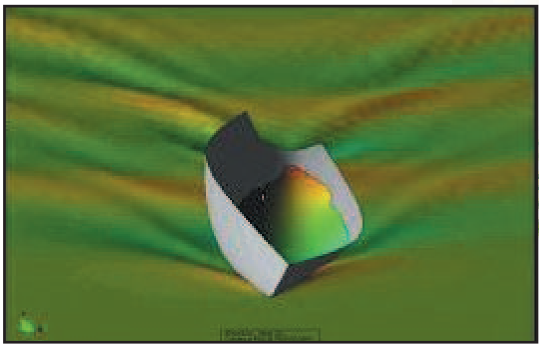
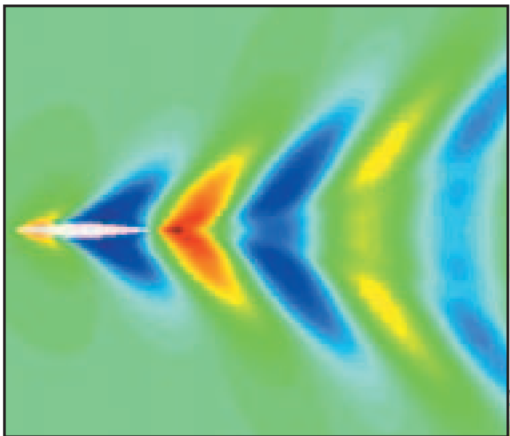
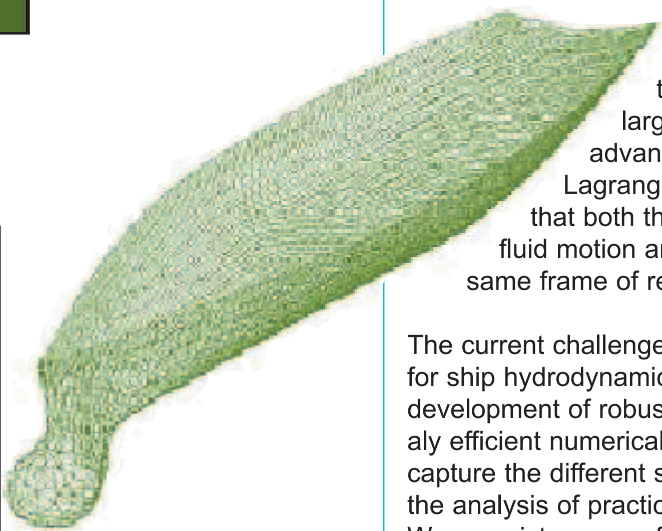


Figure 6:
American Cup sailing boat Bravo España. Wave pattern using an ALE/FEM approach.





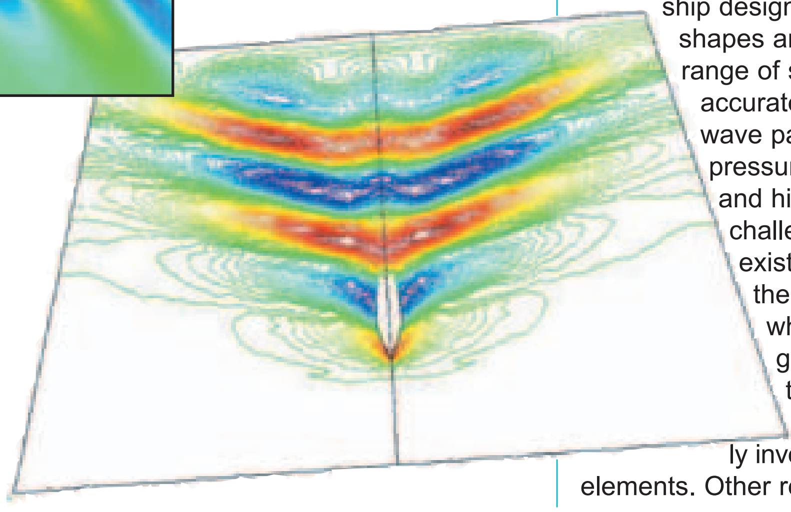


Figure 7:
Above and right: Hydrodynamic analysis of a container ship. Surface mesh and wave patterns using ALE/FEM analysis.

are the prediction of the wake details and the propeller-hull interaction. Fine unstructured meshing adaptive mesh refinement and advanced turbulence models are crucial for the realistic solution of these problems.

Figures 1--7 show applications of the ALE/FEM formulation. The ALE examples include the analysis of a scale model of a commercial ship and an American Cup racing sail boat [5--7]. Numerical results have been obtained in all cases with linear tetrahedral meshes. Finally *Figures 8 and 9* show two applications of the Lagrangian PFEM formulation to the analysis of the flow around a rotating water mill and to the sinking of a container ship. More applications of the PFEM can be found in [9--11] and in www.cimne.com/pfem. ●

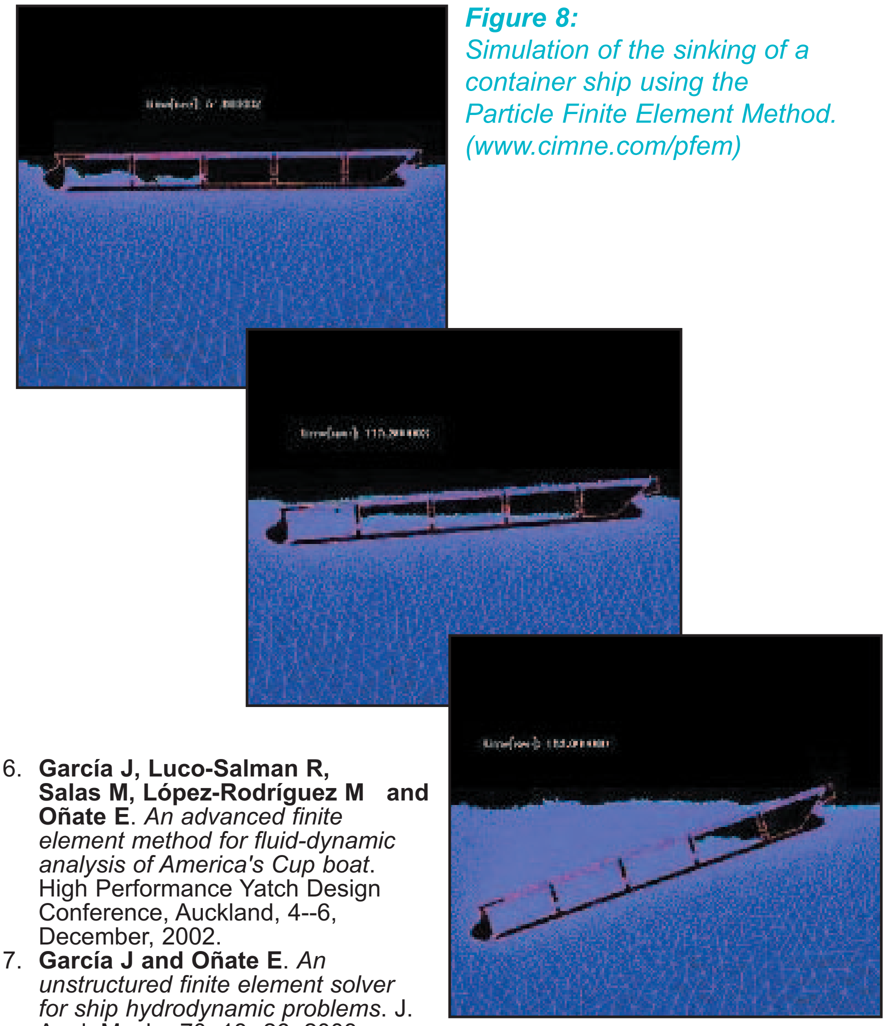


Figure 8:
Simulation of the sinking of a container ship using the Particle Finite Element Method. (www.cimne.com/pfem)

Bibliography

1. **Dawson CW**. *A practical computer method for solving ship-wave problems*. Proc. 2nd Int. Conf. Num. Ship Hydrodynamics, USA, 1977.
2. **Larsson L, Regnströn B, Broberg L, Li DQ and Janson CE**. *Failures, fantasies and feats in the theoretical/ numerical prediction of ship performance*. 22d Symposium on Naval Hydrodynamics, Washington DC, 10--14, August, 1998.
3. **Idelsohn SR, Oñate E and Sacco C**. *Finite element solution of the free-surface ship-wave problem*. Int. J.Num. Meth. Engng., 45, 503--508, 1999.
4. **Löhner R, Yang C, Oñate E and Idelsohn SR**. *An unstructured grid-based parallel free-surface solver*. Appl. Num. Math., bf 31, 271--293, 1999.
5. **Oñate E and García J. A**. *Finite element method for fluid-structure interaction with surface waves using a finite calculus for mulation*. Comput. Methods Appl. Mech. Engrg., 191, 635--660, 2001.
6. **García J, Luco-Salman R, Salas M, López-Rodríguez M and Oñate E**. *An advanced finite element method for fluid-dynamic analysis of America's Cup boat*. High Performance Yatch Design Conference, Auckland, 4--6, December, 2002.
7. **García J and Oñate E**. *An unstructured finite element solver for ship hydrodynamic problems*. J. Appl. Mech., 70, 18--26, 2003.
8. **Tdyn**. *A finite element code for fluid-dynamic analysis*, COMPASS SA, Barcelona, Spain. www.compassis.com
9. **Oñate E, García J and Idelsohn SR**. *Ship hydrodynamics. Enciclopedia of Computational Mechanics*. E. Stein, R. de Borst and T.J.R. Hughes (Eds.), John Wiley Vol. 3, Chapter 18, pp. 579 - 607, 2004.
10. **Idelsohn SR, Oñate E and Del Pin F.** *The Particle Finite Element Method: a powerful tool to solve incompressible flows with free-surfaces and breaking waves*. Int. J. Num. Meth. Engng., 61, 964--989, 2004.
11. **Oñate E, Idelsohn SR, del Pin F, Calvo N. and Aubry R**. *The particle finite element method. An overview*. Int. J. Computational Methods, 1, (2), 267--307, 2004.

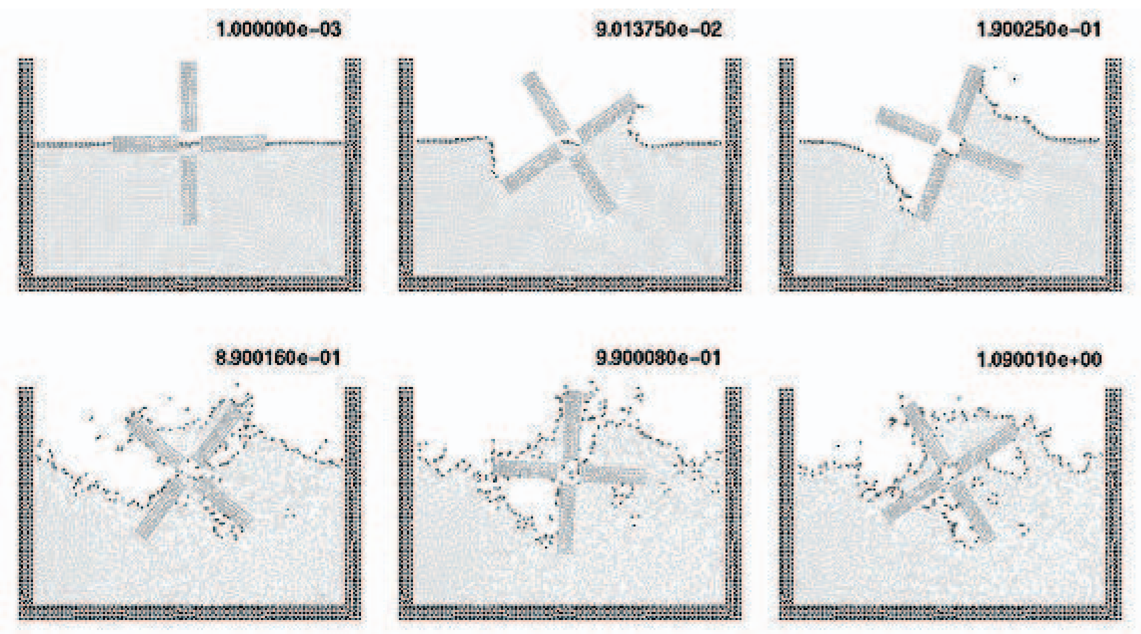


Figure 9:
Rotating water mill analyzed with the Particle Finite Element Method

Israeli Association for Computational Methods in Mechanics (IACMM)

Dan Givoli
Chairman
Dept. of Aerospace Engineering
Lawrence and Marie Feldman
Chair in Engineering
Technion -Israel Institute of Technology

givolid@aerodyne.technion.ac.il
Tel.: +972-4-8293814,
Fax: +972-4-8292030
http://www.iacmm.org.il

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

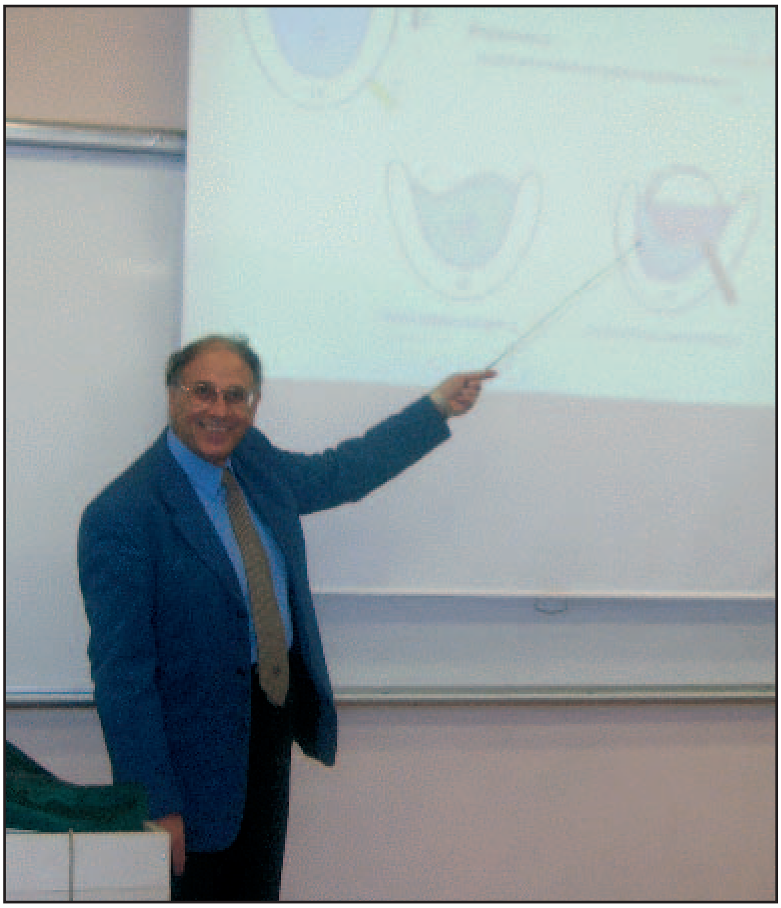


Figure 1:
Prof. Roger Ohayon lectures on the sloshing problem

During the last ten years IACMM has grown, attracting many members from both academia and industry, and has established itself as the leading CM force in the country.

One major type of activity that IACMM has constantly been involved in is the IACMM Symposium. IACMM Symposia are usually held twice a year, in the fall and spring. Eighteen IACMM Symposia were held so far; the 19th will be held in late October 2005 in Tel Aviv. Each Symposium consists of one full day of lectures.

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

- "Multigrid Methods" (given by Irad Yavne),
- "Computer Aided Design" (given by Michel Bercovier),
- "*p*-version FEM" (given by Zohar Yosibash),
- "High Performance Computing" (given by Moshe Goldberg),
- "Structural Optimization" (given by Moshe Fuchs),
- "Computational Aeroelasticity" (given by Mordechay Karpel),
- "Hydrodynamic Stability Analysis" (given by Alexander Gelfgat),
- "Computational Fracture Mechanics" (given by Leslie Sills),
- "Fuzzy Logic" (given by Yossi Levitas) and
- "Genetic Algorithms" (given by Daniel Lewin).

Figure 2:
IACMM Council members with Prof. Ohayon.
From left to right:
Prof. Zohar Yosibash from Ben-Gurion University of the Negev (the local host), Prof. Dan Givoli from the Technion, Prof. Isaac Harari from Tel Aviv University (the current President of IACMM), Prof. Roger Ohayon,
Prof. Pinhas Bar-Yoseph from the Technion, and Dr. Erez Gal from Ben-Gurion University of the Negev.

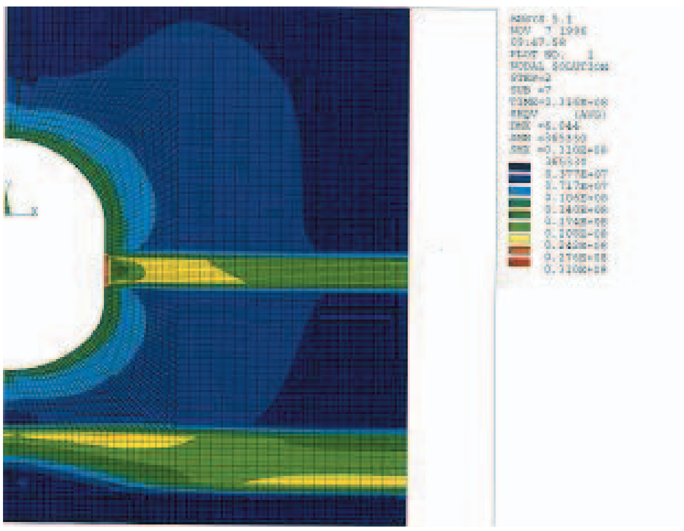
Often IACMM invites eminent scientists from abroad to give keynote talks at IACMM Symposia. Past speakers included Rafi Haftka from the University of Florida, who spoke on new optimization techniques, Olivier Pironneau from the University of Paris VI, who spoke on domain decomposition methods, Michel Romerio from EPFL at Lausanne, Switzerland (whose invitation was kindly supported by the Cray company), who spoke on computational models for metal processes, and Ch. Hirsch from Vrije University in Brussels, Belgium, who spoke about trends in multiphysics CFD.

Most recently (Oct. 2004), IACMM had the pleasure of hosting Prof. Roger Ohayon from Conservatoire National des Arts et Metiers (CNAM), a leading international authority in the area of computational methods for fluid-solid interaction problems. Prof. Ohayon gave a very interesting keynote lecture on the subject. In passing, Prof. Ohayon pointed to the change that had occurred in recent years in the way CM is used in industry. The traditional approach said: ***"Do not dare do only computations, without a good basis of experiments to support them."*** The modern approach says, in addition: ***"Do not dare do only experiments, without a good basis of computations to support them!"*** In other words, computations now become essential in designing required laboratory experiments, and are percieved as an integral part of the experimental system.

Fig. 1 shows Prof. Ohayon talking about a sloshing problem during his lecture.

Fig. 2 gives a view of an evening meeting of Prof. Ohayon an IACMM council members.

Figure 3:
Stress analysis of a large salt cave.



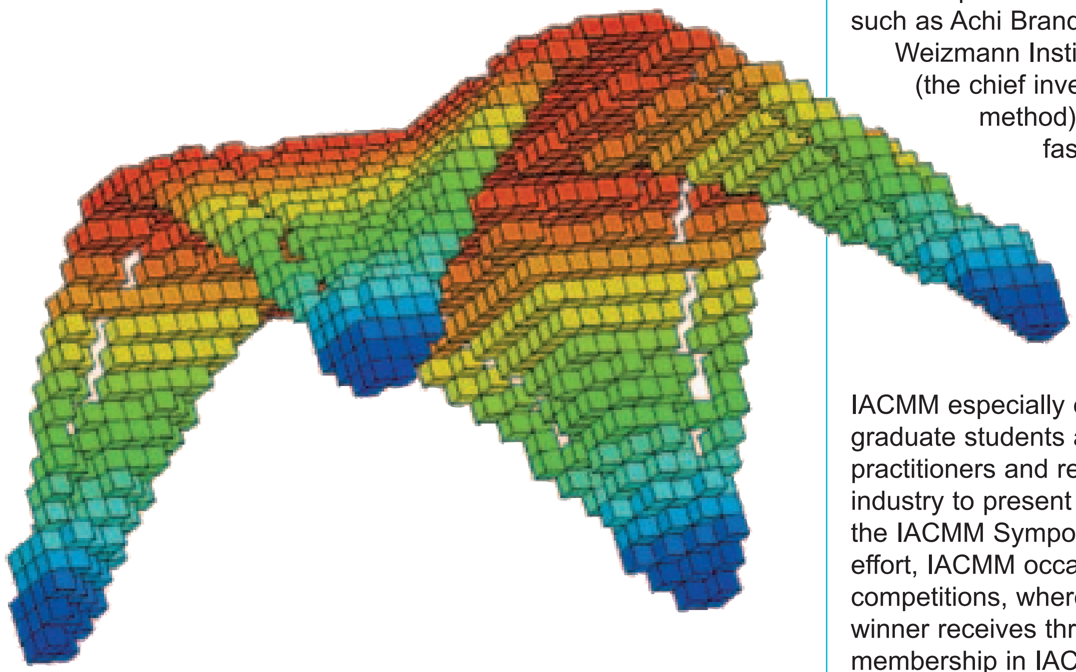


Figure 4:
Three dimensional topology optimization. The initial domain is a cube, whose four lower corners are supported, and which is loaded by a uniform load at the top.

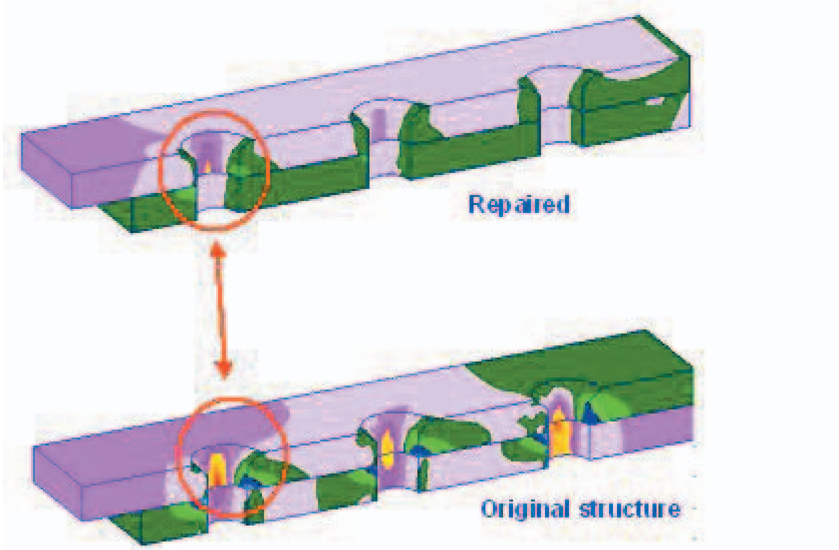


Figure 5:
Finite element stress analysis of a composite patch.

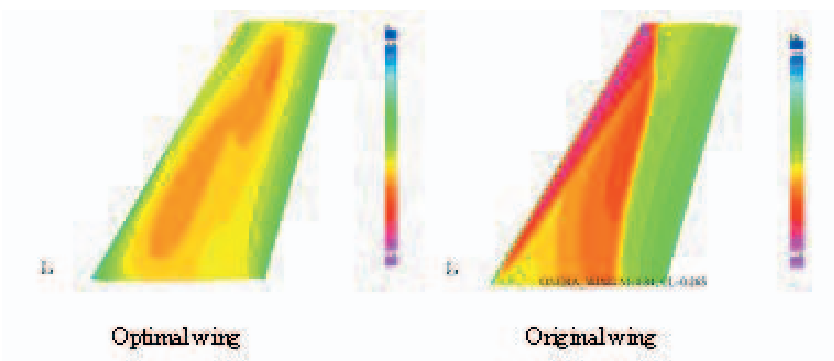


Figure 6:
Pressure distribution in original and optimal wings.

The list of invited speakers also included prominent Israeli researchers, such as Achi Brandt from The Weizmann Institute of Science (the chief inventor of the multigrid method), who spoke about fast multiscale solvers, and Uri Kirsch from the Technion, who spoke about Directed Structural Optimization.

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

IACMM has its own Newsletter which is published in Hebrew twice a year and is edited by the author. This is much more than a CM bulletin board. It includes short articles and surveys on various CM topics, book reviews, riddles on CM topics, etc.

Past issues included articles on;
- the dynamic analysis of large salt caves (by Amiel Harshaga from Israel Electric Company; see *Fig. 3*);
- topology optimization (by Moshe Fuchs from Tel Aviv University, see *Fig. 4*);
- analysis of composite material patches in aircrafts (by Ido Kressel et al. from Israel Aircraft Industries, see *Fig. 5*);
- and aerodynamic shape-optimization for wings (by 'Boris Epstein and Sergey Peigin from Israel Aircraft Industries, see *Fig. 6*).

IACMM is naturally affiliated with IACM. In addition, IACMM is also affiliated with the European CM body, ECCOMAS. Caption for figures ●

http://www.iacmm.org.il

For all inclusions under USACM please contact:

Wing Kam Liu
Institute on Nano Mechanics and Materials
Northwestern University
Voice: 847-491-7094
Fax: 847-491-3915
w-liu@northwestern.edu

NORTHWESTERN UNIVERSITY

UNIVERSITY OF CALIFORNIA LOS ANGELES

7th world congress on computational mechanics

Westin Century Plaza Hotel & Spa

at Century City
Los Angeles, California USA

July 16-22, 2006

The Seventh World Congress on Computational Mechanics, co-hosted by Northwestern University and University of California at Los Angeles (UCLA), will be held in Westin Century Plaza Hotel & Spa, Los Angeles, California, USA, July 16-22, 2006. The 7th WCCM will provide a forum for the latest developments in computational mechanics and engineering, computational nanotechnology, computational materials science, computational mathematics, computational bio-sciences, and high performance computing in mechanics and applied mathematics.

The Conference will highlight all areas of computational mechanics, but special emphasis is being placed on plenary and semi-plenary lecturers working on cutting edge developments in the field. Vendor exhibits in software and publications of interests to conference attendees will also be featured.

The sessions will be held in the Westin Century Plaza Hotel & Spa, a premium luxury hotel located in the prestigious Century City, where numerous guest rooms have been reserved for the 2006 WCCM attendees. The Westin Century Plaza Hotel & Spa is only minutes away by freeway to sandy beaches, Getty Center, Santa Monica, Third Street Promenade, UCLA, Universal Studios and Disneyland, and about 25 minutes to the LAX airport. The hotel is located in the heart of Century City on Los Angeles' fashionable West Side, directly adjacent to Beverly Hills and the famed Rodeo Drive. All guest rooms in Century Plaza Hotel & Spa feature newly renovated luxury amenities and appointments, high-speed Internet access, and large private lanais affording magnificent views of the Pacific Ocean to the west and Beverly Hills and Hollywood to the east. The luxury property overlooks the ABC Entertainment Center and sits across the street from Westfield Shopping town. The hotel features a recently completed 35,000-square-foot resort spa, Spa Mystique, which was voted Los Angeles' "best day spa". The hotel is easily reached and offers abundant opportunities for cultural and theme park visits. Other nearby hotels are also available.

An extensive social program is being planned, with a reception on Monday evening and a banquet on Thursday. Los Angeles is a top destination for international travellers. A spouse's program and optional tours to world-renowned attractions such as the Disneyland, Knott's Berry Farm, Getty Center Museum, Huntington Library and Botanical Garden, Universal Studios, Disney Concert Hall, LA Museum of Art, LA Zoo, LA Museum of Natural History, and UCLA are planned.

Los Angeles is also within easy driving range of numerous other famed attractions, such as Santa Barbara, Palm Springs, Salton Sea, Big Bear Lake, Channel Islands National Park, Catalina Island, Joshua Tree National Park, Death Valley National Park, Yosemite National Park, Kings Canyon/Sequoia National Parks, San Diego (SD Zoo, Sea World, SD Wildlife Zoo), and Las Vegas. San Francisco is also about one hour away by air.

For detail information, please visit:http:
www.wccm2006.northwestern.edu

General Chairman
W. K. Liu
Technical Program Chairman
J. S. Chen
Organization Co-Chairmen
T. Belytschko
B. Moran
L. Keer
H. Espinosa
J. W. Ju
E. Taciroglu
S. Osher
T. Chan
N. Ghoniem

APACM NEWS

Asian-Pacific Association of Computational Mechanics

For all inclusions please contact:

G. Yagawa
University of Tokyo
School of Engineering
Department of Quantum Engineering and Systems
Phone: +81 3 5841 6993
Fax: +81 3 5684 3265
yagawa@eng.toyo.ac.jp

The 10th International Conference on Enhancement and Promotion of Computational Methods in Engineering and Science (EPMESC X)

FIRST ANNOUNCEMENT CALL FOR PAPERS And CALL FOR PARTICIPATION

Treasure Island Sea View Hotel, Sanya, Hainan, China

21 – 23 August, 2006

http://www.epmescx.org.cn/

E-mail: yuanmw@pku.edu.cn, yuanmingwu@hotmail.com

The series of EPMESC international conference devoted to computational methods in engineering and science was created by a group of prominent scholars in this field: Prof E. A. e Oliveira, Prof Y. K. Cheung, Prof T. Kawai and the late Prof S. F. Luo. The first was held in Macao in 1985 and thereafter held alternately in Macao and a city in China including Guangzhou, Dalian and Shanghai. The tenth EPMESC international conference will be held in Sanya, Hainan Island of China. The Conference Board and the Organizing Committee invite all involved with computational methods in engineering and science to participate and contribute to the conference to foster creation of knowledge as well as friendship.

Sanya is a beautiful ecological tropical city in southernmost China. Treasure Island sea view hotel (4-star), the conference venue, is right located in the side of the beach. You can enjoy the swimming, breath taking sights and sounds of the sea.

The following subject areas have been selected for presentation and discussion in the technical sessions of the Conference: Artificial Intelligent Techniques and Applications; Biomechanics; Computer Aided Design & Engineering; Computer Aided Instruction; Computational Techniques; Electromagnetism; Environmental Applications; Fluid Mechanics & Hydraulics ; Geographic Information Systems; Geotechnics ; Mathematical modeling; Numerical Methods (e.g. FEM, BEM, etc.); Physics and Material Science; Solid Mechanics ; Structural Engineering; Visualization. Papers in other relevant areas not listed above are also welcomed.

Paper summaries in PDF format file are requested to submit before Feb 1, 2006 by e-mail to the conference Secretariat at: yuanmw@pku.edu.cn oryuanmingwu@hotmail.com . Minisymposia are welcomed to be organized.

A Student Paper Competition is added to the program in this upcoming meeting. The winners will be announced and receive their awards during the Conference.
The accepted papers in full scale including those for Student Paper Competition will be collected in the proceedings published in CD-ROM.

It is a strong hope of the Organizing Committee that the researchers, professors, students in the field of computational mechanics in engineering and science come to Sanya to join this important event. ●

Preliminary Announcement of

APCOM'07 in conjunction with EPMESC XI

December 3-6, 2007

Kyoto, Japan

The **Asian-Pacific Association for Computational Mechanics (APACM)** and the **Conference Board for the Enhancement and Promotion of Computational Methods in Engineering and Science** (EPMESC) are pleased to announce that the Third Asian-Pacific Congress on Computational Mechanics (APCOM'07) in conjunction with the Eleventh International Conference on Enhancement and Promotion of Computational Methods in Engineering and Science (EPMESC XI) will be held in **Kyoto**, **Japa**n during **December 3-6, 2007**. The Japan Association for Computational Mechanics (JACM), the Japan Society of Computational Engineering and Science(JSCES) and the Japan Society of Mechanical Engineers/Computational Mechanics Division(JSME/CMD) serve as local organizers of this event.

Biography of
Professor Yuanxian Gu
(1954-2005)

Professor Yuanxian Gu was born in Dalian, Liaoning Province, China on July 31, 1954. He graduated from Dalian University of Technology in 1982, majoring in Engineering Mechanics. After getting his Ph.D. degree in 1988, he began his career as a Lecturer in Dalian University of Technology. He was promoted to Associate Professor in 1990 and full Professor in 1992. He passed away in Rio De Janeiro, Brazil on May 30, 2005 during his participation in the 6th World Congress on Structural and Multidisciplinary Optimization.

Before he passed away, Yuanxian Gu was Professor and Chair of the Department of Engineering Mechanics, Dalian University of Technology. He also served as Deputy Director of Research Institute of Engineering Mechanics of the university and Director of the State Key Laboratory of Structural Analysis for Industrial Equipment. His specialty was Computational Mechanics and his research fields widely covered structural and multidisciplinary design optimization, finite element method, CAD/CAE technology, computing visualization and engineering-software development. Among many of his honors, Professor Gu was awarded by the National Outstanding Young Science Foundation of China in 1995 and by the National Young Specialists Having Outstanding Contributions of China in 1997. He became the medallist of the National “May Day” of China in 2003 and won the National Medal of China in 2005, both are considered to be the top honors for Chinese citizens. He held the positions of Special Professor of the Yangzi Scholar Project of China since 1999 and the Excellent Specialist of Liaoning Province since 2002. He was appointed the Leader of National Innovative Research Team in 2004.

Professor Gu was one of the Vice-chairmen for the successfully organized WCCM Congress in Beijing during 2004 .He was also a Council-member of International Association of Computational Mechanics (IACM), Asian-Pacific Association of Computational Mechanics (APACM) and a member of International Society of Structural and Multidisciplinary Optimization (ISSMO). He was also a member of Executive Council of Chinese Society of Theoretical and Applied Mechanics (CSTAM), commissioner of Professional Computational Mechanics of CSTAM, chairman of Society of Mechanics of Liaoning Province and deputy commissioner of Computer Aided Design and Graphics of Chinese Society of Computer.

He was co-editor of thirteen domestic and international academic journals, including Optimization and Engineering, International Journal for Multiscale Computational Engineering Graphics and Science. He was in charge of several grants by the National Natural Science Foundation of China. He has made important contributions to the theory and numerical methods for structural optimization, integrated CAD technology, development and applications of finite element analysis and structural design optimization software systems.

Professor Yuanxian Gu will be long remembered for his professional spirit, kindness, pleasant manners, genuine friendship and his warm heart among colleagues, friends and his students. ●

S.Valliappan
Zhong Wanxie
Mingwu Yuan

The Congress will feature the latest developments in all aspects of computational mechanics, with many other emerging computation-oriented areas in engineering and science. In addition to plenary lectures and mini-symposia that highlight the latest trends in computational mechanics, numerous vender exhibits are planned.

Kyoto, surrounded by gracefully wooded hills and mirrored by 1200 years’ history, was the capital of Japan from 794-1868 AD. In addition to beautiful Imperial Villas, Kyoto has about 400 Shinto shrines and 1,650 Buddhist temples, which dot the entire city. Innumerable cultural treasures and traditional crafts attract visitors to Kyoto. Today, the city of Kyoto is also a bustling academic city that is young-at-heart, with nearly 50 institutions of higher education, and a home to many world-class corporate research giants. The congress period is the time for viewing the beautiful deep red foliage of the Japanese Maple. ●

http://www.apacm.org/apcom07-epmescXI

MECOM 2004

For all inclusions under AMCA please contact:

Victorio Sonzogni
Güemes 3450
3000 Sante Fe
Argentina

Tel: 54-342-451 15 94
Fax: 54-342-455 09 44
Email: sonzogni@intec.unl.edu.ar
http://venus.arcride.edu.ar/AMCA

VIII Argentinian Congress on Computational Mechanics

Buenos Aires, Argentina, November 16-18, 2005

Organized and hosted by: **School of Engineering and Sciences, and Center for Advanced Studies, Universidad Argentina de la Empresa (UADE)**.
Sponsored by: **Argentine Association for Computational Mechanics (AMCA)**.

In the year of its 20th anniversary, the Argentine Association for Computational Mechanics is pleased to inform that the Call for Abstracts for MECOM 2005 has resulted in more than 230 contributions. The conference has largely exceeded its original national scope, as papers have been received from many American and European countries. The contributions came mainly from Argentina, Brazil, Venezuela, Chile, and USA, but some have also been received from Spain, Uruguay, Ecuador, México, Canada, Italy, and Germany.

Besides the usual Ordinary Sessions on Fluid Mechanics, Solid Mechanics, etc., there are sixteen Invited Sessions under way, organized by researchers from Argentina and other American countries. Additionally, there will be a Poster Session, devoted to papers in which the first author is an undergraduate or graduate student, which will include awards for the best papers.

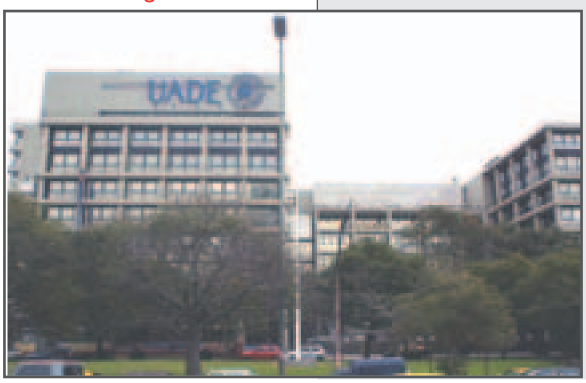
The Call for Full Papers for contributions with accepted abstracts is open until **August 19th, 2005**. Both papers and talks are welcomed in Spanish, Portuguese, and English.

Invited Session Organizers: Marcela Cruchaga & Gustavo Nonato (Moving interface problems); Ángel Menéndez, Marcelo Venere & Carlos Vionnet (Water resources and environmental engineering); Diego Celentano & Carlos García Garino (Constitutive modeling of materials); Jorge Crempien Laborie (Dynamics of structures); Gustavo Sanchez Sarmiento (Heat transfer in industrial processes); Gabriel Barrenechea (Mathematical aspects of finite elements); Fabián Bombardelli (Simulation of turbulent flows using DNS, LES and RANS); Pablo Tarela & Fernando Camelli (Numerical simulation of atmospheric dispersion processes); Gabriel Zamonsky & Pablo Lacentre (Petroleum reservoir simulation); Norberto Nigro (Computational mechanics applied to automobile industry and other terrestrial vehicles); Luis Godoy & Fernando Flores (Stability and non-linear behavior of slender structures); Mario Storti, Jorge D'Elía, Victorio Sonzogni, Guillermo Marshall & Carlos García Garino (Distributed Computing: HPC, GRID and Access Grid); Jorge Luis Baliño (Modeling and Simulation of Dynamic Systems using Bond Graphs); Miguel Cerrolaza & Gabriela Martinez (Biomedical devices modeling); Sergio Elaskar, Eduardo Zapico & José Tamagno (Space Technology); Juan Carlos Ferreri (Computational Fluid Dynamics in the nuclear industry)

Organizing Committee:
Local Committee
Axel Larreteguy *(Chairman)*
Gabriel Zamonsky *(Proceedings)*
Marcelo Raschi *(Logistics)*
Paola Dellepiane *(Secretary)*
Lelia Zielonka *(Secretary AMCA)*
Honorary Presidents
Sergio Idelsohn, *CIMEC (Argentina)*
Juan Carlos Ferreri, *ARN (Argentina)*

The congress will be held in the premises of Universidad Argentina de la Empresa, a non-profit private university (a Foundation) created more than 40 years ago by the Cámara de Sociedades Anónimas. With more than 14,000 students, it is one of the largest private universities in the country ***(see www.uade.edu.ar)***. ●

Figure 1: *Universidad Argentina de la Empresa - Congress venue*



Further information:
By mail: Comité Organizador MECOM 2005
Facultad de Ingeniería y Ciencias Exactas
Universidad Argentina de la Empresa
Lima 717, C1073AAO Buenos Aires, Argentina
By phone: (54.11) 4000-7496
By fax: (54.11) 4000-7495
Or visit: ***www.fain.uade.edu.ar/mecom2005***

The 20th anniversary of the Argentinean Association for Computational Mechanics (AMCA)

Some reflections by Juan Carlos Ferreri

This note is aimed at clarifying a paradox and stating, according to my view, who the people are that contributed to establish the AMCA, our national association for Computational Mechanics, and kept it proudly growing along its first twenty years of existence. The obvious risk in mentioning people is to forget someone, but I will accept being blamed for it.

AMCA nucleates people from different scientific disciplines with the common interest of promoting:

a) the advancement of knowledge in the field of Computational Mechanics,
b) the exchange of experience on the use of numerical methods and computational tools in both the academy and the industry,
c) the improvement of teaching at the academy and professional training in the industry and,
d) forums dedicated to discussing the way of performing research and development leading to sustainable technological development.

Now let's consider the paradox. In the January 2005 issue of the IACM Bulletin the reader may find an article related to ENIEF-2004, the XIV Congress on Numerical Methods and their Applications. ENIEF is the Spanish acronym for National Meeting of Researchers (and Users) of the Finite Elements Method. For an Argentinean freshperson in Computational Mechanics it may be hard to associate said acronym with its expanded form. This is the simple paradox that I will consider firstly.

The reason for it lasts on the first ENIEF, held at Bariloche, near the Andes Mountains in 1983. In one plenary after-session meeting, one of the organizers advanced the idea of founding a society devoted to promote the FEM as a sort of unique tool in Computational Mechanics. By these years I specialized (I still do) on the Finite-Differences Method as applied to Fluid Dynamics and Heat and Mass Transfer. I used to publish on numerical methods like linearized, alternating-direction methods applied to the Navier-Stokes equations and Heat and Mass Transfer in 3D unsteady systems. Also, natural circulation in the same physical context was the subject of my interest. Then, the objectives of such a society seemed conceptually restrictive to me. I felt discriminated and, due to this, I expressed my feelings and went away, accompanied by Prof. José Converti. Obviously, people finally agreed to promote the creation of a society with a broader scope in their objectives. However, quite reasonably, the acronym for the meeting was maintained but its full meaning changed to what I mentioned before. This should close the question on the acronym-meaning paradox.

What really counts is that the first ENIEF originated the meetings saga and lead to the creation of the AMCA two years later, i.e. 1985. Prof. Sergio Idelsohn was elected as the President of the AMCA. He still rules the society. Correspondingly, the Secretariat was established at INTEC, Province of Santa Fe, Argentina. Prof. Victorio Sonzogni soon started to contribute very effectively. The INTEC is a well-known research center for Chemical Technology that contributed to establish many of the important lines of research and development in Argentina. Computational Mechanics was no exception to this, but it must be mentioned that the National Atomic Energy Commission, through Prof. Fernando Basombrío and Dr. Gustavo Sanchez Sarmiento, who was one of the young professionals involved in this early group, were also active in this field. Dr. Sergio Pissanetzky joined this group later. In fact, they organized the first ENIEF conferences at the Bariloche Atomic Center. Other people involved in these activities were Prof. Patricio A.A. Laura from Universidad Nacional del Sur, Profs. Carlos Prato and Luis Godoy, from the University of Córdoba (Argentina) and Prof. Guillermo Marshall from the University of Buenos Aires. Dr. Eduardo Dvorkin had also begun to develop his activities at the industry by these years. All these persons constituted a bunch of outstanding professionals emerging in this field at that time. Profs. Angel Menéndez, Alberto Cardona, Guillermo Etse, Carlos Garcia Garino, Mario Storti and other important people started later. By the way, Prof. Marshall organized the 1st Symposium on Numerical Methods in Continuum Mechanics that was held in Buenos Aires by mid 1977. This meeting may be considered the real initiating event for Computational Mechanics in Argentina. About fifty papers were presented and about one hundred fifty researchers attended the meeting.

Coming back to ENIEFs, it is nice looking at the pictures in the AMCA web-site **(http://www.amcaonline.org.ar)** and verifying the steady increment of attendees. In these pictures you may also find world wide outstanding people, like in the 1st ENIEF just for example, where Professor Richard H. Gallagher delivered a course on FEM and participated actively. It is also possible to verify the increasing quality of contributions by looking at the corresponding proceedings. The ENIEFs and other meetings, like their regional equivalents named MECOMs and their associated series of publications are one way of finding documented support for a part of the AMCA´s activities. The more recent IACM Bulletin constitutes another valid documentation site.

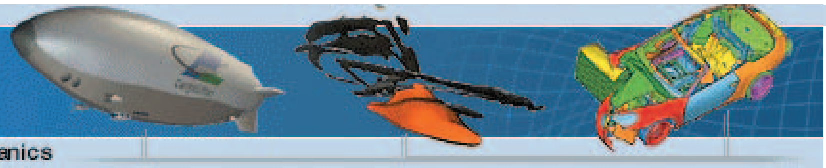
For sure there is more than one person that may be given credit for the success of the AMCA along these twenty years. However, out of any doubt, it was Prof. Idelsohn that marked all its development. He also used inviting influential members of the world wide academy to come to Argentina. Because of this, most young people belonging to the Computational Mechanics community benefited from these presences by attending seminars, courses and conferences. Obviously, one milestone in the history of the AMCA was the organization of the IACM International Congress on Computational Mechanics in 1998. All the "living textbooks" were present at the sessions, delivering plenary conferences facing some eight hundreds attendees here, down earth. A huge social dinner including a tango show was also a remarkable event. In this opportunity, the close collaboration of the Spaniard friends was noticeable. It was nice being there. Once again, Prof. Idelsohn left his imprint on the activities. I think that it is the time to mention Mrs. Lelia Zelionka, Sergio´s wife and factotum at the AMCA Secretariat, who was key to the persistence of administrative order at the AMCA and to the organization of all the ENIEFs.

It should be obvious that, after twenty years, a number of younger people must have appeared, coping with the leading roles in the organization of major events. Once again, they have been allowed, after discussing pros and cons with AMCA´s ad hoc committees, to organize the meetings at their institutions. This activity contributed to consolidate most recently established groups.

AMCA is now firmly established in Argentina as a professional and academic society; it has nearly two hundred members, participates at the IACM activities promoting knowledge in this particular area, seems internationally recognized and, more importantly in my view, supports the idea of a "famiglia" of dedicated senior friends (we joked by calling ourselves "the cousins") who join regularly to enjoy exchanging experience among them and with foreign experts in a friendly atmosphere, surrounded by an always increasing number of skilled, younger colleagues. It seems assured that the latter will pursue on the AMCA present tradition. This should be enough for most of us. ●

Juan Carlos Ferreri,
July 2005
Researcher and Staff Member at the Nuclear Regulatory Authority of Argentina, and founder member of AMCA

gacm
German Associaton for Computational Mechanics



news

For all inclusions under GACM please contact:

M. Bischoff

Phone: + 49 89 28922435
Fax: + 49 89 28922421
bischoff@bv.tum.de
http://www.gacm.de

News from German Universities

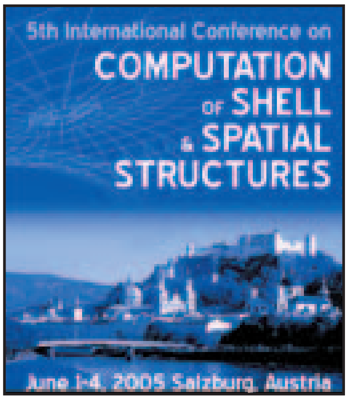
Excellence Initiative

After a long political discussion the 16 states and the federal government of Germany agreed on an Excellence Initiative to fund top-level research and education of German Universities for the next five years. The original proposal of the government in Berlin to select up to ten so-called Elite Universities has fortunately been turned down and replaced by additional funding of 30 excellence clusters and 40 high rank graduate schools. The selection is based on a fair quality oriented competition among all universities controlled by the well established peer review process of the German Research Council. ●

Tuition Fees

Germany is probably one of the last countries without tuition fees at the higher education institutions. Several states intend however to introduce moderate tuition fees in the near future; a sum of 500 Euro per semester is currently under discussion. These initiatives are accompanied by lively demonstrations of the current student population, with the argument, among others, that the universities will lose this extra money anyway by other economy measures enforced by the state governments. Despite these discussions it is very likely that tuition fees will be introduced in the years to come. ●

Ekkehard Ramm



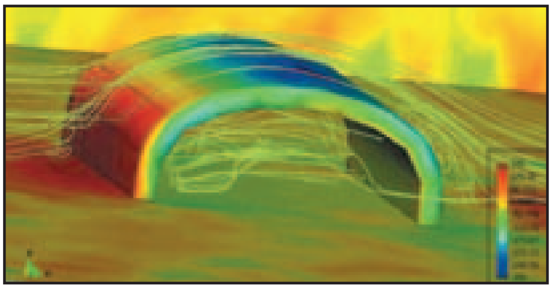


Figure 1:
Aerodynamic Analysis of Inflatable Pavillion (Oñate et al.)

Figure 2:
Discussion on Shell Models: Manfred Bischoff, Ekkehard Ramm, Tom Hughes and Robert L. Taylor (from left)

5th International Conference on Computation of Shell and Spatial Structures

June 1-4, 2005

The **5th International Conference on Computation of Shell and Spatial Structures (IASS IACM 2005)** took place in the Conference Center St. Virgil in **Salzburg**, **Austria**, **June 1-4, 2005**. It has been organized by E. Ramm (Universität Stuttgart), W.A. Wall, K.-U. Bletzinger and M. Bischoff (Technische Universität München) under the auspices of IACM, GACM and the International Association for Shell and Spatial Structures (IASS). It was also closely related to ECCOMAS, the European Community on Computational Methods in Applied Sciences, representing the interests of IACM within Europe. It followed the successful meeting of the same series held in Chania, Crete, in 2000.

Plenary lectures by T.J.R. Hughes, M. Kawaguchi, N. Kikuchi, E. Oñate, S. Pellegrino, R. Rammerstorfer, F. Seible and P. Wriggers have been scientific highlights of the meeting and reflected a well-balanced profile of scientists engaged in modeling, analysis and construction of shell and spatial structures and related subjects like material modeling, interaction problems and forfinding methods. Moreover, a total of 234 accepted papers, submitted from 38 countries and presented in five parallel

Bavarian Graduate School of Computational Engineering

Multidisciplinary Education for Elite Students

The Bavarian Graduate School of Computational Engineering (BGCE) is a combination of the three international master programs;

- Computational Engineering (Friedrich-Alexander-Universität Erlangen-Nürnberg)
- Computational Mechanics (Technische Universität München) and
- Computational Science and Engineering (Technische Universität München).

The school is part of the Elitenetzwerk Bayern (Elite Network Bavaria), already established in 2004. It is an initiative of the State of Bavaria to support education and advancement of highly talented students. With the help of this network it is possible to offer an elite degree program for the best students within the aforementioned master programs. After their first semester in one of the three programs, selected applicants are admitted to BGCE, in parallel to their ongoing master's studies. During their next two semesters they earn 30 additional credits – for a tailored combination of summer schools, block tutorials, advanced courses, project based education, and soft skills training.

Outstanding performance in one of the three master programs will be appreciated by the newly introduced academic degree of a "Master of Science with Honours" – the first generation of students aiming for that title are already on their way.

Lectures start in winter term, deadline for application is March 15 in the same year.
For more information visit **www.bgce.de;** here you also find links to the home pages of the individual programs and the new online application systems which will be available in October this year.

A Conference on Advanced Structural Concepts and Methodologies

Salzburg, Austria

sessions covered a multitude of aspects in advanced structural concepts and methodologies.

Besides the gratifying response by numerous well-known scientists to invitations to both arrange and contribute to a number of organized sessions, the special flair of the venue St. Virgil as well as an extensive social program, taking the attendees to picturesque locations in and around Salzburg, may have contributed to the likewise relaxed and scientifically inspiring atmosphere of the meeting.

The next meeting of the series is planned to take place in 2008 in Ithaca, USA, hosted by Cornell University and chaired by Professor John Abel.

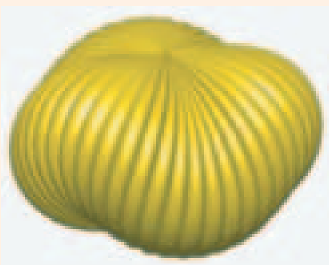


Figure 3:
Buckling of Pumpkin Balloon (Pelegrino et al.)

Figure 4:
Wolfgang Wall and Franz Rammerstorfer

Figure 5:
Karl Schweizerhof and Peter Wriggers

IndACM

For all inclusions under IndACM, please contact:
Prof. Tarun Kant

Tel: +91-22-2576-7310

Indian Association for Computational Mechanics

A REVIEW

IndACM web page

A new home page for IndACM is being hosted at

http://indacm.civil.iitb.ac.in

The forthcoming
International Conference on Computational & Experimental Engineering and Science
will be held at
Chennai:

http://www.icces-india.org/index.html

IndACM in collaboration with ***IIT Kanpur*** organized an
International Congress on Computational Mechanics and Simulation (ICCMS-04)
during Dec 9-12, 2004.
The details of the conference can be seen at:

http://www.iitk.ac.in/news/ICCMS/

Invited Lectures

Dr. Gangan Prathap, Director, CSIR Centre for Mathematical Modeling & Computer Simulation, Bangalore has given the following lectures:

- ***'Management by stress model of finite element computations'*** at GE – John F. Welch Technology Center on 8 April 2005
- ***'The unsymmetric finite element formulation and variational incorrectness'*** at CMMACS on 17 June

Three members of IndACM
have been invited to be on the editorial board of
International Journal of Computational Methods in Engineering Science & Mechanics,
published by Taylor & Francis:

http://www.tandf.co.uk/journals/titles/15502287.asp

- ***Dr. S. Gopalakrishnan*** - Department of Aerospace Engineering, Indian Institute of Science, Bangalore
- ***Prof. Tarun Kant*** - Department of Civil Engineering, Indian Institute of Technology, Bombay
- ***Dr. G. Prathap*** - CSIR Centre for Mathematical Modeling & Computer Simulation, Bangalore

A Brief History

For all inclusions please contact:

Paulo R. M. Lyra
or
Ramiro B. Willmersdorf
Departamento de Engenharia Mecânica CTG
Universidade Federal de Pernambuco
Av. Acadêmico Hélio Ramos S/N
Cidade Universitária
Recife/PE 50740-530
Tel:(081)21268230 (R.235)
Fax:(081) 21268232
E-mail:
presidente@abmec.org
tesouraria@abmec.org
http://www.abmec.org

ABMEC was founded in **September 1997** during the Workshop on Computational Methods for Oceanic and Atmospheric Flows held at LNCC, Rio de Janeiro, as “Associação Brasileira de Mecânica Computacional” (Brazilian Association on Computational Mechanics). ABMEC was created by a group of engineers and researchers who believed strongly that computational simulation was one of the most important tools for the understanding of natural phenomena and the solution of real world engineering problems. As such, ABMEC has always had a strong focus on education, directed to both students and engineering professionals.

ABMEC had its name changed in 2004 to **“Associação Brasileira de Métodos Computacionais em Engenharia”** (Brazilian Association on Computational Methods in Engineering). The association has been recently under reorganization and revitalization, promoting plurality and interdisciplinarity. Several important activities have been undertaken in the last few months, such as:

The definition of CILAMCE as the official annual ABMEC conference.
The award of the Honorary Presidency of ABMEC to Professor Agustin Juan Ferrante, in recognition of his contributions to the Brazilian computational mechanics community.

A new name, logo mark and web site were created.

It was started a large effort to invite former members back into the association, and to recruit new affiliates;
ABMEC is sponsoring the organization of conferences on computational mechanics and related subjects in Brasil, such as:

CILAMCE 2005	–	**www.inf.ufes.br/cilamce2005/**
SIMMEC 2006	–	**www.cefetmg.br/simmec2006/**
VECPAR 2006	–	**http://vecpar.fe.up.pt/2006/index.html**
LNCC Workshops	–	**www.lncc.br**

Joint sponsorship, together with the Argentinean Association of Computational Mechanics and the Mexican Association of Numerical Methods in Engineering and Applied Sciences, of the Latin American Journal of Solids and Structures (http://www.lajss.org).

A Brief History of CILAMCE Congresses

The CILAMCE Congresses, encompassing different Engineering fields, started in 1979 in Porto Alegre as a continuation of the pioneering civil engineering conferences held in Rio de Janeiro in 1977 and in São Paulo in 1978, which congregated practically all of the nascent computational mechanics community in Brazil. Over the last 25 years the CILAMCE conference has played a major role in the dissemination of the most recent computational applications and computational developments throughout the Iberian Latin American community. Last year it was held in Recife and over the previous years it was organized sixteen times in Brasil and nine times abroad.
The previous events took place in: Porto Alegre (1979), Curitiba (1980), Buenos Aires/Argentina (1982), Santiago/Chile (1983), Salvador (1984), Madrid/Spain (1985), São Carlos (1986), Rio de Janeiro (1987), Córdoba/Argentina (1988), Porto/Portugal (1989), Rio de Janeiro (1990), Santa Fé/Argentina (1991), Porto Alegre (1992), São Paulo (1993), Belo Horizonte (1994), Curitiba (1995), Pádua/Italy (1996), Brasília (1997), Buenos Aires/Argentina (1998), São Paulo (1999), Rio de Janeiro (1999), Campinas (2001), Giulianova/Italy (2002), Ouro Preto (2003), Recife (2004).
See **www.abmec.org/cilamce/history/** for a photographic historical album of all the previous editions. ●

CILAMCE2004

Following the success of the previous **Iberian Latin American Congress on Computational Methods in Engineering (CILAMCE)**, the 25th Jubileu edition was held in Recife, Pernambuco, Brasil, **12 to 15 of November 2004**. It was organized by the Federal University of Pernambuco (UFPE) and it was sponsored by the Brazilian Association for Computational Methods in Engineering (ABMEC). The organizing committee consisted of: Paulo R. M. Lyra (President) Silvana M. B. Afonso da Silva (Vice-President) and Fábio S. Magnani, Leonardo J. do N. Guimarães, Lícia M. da Costa and Evandro Parente Júnior as members.

Recife, capital of Pernambuco, is one of the state capitals with the strongest character in Brasil, in which several important political-historical events took place. It is a very attractive tourist city in the northeast region, with several historical sites, nice beaches and lively and multi-cultural nightlife.

A special session celebrating the 25Th anniversary of this multidisciplinary and well-established congress happened during the opening ceremony. An award was given to Prof. Agustin Juan Ferrante in recognition for his contributions to the start and consolidation of the CILAMCE congresses.

Some Innovations From Previous Editions

Plurality and Multidisciplinarity
The congress scope was broadened to cover the vast majority of engineering and several applied sciences fields.
Paper Submission and Reviewing Process
Another innovation of this edition of the CILAMCE was the paper submission and reviewing process performed fully on-line.
Undergraduate Students Paper Competition
A specific mini-symposium called "Research Beginners on Computational Mechanics" with a prize for the three best papers was created to stimulated the participation of undergraduate students. They were: Eduardo R. R. Brito Junior (UFPE), Flávia M. G. Villarroel (PUC-Rio) e Flávio T. Da Fonseca (UFMG).

Journal Papers Publication
A committee was formed to select the best papers of the conference for publication on two International Journals, Communications in Numerical Methods in Engineering and a special edition of the Latin American Journal of Solids and Structures.

Some Statistics of the 25th Edition
Participants: There were researchers from 16 countries (Americas, Europe and Asia) and from 20 states of Brasil. Besides, we had around: 45 undergraduate students, 110 graduate students and 445 professionals. Initially more than 1000 abstracts were submitted, then 642 full papers were submitted and after the three stage reviewing process 586 papers were accepted to be present in the conference and published in the conference proceedings.

Scientific Programme: 6 invited plenary lectures and 16 invited mini-symposia keynote lectures performed by respected international experts, 32 thematic mini-symposia with contributed papers, encompassing most Engineering and Applied Sciences fields and one "Research Beginners" mini-symposium.

The Congress banquet and ball happened at Brum's Fortress, a nice historical place built in the 17th century by the Portuguese and Dutch. After the student award session, we had folk dance presentations, dinner and a plenty of drinks and a dancing throughout the whole night.

There was an unofficial post event activity as well, as several CILAMCE participants decided to extend their visit and go to the wonderful Porto de Galinhas beach, where there were a lot of non-technical and technical conversations. On the 14th of November we've got to know that it was Prof. Graham F. Carey 60th anniversary, which he celebrated surfing and drinking cold beer on the beach. ●

Plenary Lectures

Antonio Gens, - Universidad Politécnica de Cataluña/Spain, "Coupled Analysis In Geomechanics";
David Darmofal, - Massachusets Institute of Technology/USA "Towards a Higher-Order Solver for Aerodynamic Applications using a Discontinuous Galerkin Discretization";
Gláucio Hermógenes Paulino University of Illinois at Urbana-Champaign/USA, "Simulation of Dynamic Failure of Functionally Graded Composites";
Graham F. Carey, - University of Texas at Austin/USA, "Modeling Issues and Adaptive Meshing for Nonlinear Applications With Parallel PC Cluster Simulations";
Nigel P. Weatherill, - University of University of Wales - Swansea/UK, "Towards Mesh Generations for Computational Mechanics applications";
Vassili Toropov, - Altair Engineering, UK, "Approximations Techniques in Engineering Design Optimization".

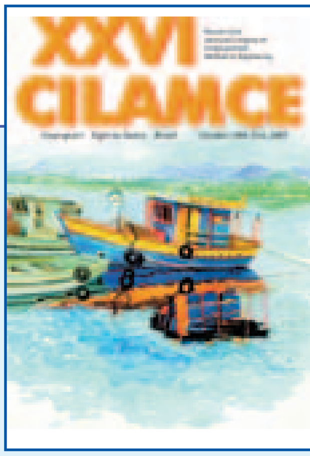
Figure 1:
Opening Ceremony.

Figure 2:
Plenary Section.

Figure 3:
Prof. Agustin Juan Ferrante receiving ABMEC award from Silvana M. B. Afonso

Figure 4:
Some of the invited speakers during the dinner:
José César de Sá (Portugal),
Vassili Toropov (UK),
David Darmofal (USA),
Paulo R. M. Lyra (Brasil),
Graham F. Carey (USA),
Nigel P. Weatherill (UK).

CILAMCE2005



The 26th edition will be held in Guarapary, Espírito Santo, Brasil, 19 to 21 of October 2005.
It is being organized by the Federal University of Espírito Santos (UFES). The organizing committee consists on: Andréa M. P. Valli (Chairman), Neyval C. Reis Jr. (Co-Chairman), Antônio M. F. Frasson, Fernando C. M. Menandro, Juan S. R. Saenz, Lucia Catabriga, Marta M. da C. Cruz, Raul H. Cardoso Lopes, Walnório G. Ferreira, as members.

Date and Venue
The XXVI CILAMCE will be held in October 19-21, 2005, at the Centro de Convenções Flávio Schneider of SESC, in the city of Guarapari, State of Espírito Santo (ES), Brazil. The SESC is located 50 kilometers from Vitória, capital of the ES, and has inside its private area the Convection Center (transfer from the airport will be provided), a comfortable hotel, restaurants, bar, swimming pools and free parking. For the plenary and keynote lectures a 400-seat auditorium will be used, and for the technical contributions 8 rooms ranging from 55 to 128 seats will be available.

Scientific Program
The CILAMCE 2005 will be organized in a set of mini-symposia covering a vast range of multidisciplinary subjects on computational methods in engineering and applied sciences. The scientific program of the Congress consists of invited plenary lectures and invited mini-symposia keynote lectures by respected experts, contributed papers and poster presentations for under-graduated students.

Confirmed Plenary Lecturers
Abimael F. D. Loula, Laboratório Nacional de Computação Científica (LNCC), "Discontinous Finite Element Methods for the Solution of Helmholtz Problems"; Eduardo A. de Souza Neto, University of Wales Swansea, "Contact and Friction Modelling"; Isaac Harari, Tel Aviv University, "Spatial Stability of Semidiscrete Formulations for Transient Computation"; J. N. Reddy, Texas A&M University, "Computational Models of Materials and Mechanics"; Mary F. Wheeler, The University of Texas at Austin, "Computational Challenges in Geomechanics"; Rainald Löhner, George Mason University, "Large-Scale Simulation of Flows with Violent Free Surface Motion";

Mini-Symposia
Advanced Analysis in Steel Structures; Advanced Turbulence Modelling for Industrial CFD; Analysis and Design of Offshore Structures and Pipelines; Beams, Plates, Shells and Solid Structures; Biomechanics; Boundary element methods; Computational Fluid Dynamics; Computational Geo-mechanics and Geophysics; Computational Mechanics of Advanced Materials Concrete Structures; Environmental Flows; High Performance Computing; Identification of Structures; Industrial CFD Applications; Mesh Generation and Adaptivity; Non-linear Analysis, Stability and Structural Dynamics; Numerical Analysis and Computational Simulation Numerical Methods in Acoustics and Vibrations; Numerical Methods in Electricity and Electromagnetism; Numerical Simulation and Optimization of Thermal Systems; Numerical Simulation and Optimization of Transportation Systems; Numerical Simulations in Chemical Engineering Numerical Simulation of Non-linear Dynamic Coupled Problems; Object Oriented Systems; Optimization; Plasticity, Damage, Fracture and Fatigue; Reservoir Simulation; Soft Computing, Data Modelling and Information Technology; Structural Optimization; Structural Reliability.

Further Information
For further information go to the conference homepage
http://www.inf.ufes.br/~cilamce2005/,
or send an e-mail to cilamce2005@inf.ufes.br. ●

CHILEAN SOCIETY FOR COMPUTATIONAL MECHANICS

The Universidad Técnica Federico Santa María (UTFSM) at Valparaíso (Chile) has hosted the JMC 2005, IV Workshop on Computational Mechanics. The annual meeting organised by the Chilean Society for Computational Mechanics (CSCM) was fruitful in speakers and participants from different Chilean universities and areas of sciences. Several works are fully reported in "Cuadernos de Mecánica Computacional", the journal of the Society, covering different computational mechanics aspects ranging from basic research to industrial applications. It is important to remark that several students from different levels have attended the meeting and many papers were co-authored by postgraduate students who have the possibility to present their first research works. The CSCM thank to the Mechanical Engineering Department of UTFSM who fully supported the visit of Prof. Rainald Löhner offering us the exceptional possibility to have him as Plenary Lecturer. Moreover, the Head of this Department remembered the 10th birthday of the CSCM giving a present to the Society (founded in 1995).

Figure 1:
Participants of the IV Workshop on Computational Mechanics hosted by the Universidad Técnica Federico Santa María (UTFSM) at Valparaíso, August 26th 2005

The next workshop will be held in August 25th 2006 at Universidad de Concepción in Concepción (Chile) jointly organized by the Departments of Civil Engineering and the Mechanical Engineering. Information about the CSCM (SCMC in Spanish) and its activities could be found in the web site:
http://www.dim.udec.cl/scmc/ ●

Figure 2:
Gerd Reinke (Head of the Mechanical Engineering Department - UTFSM), Marcela Cruchaga (President of CSCM), Rainald Löhner (Invited Professor) and Franco Perazzo (Chairman of the workshop JMC 2005) during the opening ceremony

GRACM 2005
The Fifth GRACM International Congress on Computational Mechanics

A Conference dedicated to the memory of Professor John Argyris.

The Fifth Congress of the Greek Association of Computational Mechanics was hosted by the **University of Cyprus** in **Limassol**, Cyprus on **June 29-July 1, 2005** and was attended by 140 participants from 12 countries.

The aim of the Congress was to become a forum for critical discussions on past developments and future applications and research needs in the field of Computational Mechanics, as well as to encourage graduate student participation to pursue advanced research in computational methods and mathematical models for the solution of wide range engineering problems.

Plenary lectures were given by: N. Bicanic "Some aspects of computational modeling of safety critical concrete structures"; C.R. Kleijn "Multi-scale computational modelling of fluid mechanics in thin film processing"; E. Ramm "A particle model for cohesive frictional materials"; C. Pantelides "Process systems engineering - Problems, models and techniques"; G. Paulino "Cohesive zone modeling of dynamic crack propagation in functionally graded materials"; M. Tanaka "Recent applications of the boundary element method to some inverse problems in engineering"; Z. Yosibash "p-FEM analysis of singularities: Theory and applications".

Congress Chairmen: M. Papadrakakis, National Technical University of Athens; G. Georgiou, University of Cyprus; P. Papanastasiou, University of Cyprus. ●

Figure 1
Profs. Pauline, Papadrakakis and Ramm at Curium.

COUPLED PROBLEMS 2005

An ECCOMAS Thematic Conference

The **first International Conference on Computational Methods for Coupled Problems in Science and Engineering** took place on **Santorini Island** in **Greece** on **May 25-28, 2005**.

The Conference was jointly organized by the Greek Association for Computational Mechanics (**GRACM**), the National Technical University of Athens (**NTUA**) and the International Centre for Numerical Methods in Engineering (**CIMNE**) in Barcelona in cooperation with the University of Padova and the Universitat Politechnica de Catalunya. The Conference attended 200 delegates from many different countries.

The conference objective was to present and discuss state of the art mathemacial models, numerical models and computational techniques for solving accurately and with affordable computing times coupled problems of multidisciplinary character in science and engineering. Emphasis was given on showing the potential of new computational methods for solving practical multidisciplinary problems of industrial interest.

The Plenary lectures were given by:
R. Codina, "Coupling Rigid Body Motion and Incompressible Flow via a Chimera Strategy"; C.A. Felippa "Taming Complexity in the Synthesis of Partitioned Analysis Methods for Coupled Systems"; T.J. Hughes "Isogeometric Analysis"; S. Idelsohn "Applications of the Particle Finite Element Method to Solve Coupled Problems"; G.E. Karniadakis "Spectral/hp Element Methods for Coupled Problems"; P. Ladevèze "Computational Strategy Suitable for Multiphysics Problems"; W.K. Liu "Applications-Driven Multiresolution Approaches to Multiscale Computations"; D.R. Owen "Computational Modelling of Hydro-Fracture Flow in Porous Media"; K. Runesson "Error Control and Adaptivity in Space-time of Promechanics Problems".

Conference Chairmen:
M. Papadrakakis, National Technical University of Athens, Greece,
E. Onate, International Centre for Numerical Methods in Engineering, Barcelona, Spain, and
B.S. Schrefler, University of Padova, Italy. ●

conference notices

ECCOMAS CFD 2006

European Conference on Computational Fluid Dynamics

Egmond aan Zee, The Netherlands
September 5 – 8, 2006

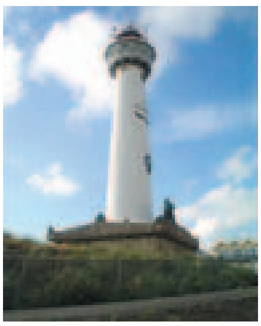
Under the aegis of **ECCOMAS (European Community on Computational Methods in Applied Sciences)**, the ECCOMAS CFD 2006 Conference will take place **September 5-8, 2006**, in Egmond aan Zee, the Netherlands. Egmond aan Zee is a picturesque seaside village, at 45 km from Amsterdam. The conference will take place in Hotel Zuiderduin, located almost at the beach. The conference website is **http://pcse.tudelft.nl/eccomas2006/**.

Over the years, the scope of the successful series of ECCOMAS CFD Conferences has been extended beyond computational fluid dynamics. A broad part of the computational sciences and their application in applied sciences and engineering is covered. The main themes of the conference are:
- Computational Fluid Dynamics
- Computational Acoustics
- Computational Electromagnetics
- Computational Mathematics and Numerical Methods
- Optimization and Control
- Computational Methods in Life Sciences
- Industrial Applications

The format of the preceding editions of this series of conferences will be followed. There will be nine invited plenary speakers, and the program will further consist of Minisymposia, Special Technology Sessions and contributed presentations.

Abstracts and proposals for Minisymposia and Special Technology Sessions are to be sent to: **eccomascfd2006@math.tudelft.nl.**
Deadline: January 15, 2006.

For further information please visit:
http://pcse.tudelft.nl/eccomas2006/
or mail to
eccomascfd2006@math.tudelft.nl ●



CSSM 2006

III European Conference on Computational Solid and Structural Mechanics

The III European Conference on Computational Solid and Structural Mechanics organised by **APTMAC - Portuguese Association for Theoretical, Applied and Computational Mechanics**, will be held at **LNEC - National Laboratory for Civil Engineering** in **Lisbon, Portugal** on **5 - 8 June 2006.**

The choice of LNEC to host CSSM 2006 is not only due to the excellent conference facilities, but also as a tribute to the contribution that this renowned laboratory has in the development of computational mechanics in Portugal and worldwide.

The conference will address all the areas of Computational Solid and Structural Mechanics. Several keynote and invited lectures, given by the most prominent researchers in this area, will address the most recent and advanced developments in this field of research and technology.

LNEC is located near the city centre, with easy access to the main historical and cultural attractions in Lisbon.

Hanging on the edge of the Atlantic Ocean, and with a personality split between Western Europe and Northern Africa, Lisbon is an European city like no other.

The social programme will take advantage of the fine weather, the historical richness and beauty, and the cosmopolitan and cultural advantages of this ancient city.

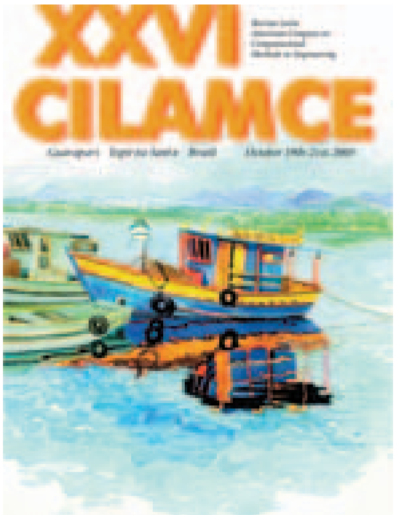
For further details and descriptions please visit:
http://www.cssn2006.org ●

CILAMCE2005

The 26th edition will be held in **Guarapary**, Espírito Santo, Brasil, **19 to 21 of October 2005**.

It is being organized by the Federal University of Espírito Santos (UFES). The organizing committee consists on: Andréa M. P. Valli (Chairman), Neyval C. Reis Jr. (Co-Chairman), Antônio M. F. Frasson, Fernando C. M. Menandro, Juan S. R. Saenz, Lucia Catabriga, Marta M. da C. Cruz, Raul H. Cardoso Lopes, Walnório G. Ferreira, as members.

The XXVI CILAMCE will be held in October 19-21, 2005, at the Centro de Convenções Flávio Schneider of SESC, in the city of Guarapari, State of Espírito Santo (ES), Brazil.



The CILAMCE 2005 will be organized in a set of mini-symposia covering a vast range of multidisciplinary subjects on computational methods in engineering and applied sciences. The scientific program of the Congress consists of invited plenary lectures and invited mini-symposia keynote lectures by respected experts, contributed papers and poster presentations for under-graduated students.

For further information go to the conference homepage **http://www.inf.ufes.br/~cilamce2005/**, or send an e-mail to **cilamce2005@inf.ufes.br.** ●

Book Report

Adaptive Finite Elements in Linear and Nonlinear Solid and Structural Mechanics

Series: CISM International Centre for Mechanical Sciences, Number 416

Stein, Erwin (Ed.) 2005, V, 363 p. 214 illus., Softcover
ISBN: 3-211-26975-4, 82,00 €, Springer

The work deals with a systematic theoretical and problem-oriented treatment of fundamental topics in the wide area of error-controlled adaptive finite element methods for analyzing engineering structures with elastic and inelastic material behavior applied to engineering structures. Different types of error estimators are presented from both mathematical and engineering points of views: global estimators and goal-oriented estimators based on duality techniques, controlling h-, p-, and hp-adaptivity.

Special features are: combined model and discretization adaptivity for thin-walled structures, hierarchic modeling in elasticity and related hp-adaptivity, error estimators of constitutive equations, adequate mesh refinement techniques and error-controlled adaptive elastic-plastic analysis of contact problems.

The benefits are seen in new methods and results of leading researches in the field which provide deeper insight into recent developments of a posteriori error analysis and adaptivity.

Written for:
Computational mathematicians, mechanicians, and engineers. ●

Fundamentals of Fluid Mechanics, 5th Edition

Bruce R. Munson, Donald F. Young, Theodore H. Okiishi (Eds)
ISBN: 0-471-67582-2 Wiley
Hardcover, 816 pages
July 2005, €58.50

Master fluid mechanics with the #1 text in the field!

Effective pedagogy, everyday examples, an outstanding collection of practical problems--these are just a few reasons why Munson, Young, and Okiishi's Fundamentals of Fluid Mechanics is the best-selling fluid mechanics text on the market. In each new edition, the authors have refined their primary goal of helping you develop the skills and confidence you need to master the art of solving fluid mechanics problems.

This new Fifth Edition includes many new problems, revised and updated examples, new Fluids in the News case study examples, new introductory material about computational fluid dynamics (CFD), and the availability of FlowLab for solving simple CFD problems. ●

Announcement

of the

John Argyris Award

for the best paper by a young researcher

in the field of

Computational Mechanics

It is our pleasure to announce the third competition for the John Argyris Award for the best paper by a young researcher in the field of Computational Mechanics.

This Award has been initiated to honour Professor John Argyris whose research work for more than 50 years had a pioneering impact on computational mechanics both in theory and in practice. The award recognizes his significant contribution both to the field and to the international journal Computer Methods in Applied Mechanics and Engineering, of which he was a founding editor and editor-in-chief for 30 years, and is sponsored by **Elsevier**, publisher of the Journal.

The award certificate and a prize of 2000 euros will be conferred on the winner by the President of the **International Association for Computational Mechanics (IACM)**. The presentation is scheduled to be made at the **VII World Congress on Computational Mechanics (WCCM VII)** to be held in **Los Angeles, California, USA**, from **16-22 July 2006**.

Papers to be judged:
Each applicant may submit a paper accepted for publication not earlier than 31 March 2004 in the journal Computer Methods in Applied Mechanics and Engineering.

The papers are to be submitted either electronically or by surface mail, by 31 March 2006, to the President of IACM, Professor Eugenio Onate, at the following address:

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

The winner will be notified by the president of IACM during **May 2006**.

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

All applicants must be under the **age of 35** on 31 March 2006.

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

iacm news

ABMEC
The Brazilian Association for Computational Methods in Engineering (ABMEC) is proud to announce its reorganised and revitalised name and image under the guidance of **Paulo Lyra.**

MACM
The Malaysian Association for Computational Mechanics (MACM) is pleased to inform us of its official status. At the head is **Prof. Ahmad Kamal Ariffin of** the Dept. of Mechanical Eng., University of Kebvangsaan, Malaysia (kamal@ukm.my) together with **Shahrir Abdullah** of UKM as Secretary.

Royal Netherlands Academy of Arts and Sciences
Congratulations to **Rene de Borst** who was recently elected as a Member of the Royal Netherlands Academy of Arts and Sciences (KNAW).

USACM
The new Executive Committee of **The United States Association for Computational Mechanics** for the years 2004 - 2006 has been elected.
The President is **Joseph E. Flaherty**, the Vice-President is **Gregory Hulbert** and the Secretary/Treasurer is **Tom Bickel**.

Honorary Fellowship to Prof. B. Schrefler
Prof. B. Schrefler has been awarded an **Honorary Fellowship** from the **University of Wales at Swansea**. We congratulate him by his success.

IACM Executive Council Changes
Prof. M. W. Yuan from University of Beijing substitutes **Prof. W. Zhong** in the **Executive Council of IACM**. **Prof. W. Zhong** has become a new **Honorary Member of the IACM Executive Council**. We congratulate Profs. Yuan and Zhong for the new appointments.

Prof. Dr. Adnan Ibrahimbegovic receives Humboldt Research Award
We have the honour to inform you that a faculty member of the **Ecole Normale Superieure de Cachan**, Laboratoire de Mecanique et Technologie,
Prof. Dr. Adnan Ibrahimbegovic, has been elected the recipient of a **Humboldt Research Award** after having been nominated for this Award by the German scientist Prof. Dr. Hermann G. Matthies. This Award is conferred in recognition of lifetime achievements in research.

- John Argyris Foundation -

In January 2005 the **"John Argyris Foundation (JAF)"** was established. Chairman of the foundation is Holger Argyris, son of John Argyris and Vice Chairman is M. Papadrakakis, Professor at the National Technical University of Athens, Greece.

The foundation was created in memory of John Argyris, a person with great vision, class and presentation, who dramatically influenced Computational Engineering and Science and who will be long remembered as one of the great pioneers of the discipline in its formative years and beyond

The purpose of the Foundation is to disseminate the accomplishments of John Argyris by encouraging young scientists to undertake research in the fields of Computational Mechanics where John Argyris contributed with his innovative and outstanding work, as well as by promoting Computational Mechanics at large amongst young scientists and engineers by establishing special awards and scholarships. In order to achieve the aims and goals, the Foundation will collaborate with the **International Association of Computational Mechanics (IACM)**, the **European Community on Computational Methods in Applied Sciences (ECCOMAS)** and the **Greek Association for Computational Mechanics (GRACM)**.

ERRATA

Issue No 17 - January 2005. Article: *Computational Solids Mechanics at the Centre for Computational Methods.* This article was authored **by Dr Guillermo Etse** from the National University of Tucuman, Argentina and not by Victorio Sonzogni as stated.

conference diary planner

2 - 4 October 2005	**II International Conference on Textile Composites and Inflatable Structures** *Venue:* *Stuttgart, Germany* *Contact:* *congress.cimne.upc.es/membranes05*
19 - 21 October 2005	**XXVI CILAMCE - Iberian Latin American Congress on Computational Methods in Engineering** *Venue:* *Guarapari Espirito Santo, Brazil* *Contact:* *www.inf.ufes.br/cilamce2005/*
16 - 18 November 2005	**MECOM 2005 - VIII Argentinian Congress on Computational Mechanics** *Venue:* *Buenos Aires, Argentina* *Contact:* *www.ai-meth.polsl.pl*
16 - 18 November 2005	**AL-METH 2005 - VI Symposium on Artificial Intelligence** *Venue:* *Gliwice, Poland* *Contact:* *www.al-meth.polst.pl*
1 - 6 December 2005	**ICCES - International Conference on Computational and Experimental Engineering and Sciences** *Venue:* *Chennai, India* *Contact:* *www.icces-india.org*
22 - 23 February 2006	**3rd Conference on Advances and Applications of GiD** *Venue:* *Barcelona, Spain* *Contact:* *www.gidhome.com/2006*
27 - 30 March 2006	**EURO-C 2006 - Computational Modelling of Concrete Structures** *Venue:* *Mayrhofen, Austria* *Contact:* *http://euro-c.tuwien.ac.at*
5 - 8 June 2006	**ECCM 2006 - III European Conference on Computational Mechanics. Solids, Structures and Compled Problems in Engineering** *Venue:* *Lisbon, Portugal* *Contact:* *www.eccm2006.org* *email:* *carlosmotasoares@dem.ist.utl.pt*
28 - 30 June 2006	**SEECCM-06 - First South-East European Conference on Computational Mechanics** *Venue:* *Kragujevac, Serbia* *Contact:* *www.seeccm06.kg.ac.yu* *email:* *nfilipov@hsph.harvard, brckg@kg.ac.yu*
2 - 6 July 2006	**ICSV13 - 13th International Congress on Sound and Vibration** *Venue:* *Vienna, Austria* *Contact:* *http://icsv13.tuwien.ac.at*
10 - 12 July 2006	**IABEM 2006 - International Association for Boundary Element Methods** *Venue:* *Graz University of Technology, Austria* *Contact:* *www.iabem2006.tugraz.at*
16 - 22 July 2006	**WCCM7 - VII World Congress on Computational Mechanics** *Venue:* *California, USA* Contact: www.wccm2006.northwestern.edu *Email:* *WCCM7@mail.mech.northwestern.edu.*
5 - 8 September 2006	**Computational Fluids Dynamics - ECCOMAS CFD 2006** *Venue:* *Egmond aan Zee, The Netherlands* *Contact:* *www.eccomascfd2006.nl*
12 - 15 September 2006	**5th International Conference on Engineering Computational Technology** *Venue:* *Las Palmas de Canaria* *Contact:* *www.civil-comp.com/conf/España*
5 - 7 September 2007	**COMPLAS 2007 - 9th International Conference on Computational Plasticity. Fundamentals and Applicatons** *Venue:* *Barcelona, Spain* *Contact:* *complas@cimne.upc.edu*
26 - 28 September 2007	**ADMOS III - International Conference on Adaptive Modeling and Simulation** *Venue:* *Göteborg, Sweden* *Contact:* *admos07@cimne.upc.edu*
3 - 6 December 2007	**APCOM'07 Asian-Pacific Association for Computational Mechanics together with EPMESC XI -The Conference Board for the Enhancement and Promotion of Computational Methods in Engineering and Science** *Venue:* *Kyoto, Japan* *Contact:* *www.apacm.org/apcom07-epmescXI*
30 June - 5 July 2008	**WCCM8 / ECCOMAS Congress 2008** *Venue:* *Lido Island, Venezia, Italy* *Contact:* *www.iacm.info / www.eccomas.org*