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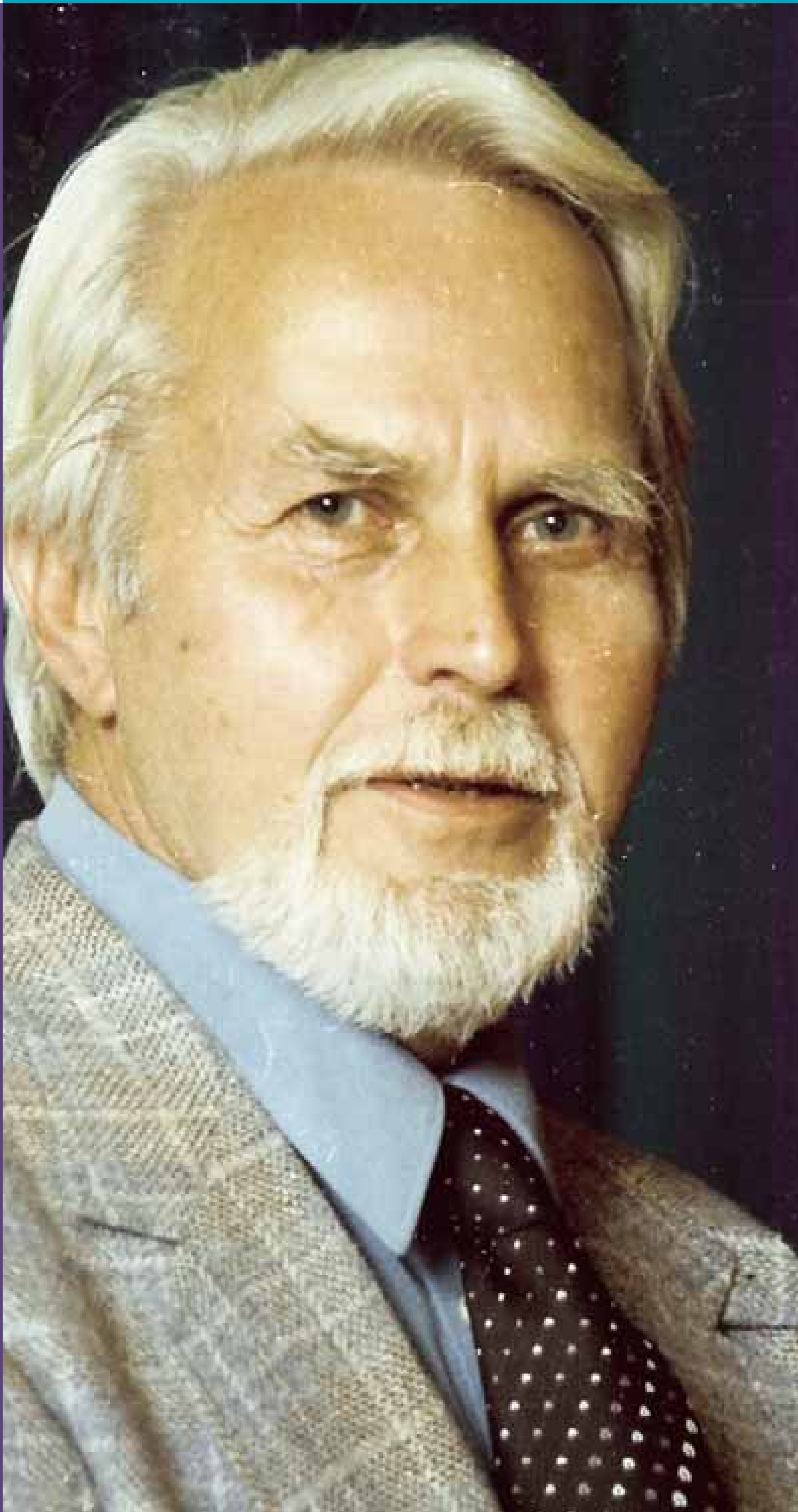

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Editorial Address
IACM Secretariat, Edificio C1, Campus Norte UPC, Gran Capitán s/n, 08034 Barcelona, Spain. Tel: (34) 93 - 405 4697, Fax: (34) 93 - 205 8347,
Email: iacm@cimne.upc.edu ***Web***: www.iacm.info

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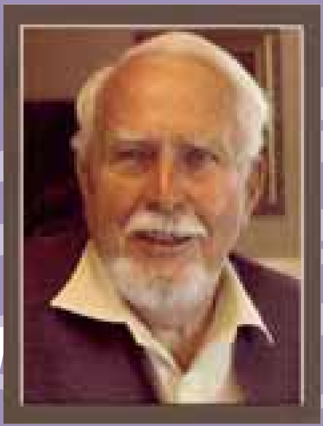


editorial

This issue of Expressions is dedicated to the memory of Prof. Olgierd (Olek) C. Zienkiewicz who passed away in Swansea (UK) on January 2nd 2009.

For this purpose, in addition to some scientific contributions which conform the style of Expressions, we have selected a few articles on Olek's life and achievements written by distinguished friends and colleagues of Olek around the world.

Quoting words of R.L. Taylor in his article, Olek was a great engineer and scientist, and also a great adventurer who enjoyed travelling to nearly every corner around the world spreading knowledge in the field of computational mechanics.

I had the opportunity to complete a Ph.D. in University of Swansea under Olek's supervision in the period 1975-78. Those were the days when IACM was thought and eventually created by Olek, Dick Gallagher and a group of distinguished scientists in the field around the world.

With Olek's and Dick's thrust IACM soon expanded worldwide rapidly. This was indeed also thanks to the excellent work of the successive IACM Presidents (J. T. Oden, A. Samuelsson and T. Hughes) who made of IACM the leading organisation in the world in the field of computational engineering and sciences.

The momentum of IACM is clearly shown in the many scientific events that are held around the world regularly. This year 2009, for instance, some 50 large and small international conferences and workshops will take place worldwide under the organisation and auspices of the 35 organisations affiliated to IACM, representing 48 countries in the five continents.

A landmark in the history of IACM was the big success of the 8th World Congress on Computational Mechanics (WCCM8) held in Venice on July 2008 with over 3000 participants. Plans are already on the way to held WCCM9 in Sydney on July 2010 in conjunction with the 4th Asian Pacific Congress in the same field. After that, WCCM10 will take place in Sao Paulo (Brazil) in 2012 and so on...

The vitality of IACM, now entering in a new era with the new Constitution recently approved, is perhaps the best homage that we could offer to Olek. He certainly was proud to see how IACM has progressed over the years. Olek's presence and advice will certainly be very much missed, but his scientific and personal legacy to our community and to the world will remain vivid in IACM for ever.

Eugenio Oñate
President of IACM

Some Recollections of
O.C.Zienkiewicz

by
R.L.Taylor

Olek Zienkiewicz was my friend for forty years. He was the greatest engineer that I have ever known but he was also a great adventurer who enjoyed travels to nearly every corner of the globe. To me he was the Ambassador of Finite Elements, as during his travels he shared his knowledge and enthusiasm for the subject to all he met. Fortunately, much of what he knew is preserved in his nearly 600 publications. My first knowledge of the research activities on finite element methods being performed at Swansea by Olek and his colleagues occurred in the mid1960's. At that time a report arrived in Berkeley describing what was then a new method of interpolation for quadrilateral elements. The report introduced a method called 'isoparametric elements'. It was a great disappoint-ment to me how simple the concept was as I had been trying to use tensor analysis to devise interpolations for the general quadrilateral. The concept of isoparametric elements combined with numerical integration was a radical change to the procedures then being used to develop elements. For the first time we were able to develop a quadrilateral shaped element from a single interpolation instead of previous forms as a composite of four triangles. More over what this simple concept allowed is to easily implement the formulations we were developing for thermo-viscoelastic material models.The use of numerical integration, an essential part of implementing the isoparametric concept, also allowed element routines to be developed without tedious hand calculation of integrals. Today it is impossible to imagine use of any other method!

This report also was responsible for changing my life and activities over the next four decades. When it came time to apply for my first sabbatical leave Swansea was my obvious choice. In 1968, while traveling to the Second Conference on Matrix Methods in Structural Mechanics in Dayton, Ohio, I met Olek for the first time and was pleased to be invited to Swansea for the next academic year. Fate stepped in that year to keep Olek near Swansea as early in my visit he had an operation to adjust the alignment of his leg to ease difficulties in walking. During his post-operative recovery in the hospital and later at his home, we met regularly to discuss topics on finite elements. Going to his home meant being served coffee or lunch by Helen, and meeting his children – Andy, David and Krysia. It was due to his surgery that Olek was not able to travel widely. This allowed the friendship and love between our families to blossom and grow.

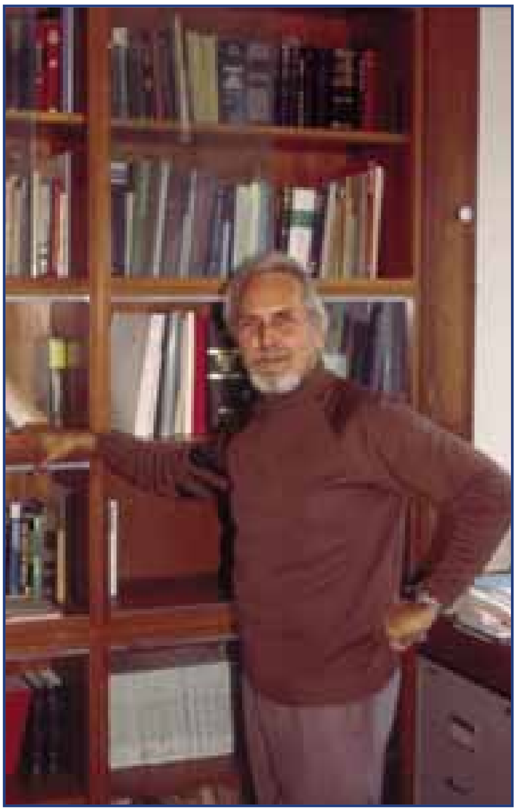


Figure1: *Olek in his office in 1969*

Working with Olek often involved withstanding cigar smoke as well as guarding his car parked on the double yellow line as he stoped to replenish his supply for the day! However, this was a small price to pay for the other adventures our families enjoyed that year – including searching for mushrooms, gathering samphire and wild berries on the Gower, and exploring the Welsh castles. Looking back over the years it is amazing how little Olek changed in appearance from the 1960's to the present (*see figure 1*).

Among many technical topics we discussed that year was the possibility of solving shell problems using curved three-dimensional isoparametric elements. Working with Olek's doctoral student James Too, we did succeed in developing a successful shell formulation based on an isoparametric form combined with shell approximations and reduced integration. This element became the basis for three dimensional shells in the second and subsequent editions of Olek's classical book on finite elements and was also used extensively in analysis of arch dams.

Our family returned to Swansea for two subsequent sabbatical leaves during the years 1976 and 1984. These latter leaves started my associations with Olek on additional revisions of his classical FEM book as well as on other research activities. In particular we extended the concept of the 'patch test' to mixed problems. The patch test was originally used as a means of assessing the ability of non-conforming plate elements based on Kirchhoff theory to reproduce constant curvature when assembled in arbitrary patches. Subsequently, much work was performed on developing elements based on Reissner-Mindlin theory where mixed methods were essential to achieve good performance in 'thin plate' applications. The use of the mixed patch test led to the introduction of a concept we called 'linked interpolation' and this finally allowed us to achieved this goal. After retirement as Head of Civil Engineering at Swansea in 1987, Olek spent two months each year at the International Center for Numerical Methods in Engineering (CIMNE) at Universitat Politécnica de Catalunya (UPC) in Barcelona, Spain. In 1989 Olek was appointed as the UNESCO Chair of Numerical Methods in Engineering at UPC. This was the very first UNESCO chair in the world and arose from interactions with Geoff Holister who was working at UNESCO developing support to technology and engineering. The idea of such a position arose from an idea in the book "Small World" by David Lodge. In the book professors of English imagine a UNESCO Chair that will allow them to retire into a world of continuous travel with no lecture obligations at an extravagant salary – mostly things Olek already had achieved! Following my retirement in 1994, I was invited by Professor Eugenio Oñate to also visit CIMNE each year. For the next decade Olek, Helen and I visited Barcelona each year for two months. These were immensely enjoy able times in which we discussed many topics as well as enjoyed the many beautiful ar areas surrounding Barcelona. In the late 1990's we undertook a major revision of the FEM book with much of the revision completed while we both visited CIMNE each year. The fifth edition was greatly expanded and divided into three volumes with the first volume devoted to linear basic problems, the second volume to advanced topics for solid and structural problems and the third volume to fluid dynamics problems.

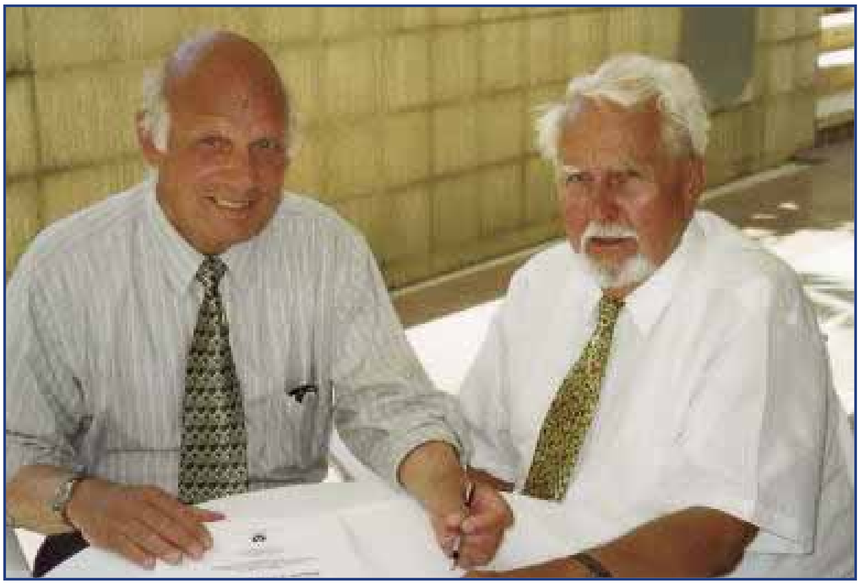


Figure 2: *Signing first copies of 5th edition.*

Work on the revisions was carried out either at CIMNE or at the apartment of Olek and Helen in Sitges. The writing of the new edition was hindered some what due to the deterioration of Olek's eyesight from macular degeneration, however, his ability to recall and formulate complex technical information from memory made the writing possible. Olek not only could recall salient facts from his own writings but could still recite long passages of Latin from his school days and sing songs by the Polish composer Wladyslaw Szpilman. The latter motivated by our watching together of the movie 'The Pianist'. Working on the book together, we discussed sections for each volume, then modifications were formulated verbally, dictated to tape by Olek and later transcribed and edited to computer files for printing. I recall vividly the day we spent at the ECCOMAS Congress in Barcelona signing copies of the first printed copies (*see figure 2*). A similar process was followed in writing the sixth edition but with much new material added by J.Z.Jhu, P.Nithiararu, N.Bićanić and B.Schrefler.

As noted above, all was not work during our two months in Spain. Weekends usually included a trip to nearby places of interest. Olek and Helen were very knowledgeable about Catalan restaurants located near Barcelona. One restaurant featured Anec Mut (amute half-duck in Catalan), and this was a favorite meal of Olek. After lunch a trip to the nearby Cistercian Monastery at Santes Creus completed an enjoyable afternoon. Another favorite trip was to Siurana - an ancient town located high in the mountains of Catalonia. This small village is well known to mountain climbers but not so well known to others - including the members of UPC! The view from the top is truly magnificent (*see figure 3*)- and , of course, Siurana featured a small restaurant with excellent local cuisine! The months spent in Spain were truly enjoyed by Olek for both the connections to colleagues at UPC as well as for the local cuisine and scenic vistas.

A characteristic of Olek was his ability to meet people at all levels of society. During his lifetime I witnessed him meet royalty as easily as working class people - all with the same grace and charm. While visiting an art exhibit in Sitges he became interested in a bronze sculpture. It did not take Olek long to learn that the name of the artist was Emilio Tristan who lived in a nearby village. The next weekend he went to the village and met Tristan and they became good friends. During one of our visits I recall driving Olek to Tristan's home where, in a few hours, a magnificent bust of Olek was sculpted.

Subsequently, we also went to the foundry where two bronze sculptures were cast. One of these along with copies of Olek's papers now resides in the Zienkiewicz Library at Swansea University. This legacy of the library and the bust can continue to remind us all of the great accomplishments of one of the truly great engineering scholars of the twentieth century. ●

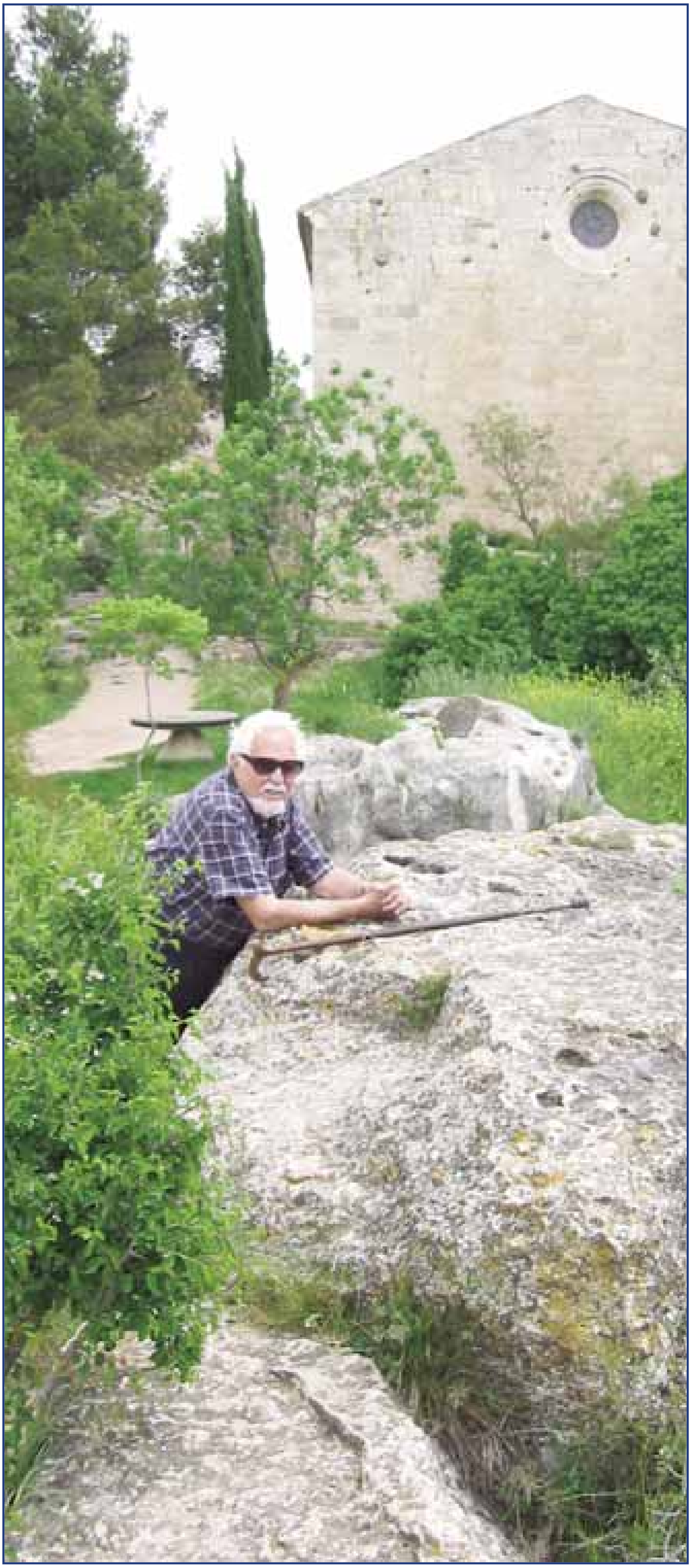


Figure 3:
Olek at Siurana, Spain

Olgierd (Olek) Cecil Zienkiewicz

18th May 1921 – 2nd January 2009

by
D. Roger J. Owen

Olek Zienkiewicz is internationally recognised as the leading founder of the Finite Element Method which is a technique that has, since the 1960s, revolutionised design and analysis procedures in civil, mechanical, aerospace and other branches of engineering. When Olek and his colleagues began research into the finite element method at Swansea in 1961, the method was already a known technique. Development of the finite element method, as we know it today, began in the mid 1950s and a substantial body of literature regarding it had been accumulated by the end of that decade. The term 'finite element' was coined by R. W. Clough, University of California at Berkeley in 1960. It was against this background that Olek entered the finite element research arena. Initially, the formulation of the method followed a traditional structural engineering approach but as the underlying mathematical basis became understood its application to other disciplines became possible. As a result, the first non-structural application was undertaken by Olek in the treatment of a groundwater flow problem. From that time the method become widely established and accepted in engineering design and the first industrial use of the technique was made by him, in Europe at least, for the stress analysis of the Clywedog dam in 1963. The methodology is still a flourishing research topic and its application has considerable potential in new scientific areas, including biomedical engineering and the life sciences.

Figure 1:
Olek Zienkiewicz, Edinburgh, 1950

Olek Zienkiewicz was born on 18th May, 1921, in Caterham, England, of a Polish father and English mother. He was the seventh son of a seventh son, which in folklore endowed him with magical and clairvoyant powers - and may, or may not, have been responsible for his remarkable career. His early life was greatly influenced by the turbulence of European history over the first half of the twentieth century. Towards the end of the First World War, Czar Nicholas of Russia was first overthrown by revolutionaries who formed a government under Alexander Kerensky, which was in turn overthrown by the Bolsheviks. In 1917 Olek's father, Casimir, held the post of Consul in Birmingham for the Kerensky government which only lasted for a short period. The practice of law is tied to the legal system of one's government so that employment in his profession in England was effectively closed to him. Therefore, in 1922 the Zienkiewicz family returned to Poland, first to Warsaw and then to Lodz, before moving once more in 1926 to Katowice where his father held the post of district judge up to the outbreak of World War II.

Recognising his obvious academic talents his parents sent him to a boarding school near Poznan and his schooling went well for two years until he suffered a sporting injury which became serious due to a staphylococcus infection of his hip bone. Known as osteomyelitis, the disease required lengthy hospital stays and operations which left him with a limp. The latter, it should be noted, never impeded him in a vigorous outdoor life that encompassed sailing, scuba diving, hiking and a general love of the outdoors and of nature. Extended hospitalisation did not deter the young Zienkiewicz from scholarly excellence and he completed his high school studies in June, 1939. He planned to compete for admission to the Warsaw Polytechnic in September and moved to Warsaw in preparation for the examination.

Fate, of course, intervened in the form of the outbreak of the Second World War on 1st September, 1939. Warsaw was soon under siege and the days that followed were among the most eventful of his entire life, which he spent building barricades, overturning trams and digging trenches. After several days, the order came to evacuate and Olek made hasty preparations to leave, taking a new camera, drawing instruments, a pair of socks – and nothing else except the clothes he was wearing. He had arranged to meet his mother and sister at a certain bridge and found that his sister was even less prepared for the times that lay ahead, having only a pair of high-heeled shoes and two packets of cigarettes. Many exciting days were to follow, including wandering through the countryside for ten days, a return to Warsaw and, eventually, a reuniting of the family in Katowice.

After several weeks the family managed to obtain a visa to Italy, which had not yet entered the war, and then subsequently on to Angiers in France, where Casimir Zienkiewicz worked for the Polish government in exile. This stay proved to be short-lived, however, with the fall of France occurring in June 1940. The family was able to keep one step ahead of the invaders and reached the east coast of France near Bayonne, where they sailed to England on the Polish ship *Batory* on the very day, 22nd June, 1940, when the armistice between France and Germany was signed.

"To those who are familiar with the work of Olek Zienkiewicz, he will surely be regarded as the major figure of the twentieth century in the numerical analysis of problems in engineering science."

Once in England Olek began to think of a university education. The British Council had available to Poles a special scholarship for study at Imperial College, where he opted for a course in Civil Engineering, as the university did not have a degree scheme in Naval Architecture which was his preferred choice. Placed first in his studies at the end of the first year, he was given two scholarships for the remaining time at Imperial College. He graduated in 1943, one of two first-class honours recipients, the other being G. Holder who subsequently became a noted aerodynamicist at the Royal Aircraft Establishment at Farnborough.

Upon graduation, Zienkiewicz discussed the possibility of research work with A. J. S. Pippard who offered a scholarship to work jointly with him and R. V. Southwell on a dam analysis project. Southwell and Pippard were two of the principal figures in the development of structural mechanics in the 1930s and 1940s. Southwell's relaxation method bridged the gap between the classical methods developed over the century prior to 1930 and the large-scale computational methods of today, which emerged in the late 1950s.

After the award of his Ph.D. in 1945, Olek moved directly into engineering practice. With his appetite for dams having been whetted by his postgraduate work, he became attracted to the design and construction of these massive structures. He approached the consultancy firm of Sir William Halcrow and was offered a post leading a survey party on a dam project in Scotland. After salary negotiation culminating in the offer of £250 per annum, he was asked if he could drive a car. 'Naturally' came the reply and he promptly went out and took the test, in those days, for a provisional licence. To the time of his death he did not take a test for a regular driving licence. Olek spent four years with Halcrow, first with the survey task and then on the design and construction of the Glen Affric Hydroelectric System in northern Scotland.

In 1949 various opportunities for a change of direction came to Olek's attention and one which appealed to him, and he accepted, was a lectureship in the Department of Engineering at Edinburgh. The department, headed by Ronald Arnold, was well known, especially in the field of applied dynamics. For advice on research avenues he went to Charles Jaeger, a noted authority in fluid mechanics, who suggested several topics in the field of hydraulics. Soon he was contributing research papers in a variety of topics, such as open channel waves, water hammer and lubrication phenomena. This was a period of ease in his academic career, steadily developing his teaching skills and honing his research techniques (*Figure 1)*. To add to this idyllic scene, he met a young graduate student from Canada, Helen Fleming who was working towards a M.Sc. degree in chemistry. They were soon engaged and were married in 1952. Their first son, Andrew, arrived in 1953 and son David was born a year later.

Towards the end of 1956, offers materialised for posts elsewhere. He eventually decided on accepting a position as Associate Professor of Civil Engineering at Northwestern University, USA. During his four years at Northwestern he developed lifelong friends such as John Dunders and Seng Lip Lee. Also, during this period their daughter Krystyna was born in 1958. Sadly, his father passed away in this same year at age 86.

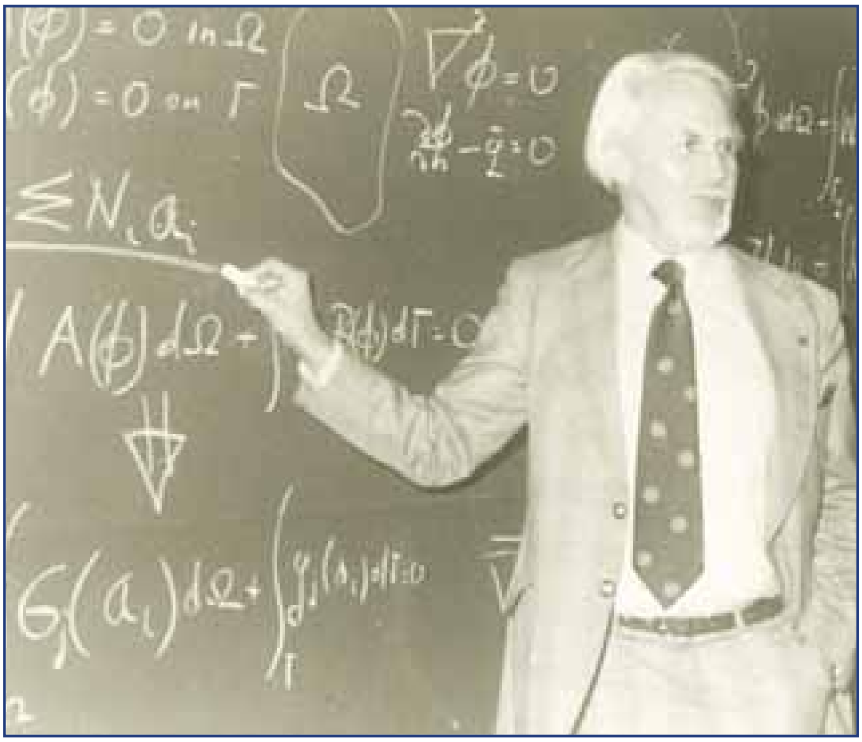


Figure 2: *Olek Zienkiewicz lecturing at UPC, Barcelona*

In 1961, he began a new adventure that led to the activities for which he became world renowned. The chair of Professor of Civil Engineering became vacant at Swansea, and Olek was successful in the ensuing competition. Although the salary was substantially less than he was receiving at Northwestern, he relished the attraction of a professorship in the UK system at that time, wherein it was possible to influence the work and professional development of many others. Moreover, it was a time of unprecedented expansion of higher education in the United Kingdom. From 1961 to the present, the Department of Civil Engineering at Swansea has achieved a reputation as one of the world's foremost centres of finite element research.

He remained at Swansea until his retirement at age 67 in 1988 and subsequently became Professor Emeritus of the University of Wales, as well as holding the UNESCO Chair of Numerical Methods in Engineering at the University of Technology of Catalunya, Barcelona for 15 years *(Figure 2)*, which was brought about by his close connection with Eugenio Oñate. Formerly Olek's Ph.D. student, Eugenio moved to the Technical University of Catalunya (UPC) in Barcelona, where he subsequently founded the International Centre for Numerical Methods in Engineering (CIMNE). This first UNESCO award to Olek attracted interest worldwide and was taken as a model to create many other UNESCO Chairs in different fields in universities around the world. Today there exist some three hundred such UNESCO Chairs.

Olek's other great passion over the remaining period of his life was revision and extension of his finite element books. It would not be out of place to refer to his text on finite element analysis as simply 'The Book'. Surely, in no other field is there a reference which has had greater supremacy among competing texts. This dominance was established immediately on publication of the version published in 1967, which was written with the assistance of Y. K. Cheung. This text, numbering 272 pages, was translated into Japanese and Russian. The next version appeared four years later in 1971, was almost twice the length of the first version, and was translated into Japanese, Russian, Polish, French and German. Subsequent versions expanded in size and scope of topics addressed, culminating with the sixth edition which is a three-volume set written collaboratively with R. L. Taylor, J. Z. Zhu and P. Nithiarasu, covering Basics and Fundamentals, Solid and Structural Mechanics and Fluid Dynamics.

Over his long career in the field of computational modelling, Olek made numerous, and often simultaneous, contributions to disparate fields that included: viscous flow analysis, geotechnical engineering, dynamics, forming processes, rock mechanics, inelastic material analysis, heat transfer, computational fluid dynamics, fluid-structure interaction and the mathematical fundamentals of the finite element method. Each of these fields is represented by a relatively large community of researchers and practitioners and each of them could be excused for concluding, on the basis of the work accomplished, that Olek had devoted himself exclusively to their domain for several years.

His accomplishments did not go unrecognised. Over his career, he was awarded over 30 honorary degrees including ones from Portugal, Ireland, Belgium, Norway, Sweden, China, Poland, Scotland, Germany, France, England, Italy, Hong Kong, Hungary and the United States. He also received numerous special honours and medals including the Prince Philip Medal of the Royal Academy of Engineering, the Carl Friedrich Gauss Medal of the German Academy of Science, the Worcester Reid Warner Medal of the American Society of Mechanical Engineers, the Nathan Newmark Medal of the American Society of Civil Engineers, the James Alfred Ewing Medal of the Institution of Civil Engineers, the Timoshenko Medal of the American Society of Mechanical Engineers, the Newton-Gauss Medal of the International Association for Computational Mechanics, the Gold Medal of the Institution of Structural Engineering and the Gold Medal of the Institution for Mathematics and its Applications. He was elected to the Royal Society and the Royal Academy of Engineering in 1978 and was a Foreign Member of the United States Academy of Engineering, the Polish Academy of Science and the National Academies of Science in China and Italy. He was appointed CBE in 1989.

To those who are familiar with the work of Olek Zienkiewicz, he will surely be regarded as the major figure of the twentieth century in the numerical analysis of problems in engineering science.

I first met Olek in 1961 when he took up his position as Professor of Civil Engineering at Swansea, where I was an undergraduate student at the time. After graduating, Olek encouraged me to go abroad for postgraduate study and arranged a Ph.D. position at Northwestern University. Upon completing this degree in 1967, Olek persuaded me to take a position as a Research Fellow at Swansea. I was rapidly introduced to the finite element method and was seduced by the exciting research prospects in the area and the enthusiastic and refreshing manner in which Olek ran the department. Administrative tasks were kept to an absolute minimum, teaching duties were efficiently dispatched and research was encouraged at every opportunity. Through creation of the world renowned Institute for Numerical Methods in Engineering at Swansea, there was a continual exchange of research visitors and it was not unusual to find six to eight scholars, each of them an academic of substantial rank at his/her home institution, visiting the department at any given time. I subsequently spent the next forty years working at Swansea.

Olek's stature in the field of finite elements is not only due to his scientific achievements but in no small measure a result of his extraordinary personality. As well as relishing academic debate with his peers, Olek was never happier than when discussing research issues with younger colleagues. One of his significant strengths was the ability to synthesise a particular research topic, extract the essential theoretical and computational features and to describe the resulting solution algorithms to students in a concise and transparent manner. In this respect, he provided countless engineers and researchers with the incentive and enthusiasm to participate in the exciting field of computational modelling. Over his research career, he supervised some seventy Ph.D. students, many of whom today hold leading positions in academia and industry.

Olek's decision to spend his entire academic career at Swansea was undoubtedly influenced by his love of sailing *(Figure 3)*. Students and research visitors to Swansea were frequently roped in to act as crew, but all competitive instincts during a race would be quickly abandoned if a particularly interesting finite element discussion arose. He was gastronomically adventurous, especially with regard to fungi where his Polish ancestry made him particularly bold, and many friends and colleagues can bear witness to his love of oysters which he consumed in large quantities at every conceivable opportunity. He had an extremely engaging nature and made countless friends during his extensive travels. A particular characteristic was his enquiring mind, which combined with his formidable intellect, ensured that late night discussions after dinner were far ranging and challenging. Olek will be greatly missed by all who had the privilege to know and work with him over his long career. ●

Figure 3: *Olek Zienkiewicz sailing his yacht Archimedes, Swansea 1995*

Personal Recollections of a Great Scientist and Master

by
Eugenio Oñate

I met Prof. Olgierd C Zienkiewicz for the first time on September 10th 1975. The meeting took place in his office at the Civil Engineering Department of University College of Swansea in Wales where I had just arrived to follow a course of Master of Science. I was 23 years old at that time and had just finished my studies in Civil Engineering at the Technical University of Valencia in Spain.

I did not see Prof (I did not start calling him Olek until many years later) much during my MSc course other than in the classes he lectured. There I was introduced to the fascinating world of the finite element method. Little would I know that what I learned in his classes was going to mark the direction of my future career.

I did well in my MSc. exams and this attracted the interest of Olek in me. After the end of my Master Thesis he offered me the opportunity to pursue a PhD under his supervision. My primary interest at the time was the structural analysis of bridges. His offer was, however, to study the deformation of aluminium sheets in rolling and stamping processes with support from an Alcoa Grant. He explained that my knowledge of structural mechanics would be directly applicable for solving these apparently very different type of problems. This was indeed a discovery to me and for the first time I appreciated the value of knowledge transfer across disciplines.

Figure 1:
Helen and Olek Zienkiewicz and friends after dinner in Barcelona (2003). Standing: R.L. Taylor, B. Schrefler, Xavier and Merce Oliver, Marisa Oñate Sitting: Lelia and Sergio Idelsohn, Olek and Helen Zienkiewicz, E. Oñate

Working close to Olek during my PhD was indeed a pleasure and a privilege. During that period I got to know him and his family quite well. I particularly appreciated the way he and his wife Helen were open to receive regular visits of PhD students like myself in their home. This was really an important moral support to overcome the difficulties which are inherent to research life abroad.

Time went on and I was about to complete my PhD when Olek received an invitation to take part in a conference on Numerical Methods organised at the School of Mechanical Engineering of the Technical University of Catalonia (UPC) in the city of Terrassa, close to Barcelona (Spain). Olek accepted the invitation and offered to have me join him on the trip. This journey took place in early September 1978. Prior to UPC we visited Madrid and there Olek introduced me to some prestigious civil engineers experts in dam analysis with whom he had established a close friendship over the years. These meetings and the subsequent ones in UPC opened the door for my return to Spain after getting my PhD in Swansea.

Figure 2:
Olek Zienkiewicz with students and colleagues at CIMNE, Barcelona (2005)

On February 14, 1979 I joined the UPC as an Associated Professor in Structural Mechanics. My academic position at the UPC meant the starting point of a long term cooperation with my colleagues in the University of Swansea. On December 1979 we held the first joint course on Introduction to the Finite Element Method in Barcelona. This course soon became a classic in Spain and was repeated for ten consecutive years. The driving forces in the course from the Swansea side were Prof Roger Owen and the late Prof Ernest Hinton. Olek was a regular invited lecturer to these course as well.

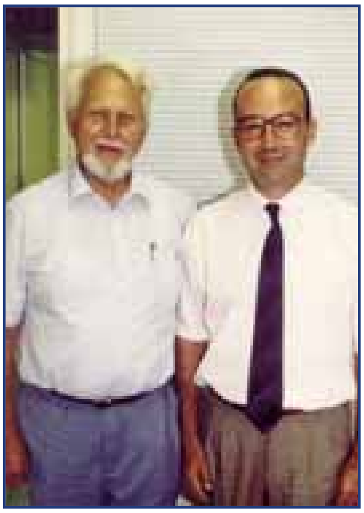


Figure 3:
Olek Zienkiewicz and Eugenio Oñate in CIMNE (1991)

"His presence will be very much missed, but the influence of his legacy, and the memory of his friendship and support will remain vivid in our minds for ever."

During 1983-89 I was the Director of the School of Civil Engineering at UPC. That was the period when the cooperation between Swansea and Barcelona extended to many activities and interchanges. An example was the joint organisation of international conferences. Thus, after the success of a conference on Numerical Methods for Non Linear problems held in Barcelona in 1983, Roger Owen, Ernest Hinton and myself started the series of international conferences on Computational Plasticity (COMPLAS) in 1986. Time has flown and the tenth edition of the COMPLAS conference series will take place the first week of September 2009 in Barcelona.

The participation as a plenary speaker in many of the COMPLAS conferences brought Olek even closer to Barcelona and UPC. As a consequence, when he retired from his position at the University College of Swansea in 1987 he decided to visit the UPC for two-three months every year. Olek and Helen's visits continued without interruption for the following twenty years and indeed consolidated their personal liaison and friendship with many colleagues and students at UPC.

The period 1987-2007 was one of extraordinary activity for UPC and the scientific community in Spain, mainly due to Olek's influence. Following his initiative in March 1989, we created the Spanish Association for Numerical Methods in Engineering (SEMNI). Immediately after that, SEMNI joined the International Association for Computational Mechanics (IACM) created a few years earlier on the initiative of Olek and other distinguished colleagues in UK and USA. SEMNI soon become a reference in the Spanish community in the field of numerical methods in engineering. The many SEMNI conferences held over the years in different Spanish cities were yet another occasion for Olek to increase his list of many friends in this country.

On March 1987 the International Centre for Numerical methods in Engineering (CIMNE) was created at UPC. The aim of this Centre was inspired by the Institute for Numerical Methods in Engineering created by Olek at the University College of Swansea some years earlier. CIMNE provided the hosting facilities for Olek during his annual visits at UPC during so many years.

The existence of CIMNE and the continuous presence of Olek in Barcelona opened many other opportunities for UPC. Among these we note the creation of the Unesco Chair on Numerical Methods in Engineering at UPC. Olek was the first recipient of this important Unesco award that later was taken as a model to create many other Unesco Chairs on different fields in universities around the world. Other landmark achievements due to Olek´s influence were the establishment of the Permanent Secretariat of the IACM at CIMNE and his support for my election in 2002 as president of the IACM.

The above lines summarise the big impact that Olek has had on the development of science in Spain and in particular at UPC, and in my career. His presence will be very much missed, but the influence of his legacy, and the memory of his friendship and support will remain vivid in our minds for ever. ●

Figure 4:
Participants in Symposium celebrating Olek's 70th Birthday - Barcelona, May 1991

Olek Zienkiewicz's Work & Impact on the Argentinean Computational Mechanics Community

by
Sergio Idelsohn

Olgierd Cecil Zienkiewicz, Olek to his friends, may be considered as one of the early pioneers and certainly the person that had the largest impact from abroad in the development and of the numerical methods applied to the engineering in Argentina.

Zienkiewicz was a Civil Engineer, but one of his main merits was to recognise the general potential for using the Finite Element Method to resolve problems in areas outside the area of Civil Engineering, in particular Mechanical Engineering, including solid mechanics, fluid mechanics and heat transfer. We can say that he was the first to use the term '*Computational Mechanics*', a name used now to refer to this speciality.

Figure 1: Professor Zienkiewicz answering a question during the Workshop held in Santa Fe, Argentina in March 1987

In Argentina, the starting point of Computational Mechanics follows a similar road. In 1968, Jose Ramon Orengo, also a Civil Engineer, was sent on a one year fellowship to the University of Liège, Belgium, to do some courses with Professor Charles Massonnet. Almost at the end of his stay, he met Professor Fraeijs de Veubeke who introduced him to a 'new method' called the Finite Element Method. He bought the book '*The Finite Element Methods for Engineering*' by O.C. Zienkiewicz and he came back to Argentina with this 'treasure'.

I recall Professor Orengo, who was then my professor, trying to find a student with enough capacity in mathematics (and in English) to understand Zienkiewicz's book. I was the student chosen. This was in 1969 and I was in my fourth year of Mechanical Engineering.

Figure 2: Professor Zienkiewicz during a break of the Workshop held in Santa Fe, Argentina in March 1987

That was really the beginning of the story. Following that, I was sent to do a Ph.D thesis with Professor Fraejs de Veubeke, due to Orengo's connection. I finished my thesis in 1974 and went back to Argentina, being the first doctor with a Ph.D in Computational Mechanics in Argentina. This story would probably have been very different without Zienkiewicz's book.

The first congress in Numerical Methods in Engineering was organised in Argentina in 1981 by Guillermo Marshall, also a Civil Engineer, with a Ph.D from University of Delft. In 1983 we started the series of ENIEF (Encuentro de Investigadores y Usuarios del Metodo de Elementos Finitos) with nearly 100

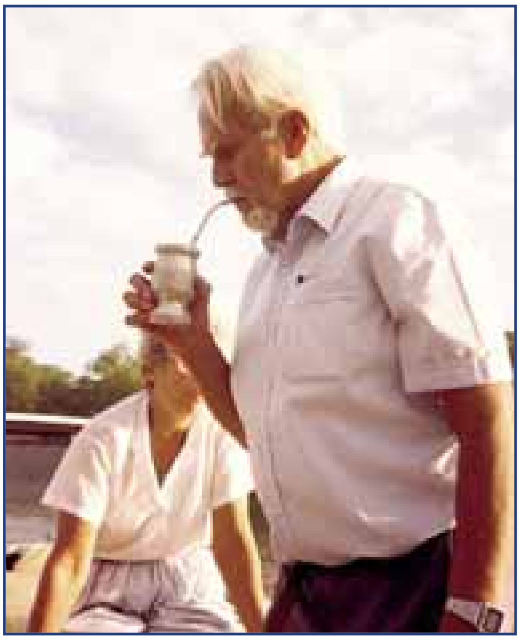


Figure 3:
Olek drinking a "mate" (typically Argentinean drink similar to a tea or coffee) during a trip on a sailing in the Parana River. Behind we can see Hellen, his wife and permanent companion. Parana, Argentina, 1987.

participants, which showed the early increase and interest on the Finite Element Method in Argentina. In 1985 the Argentinean Association of Computational Mechanics (AMCA) was created, just one or two year later than the International Association for Computational Mechanics (IACM) was founded, mainly promoted by Zienkiewicz. More than 120 members started the AMCA, which since then has organised an annual congress in the speciality.

At that moment, Zienkiewicz was a well-known researcher in the Argentinean Community and recognised as the "father" of the Finite Element Method, probably because of the influence of his book.

In 1986, Eugenio Oñate visited Argentina for the first time, and was invited to ENIEF in the city of Bariloche. Here he was surprised by the large FEM Community in Argentina and he phoned Olek from Bariloche to convince him to come and visit the country.

Figure 4:
Olek Zienkiewicz with Victorio Sonzogni and Sergio Idelsohn during a break at the Workshop held in Santa Fe, Argentina in March 1987

Following his acceptance we organised a special workshop to give Zienkiewicz a very warm welcome in Argentina. It took place in March 1987 in Santa Fe. More than 100 participants attended the workshop during 4 days in which Olek gave courses during the morning and he listened to the main Argentinean researchers during the afternoon.

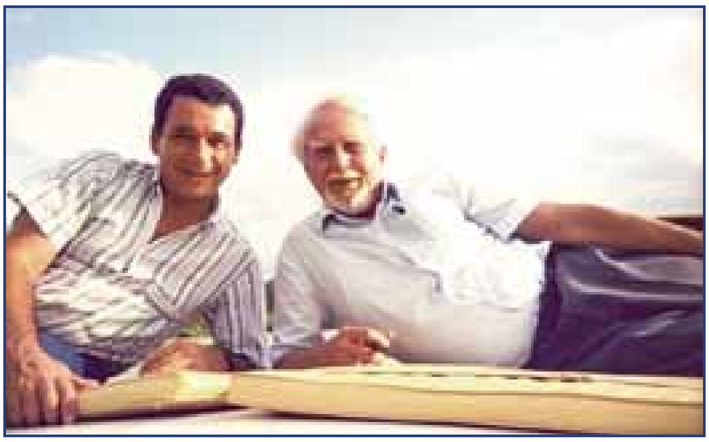
He visited Argentina again for the IV World Congress on Computational Mechanics in 1998. During this visit he was also nominated Honoury Doctor in the University of Buenos Aires.

We can say that nowadays his books on the Finite Element Method as well as the scientific journal International Journal for Numerical Methods in Engineering, which he founded in 1968, are reference texts in all the engineering domains for students, academic and researchers in the main Schools of Engineering in Argentina. ●

Figure 5:
Olek swimming in the dark water of the Parana River

Figure 6:
Olek sailing with Sergio Idelsohn

Figure 7:
Professors Orengo and Zienkiewicz on a trip on the Parana River in the City of Rosario, Argentina, March 1987



Personal Reminiscences of

O.C. "Olek" Zienkiewicz

by
Thomas J.R. Hughes

Olek's accomplishments are very well known, as are the many honours that were bestowed on him. He was truly a legend in his own time. Consequently, I will confine my remarks to some direct and personal experiences that I had with him.

The first encounter with his work

I would like to begin by mentioning an early encounter I had with his work. Before I went to graduate school, I was working at General Dynamics / Electric Boat in Connecticut. This is where I first heard of the "finite element method." I became enamored with it and I was desperately trying to learn about it from the literature. It was not easy. Many of the early papers were landmarks in the annals of obscurity. But then in 1967 I heard that Olek had written a little book, the first finite element book, which I immediately ordered. When I received it, I read it from cover to cover in four evenings after work. It was clear and concise, and I finally felt that I understood what the finite element method was all about. It meant a great deal to me. It was in many respects my beginning and provided the inspiration to work in the field throughout my career. That little book became a classic and has gone through many revisions and editions, and now consists of three very large volumes. It is now referred to in finite element circles as "the book."

"You can do anything you want."

The first visual sighting

I first saw Olek in person when he gave a seminar at MIT shortly thereafter. I travelled from Connecticut by train just to hear him speak. He was a very impressive speaker. He really looked like a professor was supposed to look. Central casting could not have done better. There was lots of excitement in the room because Olek was about to present the "isoparametric concept," which ultimately revolutionized the subject, but the image that remains in my mind was he began his the lecture with the picture of a man made out of finite elements. It got a big laugh. At the time it was so incongruous to think of a man made out of finite elements, but now it is a serious business. Who could of thought at that time that we would be eventually using medical imaging data to build anatomically and physiologically realistic models of real people for simulating medical interventions.

The first communication

My first communication with Olek was a hand written letter I received from him in 1969 offering me a research assistantship to pursue the PhD under his direction. He offered me 2000£ and said I could expect to finish in two years. For various reasons that I will not go into here, I decided instead to do my PhD studies at the University of California at Berkeley.

The first meeting

I first met Olek at Berkeley. It was after I finished my PhD and I was doing post-doctoral work with Bob Taylor. Bob had spent his first sabbatical at Swansea in 1969-70 and Bob and Olek were already great friends. Olek was at Berkeley to deliver a seminar, and after it he took Bob and me to dinner at a French restaurant. Olek ordered a steak as he was wont to do. He was very emphatic that he did not want any sauce on it! He then lectured me at length about the horrors of destroying a good steak with sauce. (In many subsequent dinners with him, in various places, I heard this theme repeated many times. The crusade went on throughout his life.) I know we must have talked about many scientifically interesting subjects that evening, but all that I remember is the soliloquy about steaks and sauce.

Figure 1:
Olek Zienkiewicz, Tom Hughes and Bob Taylor, Stuttgart, Germany, 1978

Figure 2:
Tinsley Oden and Olek Zienkiewicz, Venice, Italy, 1995.

Figure 3:
John Argyris, Ray Clough and Olek Zienkiewicz, Munich, Germany, 1999

Determination overcomes all obstacles

I also remember an interesting exchange between Bob and Olek at Berkeley by the elevator on the fourth floor of Davis Hall (the Civil Engineering building). I think of it as expressing the fact that Olek's *'determination overcomes all obstacles'*. Bob and Olek were discussing a method that Olek had developed some enthusiasm for. Bob had become convinced that there were serious problems with the method, but Olek would have nothing of it. Finally, Bob, with some exasperation said "but Olek, the method is wrong, completely wrong!" Olek replied, "Bob, don't bother me with details."

The riddle

Olek was a great international traveller. Here is the riddle that everyone in the finite element field has heard: "What was the difference between God and Olek? God was everywhere, but Olek was everywhere except Swansea."

The rival

Olek always had a very strong competitive spirit and he was very much concerned with an accurate and truthful history of the finite element method, at least the way he saw it. He was about to give a short talk about the history of the finite element method at a conference in Munich in 1999. His talk was preceded by the historical remarks of another individual who will remain anonymous. It seemed that the remarks of this other gentleman were something of a revision of the true history. Olek was fuming! He turned to me and said, "He's a damned liar. He was always a damned liar." When it was Olek's turn, he dispensed with his planned remarks and presented a rebuttal to everything the other fellow said. It was great theatre.

The last meeting

I met Olek many, many times over the years. Most of the meetings were at conferences but we also visited each other at our homes and in other places. We became very good friends. The last time I saw him was in Sitges, Spain in the summer of 2007. I was in Barcelona for a conference and Eugenio Oñate told me that he thought this would be the last time Olek would be able to visit Spain. Paal Bergan and I, and our wives, met him and his wife Helen in Sitges. He could hardly walk and his vision was all but gone. Nevertheless, he met us in one of his favorite restaurants. We had a very nice lunch and an afternoon of pleasant conversation. Despite his physical frailty, his spirit was as strong as ever. My most vivid memory of that meeting concerned an issue with an international organisation that was somewhat vexing. We agreed about a certain course of action, but I remarked that you just could not do that. Olek said, "You can do anything you want!"

Figure 4:
Olek Zienkiewicz, Tom Hughes and Paal Bergan in Sitges, Spain, 2007.

In memoriam

Olek made fundamental contributions to the development of the finite element method and tirelessly promoted it throughout the world. He was the leader of the field and his scientific impact was enormous. He was a vivacious human being, a friend and inspiration to all who knew him. He will always be on my mind and I will miss him very much. ●

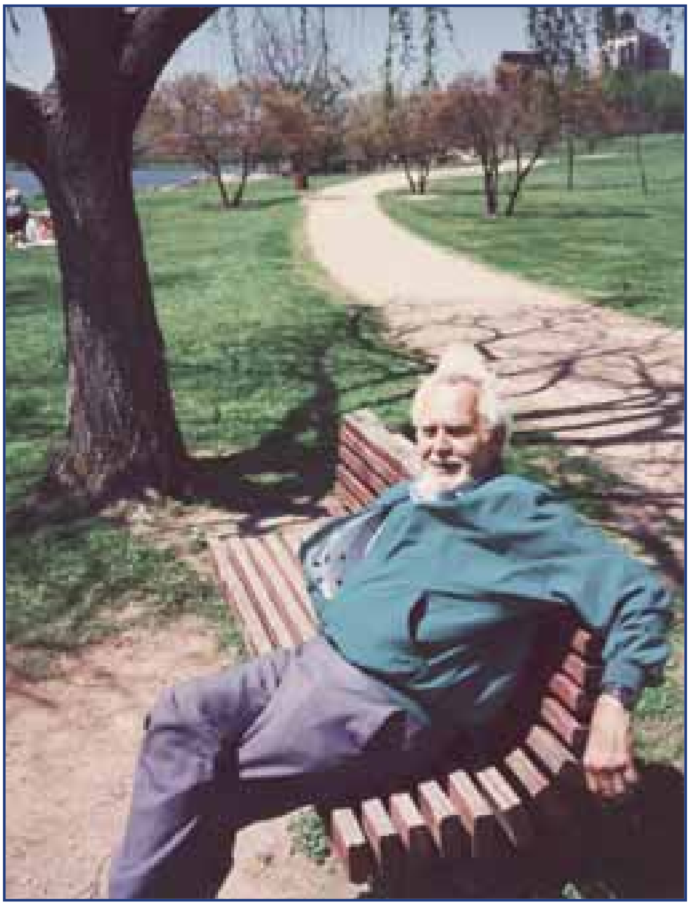
Personal Memories of
Olgierd (Olek) Cecil Zienkiewicz

by
Tinsley Oden

I first met Olek at the Dayton finite element meetings in the 1960's, which is where some say the finite element method, being born in the mid 1950's, reached its adolescence. There were a number of original and important works that formed the foundations of the subject that were presented there by engineers and scientists working in this new and exciting field. Of course, Olek was already known to many there because of his first textbook on finite elements, coauthored with Y. K. Cheung. Olek's intense interest and warmth were intriguing. We hit it off immediately and began a friendship that lasted until his passing some four decades later.

Coincidentally, I am reminded that in the 1960's I was a research engineer at General Dynamics/Fort Worth with an assignment to develop, with the help of only one other colleague, the first very large-scale finite element code for aircraft structural analysis, solid mechanics, vibrations, and even optimization for the company. I spent much time struggling with learning the basic properties and aspects of the method, and also developing codes and algorithms for a wide range of problems. The literature in those days was very thin. When I began to see the important contributions of Olek, my professional life and work became easier. Also, a few years later, when I began developing the first course in finite elements, access to Olek's work and his early book was extremely valuable in getting started in educating students in mechanics on this new collection of ideas that already begun to revolutionize engineering and computational mechanics.

Figure 1:
Relaxing by the lake in Austin



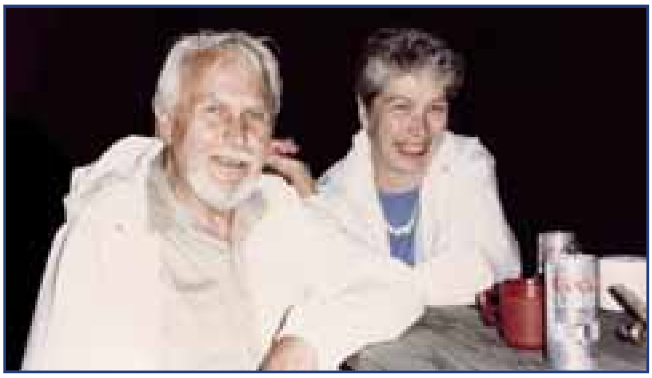
Following the Dayton meetings, we met many times at international meetings around the world in China, Africa, South America and Europe. In the early 1970's I met with Olek and Dick Gallagher at Northwestern to organize the first Finite Elements in Fluids conference shortly before he departed Northwestern for Swansea, where he spent the rest of his life. That conference was in Swansea and it was the first of a number of meetings that gradually added an important new chapter to the field of computational fluid mechanics.

Olek was a great swimmer and rarely missed an opportunity to swim, in good and poor conditions. He taught me to snorkel one time as we swam in the Mediterranean, off the coast of Portofino during the second Finite Element in Fluids Conference at Santa-Margherita, Italy. We paid a fisherman to transport us out to a reef and we spent the afternoon there looking at marine life and a beautiful statue of Cristo degli Abissi on the ocean floor. At that meeting, and many others, we talked of technical problems. We were to witness together many other developments in computational engineering and mechanics. With the help of Dick Gallagher, we organized the International Association of Computational Mechanics, IACM, and named Olek as its first president. This organization later peeled off into many national and regional-affiliated associations, which really established the subject as a rich and independent discipline in its own right, and one that has tremendous impact on all fields of science and engineering.

Olek and I were early visitors and lecturers in China. When we entered China through Hong Kong in spring 1981, we taught a one-week course along with Dick Gallagher, Ted Pian, and Ed Wilson. After the course in Haifei, we were given a grand tour of the country. Olek then led a delegation in an audience with the Minister of Education and the Minister of Defense. We discussed with him far-reaching issues on world problems and education far outside our realm of understanding or influence. We, nevertheless, were among the first westerners to lecture on finite elements in China.

Once in Paris prior to a major conference, Olek and I purchased a bottle of scotch as a gift to our French host. Unfortunately, we sampled the gift in my hotel room prior to the dinner by the host. Olek was not at all troubled by the predicament, he put the cap on the bottle and presented it to the host with the simple explanation that we had tasted it early in his honor.

Figure 2:
Olek and Helen at the ranch



I visited Olek many times at Swansea, and we met at many memorable meetings. In particular, I recall a meeting in Cracow, Poland in 1991 where we discussed, for many hours, techniques for a posteriori error estimation, the famous ZZ estimates, notions of under-integration, and many other topics. Then, we met in 1998 in Buenos Aires, where we began to see finite element methods, a subject on which Olek had spent his professional life, diversify into applications to many other areas of science and technology, including medicine, materials science, electromagnetics, and even astrophysics.

On Olek's 80th birthday, I visited the ceremony in Swansea in his honor, and we talked about his work and our friendship. I composed a short poem, which follows:

OCZ

Cigar smoke wafts down the hall
Knarled cane raps upon the wall
Bewhiskered man with features bright
Flashes through with mane so white.

Who is this king with aura white,
With carriage full of strength and might,
Who causes crowds to hush their noise
With his forebearance, words, and poise?

The man is Olek, standing tall
Cecil Zienkiewicz, if you know it all.
He's recognized as OCZ,
Professor from Swansea by the sea.

Four score years have come and gone
Since OCZ first came along
And in the intervening years
He surpassed the best among his peers.

With Southwells' lessons well in hand
He launched a school known cross the land
On FEM's and methods new
That changed forever what we do.

If one could list as best he can
What we owe to this great man
The list unraveled would be long
Of great insights and ideas strong

And, in the list, we're first to see
Field problems, then CFD.
There's isoparametrics and the rest
Then penalty and the patch test.

There's then integration, reduced too low
And adaptive meshing to and fro
And ZZ methods, last but best
Alphabetically on your list.

There's then the method for all the seasons
Defying lesser mortal's reasons.
There's many more, too much to say
To recount on this special day.

We thank the lucky stars we see
For all the work of OCZ.
For work that opened paths to view
By others in this field so new.

Four score years have come and gone
Since OCZ first came along.
We wish him here four score and ten
To befriend and guide us once again.

Cigar smoke wafts down the hall
Knarled cane raps upon the wall
Bewhiskered man with features bright
Flashes through with mane so white.

JTO, 08/2001

My impression was that he liked it. I can still envision him with his cigar and cane.

In the mid-1980's, Olek and Helen began a series of annual visits to the University of Texas at Austin to work with me on various projects. He also taught short-courses on finite element methods and on computational plasticity. These annual visits continued until the mid-1990's, and were a great attraction to students as well as to Olek's professional friends in Texas. He worked on a number of topics while at The Texas Institute for Computational and Applied Mechanics (TICAM), which was the forerunner of The Institute for Computational and Engineering Sciences (ICES). Included in his work were various versions of time-integration methods, the so-called hp-cloud methods on which we jointly published an article with Armando Duarte, and on the patch test, which led to long debates with Ivo Babuska as to its correct mathematical basis.

Olek especially loved to swim in Barton Creek pool, a magnificent natural swimming hole with cold water supplied by an artesian spring. He also snorkeled fearlessly in the lake on my ranch.

Olek and Helen spent many hours at my ranch outside Austin, particularly during the explosion of bluebonnets in the hill country each spring. There we had many adventures, including an encounter with a rattlesnake, the rattles of which adorned Olek's' desk for many years.

On one of his trips to Austin, Olek bought a large brass eagle that he wanted to put on his desk at Swansea. Helen convinced him that it was too large to go into his suitcase, too unwieldy to carry home, and best left in Texas where he could see it periodically on his visits. The eagle sits now at my ranch as a memento of Olek and serves as a reminder of him and the great times we had there.

Only a week before his death, I called Olek to inquire about his health, and talked to him briefly. He chatted about the ranch, his friends in Texas, and the times we had together. I profoundly miss him and will always cherish our times together. ●

Figure 3:
Olek and Tinsley and friend at a picnic at the ranch

Figure 4:
Olek at the Alamo

Figure 5:
Annual Institute picnic at the ranch

Professor Olgierd Zienkiewicz

Guru; Mentor; Friend

by
S. Valliappan

The main purpose of this article is to pay homage to Professor Olgierd (Olek) Zienkiewicz , a giant in the field of computational mechanics, who passed away in January 2009 and to portray him as a revered guru (teacher), a respected mentor and a wonderful friend from the experiences gained through my contact with him from 1965 to 2009. This article presents a kaleidoscope of various events during this period.

My initial contact with Olek was on a wintry, rainy and stormy day (typical Swansea weather) during December 1965 when I landed down a small airport in Swansea with my wife from a small aircraft which carried only four passengers including my wife and myself (total capacity being about a dozen passengers) from London. There was a man with beard and moustache standing in the waiting hall. He came to us and asked *"where are your suitcases"* and picked them up and loaded them in the only car waiting outside. This scenario, of course, made me to assume that he was the only porter available at the then Swansea airport! He then got into the driver's seat while I sat at the back with my wife. After driving a few minutes, he turned his head and said -

> *"I am Professor Zienkiewicz and you must be Val; now tell me all about yourself because I offered you the position of a research assistant for the project in the field of rock mechanics only on the high recommendation of your professor in the USA"!*

That was the day my relationship with Olek as my guru, mentor and friend started.

During my stay in Swansea from 1965 to 1969 there were many instances in which Olek showed his admirable nature of playing the three aforementioned roles. My research topic was "Nonlinear finite element analysis of rock mechanics problems" (which later included plasticity and soil mechanics) for which Olek had obtained a grant from the Civil Engineering Research Association. During the 1960's all three areas-finite elements, plasticity and rock mechanics - were relatively new (1960, 1964, 1966 respectively). I used to say that my research area was more like 'Chinese Chop Suey"! At that time for those involved in plasticity research, Hill's "The Mathematical Theory of Plasticity (1950)" was considered to be more like the 'Bible'. But my problem was that following the tensor notation used by Hill and then transforming to the matrix notation used in the finite element method. When I raised this problem with Olek, he said -

"Look, Val, I did my Doctoral work many years ago; now it is your thesis; you have to work on that and then teach me',

just like a distinguished guru who motivates his students to use their brain

Figure 1:
Olek Zienkiewicz,
Kai Cheung and Myself
(Somasundaram Valliappan)

power to its full potential! Thus, our pioneering work in the field of nonlinear finite element analysis resulted in two significant, very well cited publications - the one on 'initial stress method' in the first issue of *the International Journal for Numerical Methods in Engineering and Science* (1969) and the other on 'no-tension method' *in Geotechnique* (1968). It is interesting to note that both papers were written by me and Olek at the dining table in his house in Swansea while enjoying the delicious sandwiches prepared by his gracious wife, Helen!

Figure 2:
Olek with Helen, Val, Cheung and his wife Bao in Hong Kong to celebrate Olek's 70th Birthday,1991

Besides this episode, another thing which comes to my mind is that both Helen and Olek were always kind and caring to his students. During one year, when Helen invited the late Professor Nayak with his family along with us, she took special efforts to prepare purely vegetarian meals for Nayak's family. Similarly, when Nayak was sick once and admitted into the hospital, Olek was worried and asked me whether it could be because he was pushing his students to work very hard and he wanted to visit Nayak in the hospital. During that visit, he brought a couple of books on fiction and told Nayak to forget about research on plasticity for a while and enjoy reading those books and to recover his health! Another instance where Olek expressed his friendly and caring nature was when I returned to Swansea in 1974 to attend the first International Symposium on Finite Element Methods in Flow Problems. After my heart attack in 1973, that was my first trip. I arrived at Swansea by train from London and Olek came to the station with Professor Richard (Dick) Gallagher to meet me. There he told Dick -

> *"Val recently had a heart attack, so we should not let him carry his suitcases; you carry one and I will carry the other".*

One can never forget these simple humanitarian gestures expressed by a great man with a great heart!

During the early period of our research in Swansea, Olek was not familiar with the problems associated in transforming the equations into the code and solving the problems since he never had used the computer or written a computer code (even to the end). But, because of his experience he was very good in advising his students whether the results obtained were meaningful or not and where to look for the errors. During the later years he really began to appreciate the difficulties involved in writing codes. So it was not surprising when he told me before I left 'Wales' to 'New South Wales' in 1969 -

> *"Val, we will miss you here but in one way I am happy because your nonlinear analysis with incremental, iterative approach has been costing me a lot, but again, I realise that you cannot get something for nothing and we have had a good innings with your work".*

With these words, he gave me a copy of "The Finite Element Method (1967)" the first ever book written on the subject and authored by him. He signed it 'in appreciation of hard work' and I suppose that it probably meant not only my own research but also my involvement in the publication of that book with my input for the chapter on nonlinear analysis as well as my proof reading some parts of the book!

"No diagrams will be found in the work. The method which I follow requires neither figures nor arguments geometrical or mechanical, but merely algebraic operations arranged in a regular and uniform order"

Lagrange in "Mecanique Analytique'

Figure 3:
Olek Zienkiewicz, Valliappan and Ian King - Three authors of the two widely cited nonlinear analysis papers 'initial stress method' and 'no-tension method' In Okayama, Japan during International Conference on Computer Methods in Flow Analysis 1988

Figure 4:
Olek and Val in Flow Conference, (Okayama - 1988) having serious discussion,probably about IACM????

As a mentor, after my graduation while I was in Swansea he encouraged me to extend my research to other areas in numerical methods applied to engineering and science in collaboration with others. This type of mentoring continued even after I left Swansea. This has resulted in my research on nonlinear stress analysis of reinforced concrete structures which resulted in one of the very few early publications in that field (1971). Similarly, our pioneering work in the field of biomechanics resulted in the publication of stress analysis of human femur (1973) and later on prosthesis, pelvis, first molar etc. I indeed felt proud when he penned me as 'A eminent civil engineering scientist' in an article published during the Special Symposium organised to celebrate my 60th birthday. Besides motivating me to carry on with my individual research he also wanted me to get involved in complex consulting work as well as professional involvement by his proposal to bring me into the General Council of the International Association for Computational Mechanics from its inception in 1981. I can humbly claim that I have made him proud by contributing to the promotion of computational mechanics around the world especially in the Asia Pacific region and becoming the Founding Secretary General of Asian Pacific Association for Computational Mechanics and the Vice President (Asia-Australia) for the International Association for Computational Mechanics.

Olek as a friend – here are a few instances to illustrate: Back in the Swansea days whenever my wife Kamala and myself moved houses, Olek used to help us to transport the boxes with his car and looking around the new place to check that everything is O.K. As an artist himself, I remember, he would always look around to see whether there were any paintings adorning the walls. If there was none, he would go home to bring one of the paintings he had and put it up. His interest in arts also was passed on to me in appreciating good paintings and sculptures. So, later during 1995 when we visited him in Swansea I saw a beautiful sculpture in his house. Seeing my interest in that, Olek asked me whether I would like to have one and I said 'yes'. He said that it was made in Barcelona by a sculptor and during his next visit to Barcelona he would organize to get one for me. As a sincere friend, he remembered this and during his next visit to Barcelona he went the sculptor, got a few photos of the model who was indeed his girl friend and sent them for my selection. Once selected by me, he got the sculpture created and on completion shipped it to me by air with the help of Professor Robert (Bob)Taylor who was also in Barcelona at that time. Now I have that beautiful sculpture in my living room to remember my good friend, Olek.

During those Swansea years, both Olek and myself used to share the habit of smoking cigarettes, then cigars and pipes in order to overcome the addiction of cigarette smoking. Alas! we never could give up until I had a heart attack in 1973 in Sydney and gave it up. Here is the excerpt from the special message written by him for the publication brought out during my retirement –

> *"You were the first one of my students who suffered a heart attack, partly caused by overwork but I am sure accelerated by smoking in which both you and I heartily indulged.*
> *You recovered completely and carried on making your mark in the years that followed, but without the smoky background.*
> *I do appreciate your efforts in trying to make me cease the same bad habit, but it took many years before finally I also gave it up. The great moment came in 1994 when I had no alternative, but nevertheless it was an important step in my life for which I owe you much indeed".*

Both Olek and myself enjoyed hard work (as long as there was motivation) and good life with food and wine as well as smoking (when our health permitted us to do so). In this regard, I recall the words written by him for an article published during my retirement symposium in 2004 -

> *"I don't believe that you will retire soon.*
> *There is, as you say, very much more to be done…*
> *many activities in which you can still freely indulge".*

I dearly miss Olek, my guru, mentor and friend as do his former students, colleagues and researchers around the world who were his contacts and friends.

Long live the memory of Professor Olgierd Zienkiewicz among the computational mechanics community. ●

Figure 5:
Val & Kamala with Olek & Helen at a restaurant opposite to Mumbles Pier,1995

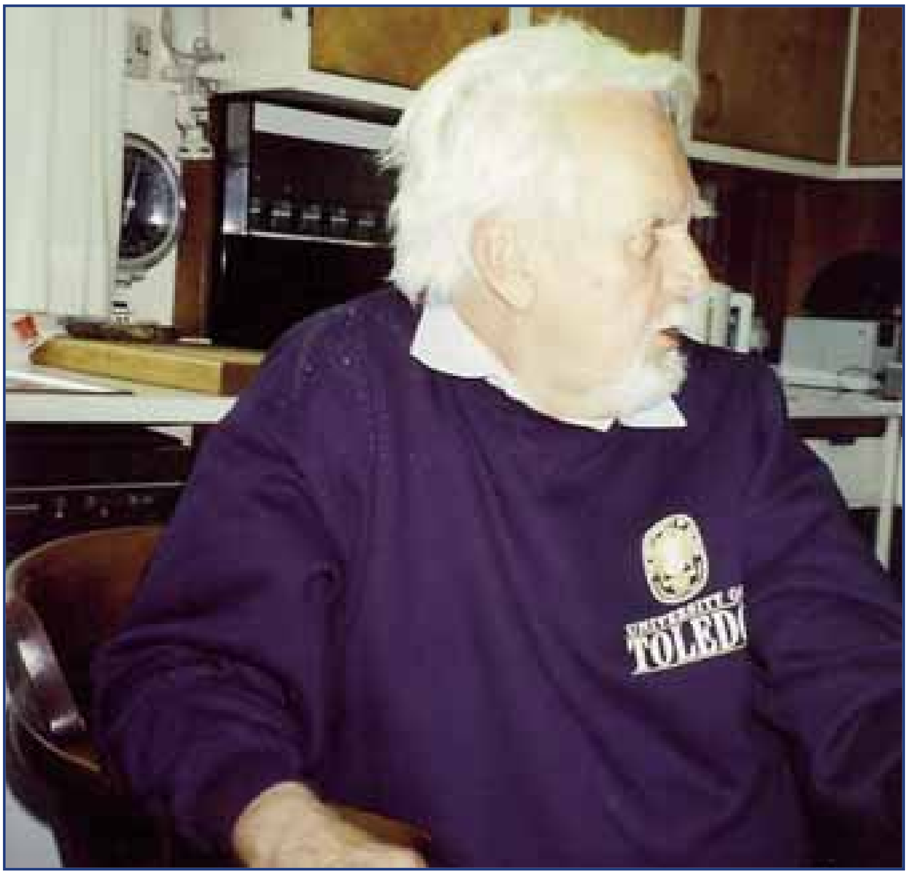


Figure 6:
Olek at his home in Langland,Swansea,1995

"Mechanics is the paradise of mathematical science because here we come to the fruits of mathematics"

Leonardo da Vinci (1452-1519)

Thank you, Dad.   Goodbye

My Dad, Olek Zienkiewicz,
was a sailor, determined to enjoy himself.

Some of the happiest photos of him are in the middle of Swansea Bay.

Many of us here sailed with him
or learned to sail with him
or just got roped into boat maintenance.
He didn't usually plan a sail, but was happy to see which way the wind was blowing and what looked interesting.

As children growing up we we all got used to wandering day-trips or holidays, full of diversions to whatever looked interesting,
Long Sunday walks on Gower - which he loved and which kept him anchored in Swansea.
Climbing up sea cliffs - often with no choice as the tide rose behind us.
Long snorkeling adventures in the Mediterranean, returning with edible fish or an octopus or just something with poisonous spines.
Sailing across the Channel to France and working out the best use of customs allowances.

While travelling he would spot a dam or a bridge under construction - or recently collapsed - and then - to his children's cringing embarrassment - march up to the security gates and never fail to talk his way in.

And we would see wonderful things !
Huge civil engineering projects .   Research labs.   Inside other people's houses.
He knew that people liked to talk about what they do and he let them know that he wanted to hear about it.

Intellectually, any question could spark a discussion - sometimes a lecture - on science. maps, history , maths, religion. If he he didn't know, then we would be sent to get the big books and do research.   I remember him ringing up a priest in the middle of the evening because we couldn't figure out the ethical point of a parable !

Gastronomically, he would try anything.   And we got the benefit of that - learning to love food from France or Yugoslavia or Poland or what to do with anything found in the sea.

Most of all he showed us there was a big world out there.   A world, most of which he visited, some of which he showed us and an awful lot of which passed through our living room in the form of his friends and colleagues.

He enjoyed sailing with all of them.
Thank you, Dad.   Goodbye.

Andrew Zienkiewicz

Copy of Olek´s son Andrew´s eulogy, read at his father´s funeral

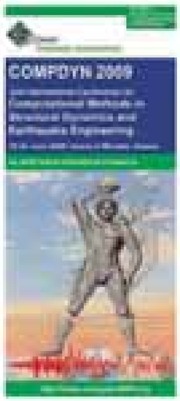
European Community on Computational Methods in Applied Sciences

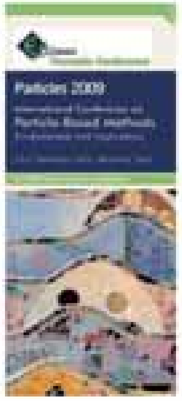
Thematic Conferences

ECCOMAS

June-December 2009

ECCOMAS organizes in Europe Thematic Conferences and Workshops in state of the art and emerging topics in computational engineering and applied sciences in cooperation with universities, research centers and industry. Previous Thematic Conferences of ECCOMAS were held in 2003 (7 conferences), 2005 (15 conferences) and 2007 (24 conferences). A total of 23 ECCOMAS Thematic Conferences will take place on 2009. For details of new and past Thematic Conferences visit the web address of each conference or www.eccomas.org

COUPLED PROBLEMS 2009
International Conference on Computational Methods for Coupled Problems in Science and Engineering
June 8 - 11, 2009, Ischia, Italy

MARINE 2009
International Conference on Computational Methods in Marine Engineering
June 15 - 17, 2009, Trondheim, Norway

IBM COLLOQUIUM 2009
Immersed Boundary Methods: Current Status and Future Research Directions
Amsterdam, Netherlands - June 15-17, 2009

EUROGEN 2009
International Conference on Evolutionary and Deterministic Methods for Design, Optimization and Control with Applications to Industrial and Societal Problems
June 15-17, 2009, Cracow, Poland

COMPDYN 2009
International Conference on Computational Methods in Structural Dynamics and Earthquake Engineering
June 17 - 19, 2009, Island of Rhodes, Greece

CMAS 2009
International Conference on Computational Methods in Applied Sciences
June 30 – July 3, 2009, Bratislava, Slovakia

MULTIBODY DYNAMICS 2009
International Conference on Multibody Dynamics
June/July 2009, Warsaw, Poland

TISSUE 2009
International Conference on Tissue Engineering
July 2-4, 2009, Leiria, Portugal

SMART STRUCTURES 09
International Conference on Smart Structures and Materials
July 20 - 22, 2009, Porto, Portugal

COMPLAS X
International Conference on Computational Plasticity
September 2 - 4, 2009, Barcelona, Spain

EURO:TUN 2009
Computational Methods in Tunnelling
September 9-11, 2009, Bochum, Germany

CONTACT MECHANICS 2009
International Conference on Computational Contact Mechanics
September 16-18, 2009, Lecce, Italy

XFEM 2009
International Conference on Extended Finite Element Methods – Recent Developments and Applications
September 28 - 30, 2009, Aachen, Germany

MEMBRANES 2009
International Conference on Textile Composites and Inflatable Structures
October 5 - 7, 2009, Stuttgart, Germany

VIPIMAGE 2009
International Conference on Computational Vision and Medical Image Processing -
October 21 - 23, 2009, Porto, Portugal

Particle 2009
International Conference on Particle-Based Methods. Fundamentals and Applications.
November 25-27, 2009, Barcelona, Spain

Lecture Notes on Numerical Methods in Engineering and Sciences 2009

CIMNE and Springer announce the joint publication of the book:

Structural Analysis with the Finite Element Method
Linear Statics
Eugenio Oñate
Volume 1 : Basis and Solids

Hardcover, 472pp.,
ISBN: 978-1-4020-8732-5, April 2009
Price 69 €
www.cimne.com

The book presents the basis of the FEM for structural analysis and a detailed description of the finite element formulation for axially loaded bars, plane elasticity problems, axisymmetric solids and general three dimensional solids. Each chapter describes the background theory for the structural model considered, details of the finite element formulation and guidelines for the application to structural engineering problems. The book includes a chapter on miscellaneous topics such as treatment of inclined supports, elastic foundations, stress smoothing, error estimation and adaptive mesh refinement techniques, among others. The text concludes with a chapter on the mesh generation and visualization of FEM results and a chapter introducing the main concepts for programming the FEM using MatLab.
The book will be useful for students approaching the finite element analysis of structures for the first time, as well as for practising engineers interested in the details of the formulation and performance of the finite element method for practical structural analysis and design.

Methods and Communities

by
Dan Givoli
Technion – Israel Institute of Technology
Haifa, Israel

I confess: I have always had a slight obsession for the subject of "scientific sociology". This has been known to my friends and colleagues, who often joke (in a good-hearted way, I am sure) about the fact that I mention this subject in almost every lecture that I give. Indeed, the observation of all kinds of differences among various scientific communities fascinates me.

One way in which this subject manifests itself in the fields of scientific computing and Computational Mechanics (CM) is the existence of different communities concerned more or less with the same type of problems but using different methods. In many cases this methodological difference has a good reason (we shall see examples of this); however, sometimes it originates merely from historical reasons. Moreover, often there is mutual lack of familiarity with the methods used in different communities.

It is obvious that a strong interaction between communities that share the same types of problems is very desirable. Such interaction enriches all the communities involved, it allows the import of existing methods for use in new fields of application, and adds important tools to each community's "tool box".

However, we must appreciate the fact that such multi-community interaction is by no means easy. Different communities have different journals, different conferences, different jargons, and sometimes even different cultures. Look, for example, at how delegates are typically dressed in a conference of mathematicians versus a conference of engineers (*Fig. 1*).

Figure 1: *A mathematician (left) and an engineer (right) at a conference*

Differences among Communities

Years ago I attended a workshop devoted to iterative linear algebraic solvers. While it is widely agreed that developing good algebraic solvers is extremely important, many of us who are interested in CM methods and FE formulations regard the algebraic solver as a "black box" in our research. Indeed this was how I saw things then. Imagine my

surprise when one of the lecturers in this workshop called the FE formulation "a black box"! He was developing an efficient solver for systems of algebraic equations that were generated by a "black box"! I suddenly realized that the situation is really symmetric, and that calling the algebraic solver (or the mesh generator, or the visualization algorithm, etc.) a "black box" is not more natural than calling the FE formulation by that name; it only depends on the point of view and interest of the related sub-community.

I have mentioned the difference in jargon among different communities. One example is the use of the word "formal". When an applied mathematician says "I have shown this formally" or "I have developed this formally" she means that she has not justified or proved rigorously whatever she is referring to, but used freely some mathematical manipulations (which might be unjustified) in the development. On the other hand, when a computer scientist makes the same statements she means quite the opposite! The word "formal" in computer science means "rigorous".

Another demonstration of the differences in jargon is the discussion I once had with a senior researcher in structural mechanics from a civil engineering department. He talked about two computational models for the same beam structure, which he called the "Timoshenko beam model" and the "FE model". I was confused by this, for obvious reasons. It took me some time to realize that what he meant by "FE model" was a FE solution of the three-dimensional elasticity equations for the beam structure. He assured me that this was a standard use of the term in his sub-community, since to solve the Timoshenko beam equations they usually used methods different than FEM.

I once wanted to tease a friend who was developing computational methods for problems related to structural closed-loop control. I said to him jokingly: "The work that we do is much more serious than that done by you control people. We solve PDEs and you always solve ODEs. Our discrete models have millions of degrees of freedom, while yours have 20 at most." He answered: "Yes, but unlike you we do everything in real time."

Arc-length Methods

In January 2008 Prof. Herb Keller (see *Fig. 2*), a well-known applied mathematician from Caltech, passed away. In the Obituary published in SIAM News his great contribution to arc-length methods [1] was clearly mentioned. How many CM practitioners who are familiar with arc-length methods associate Keller's name with these methods?

Arc-length methods are intended for the solution of nonlinear algebraic systems of the form

$$\mathbf{G}(\mathbf{d}) = \mathbf{F} \qquad (1)$$

and are capable of passing limit points. Systems of the form (1) are obtained for example by FE discretization of nonlinear elliptic PDEs, such as static problems in nonlinear solid mechanics. In this case **d** is the displacement vector, **F** is the load vector, **G**(**d**) is the load-deflection function, and eq. (1) is the discrete equation of equilibrium. An example of a load-deflection curve for a single-degree-of-freedom is shown in *Figure 3.* In this example both **G**(**d**) and the inverse relation **d** = **H**(**F**) are multi-valued. Such a load-deflection path is typical, for example, of large-deformation behavior of shells associated with snap-through and snap-back behavior. Conventional methods like Newton's method may fail to find a solution when the nonlinear dependence is non-monotone (as in *Figure 3*) and the initial guess is not close enough to the exact solution. Arc-length methods are not sensitive to the lack of monotonicity, since they find an approximate solution by "going along the arc-length" of the load-deflection path (in the space of all degrees of freedom).

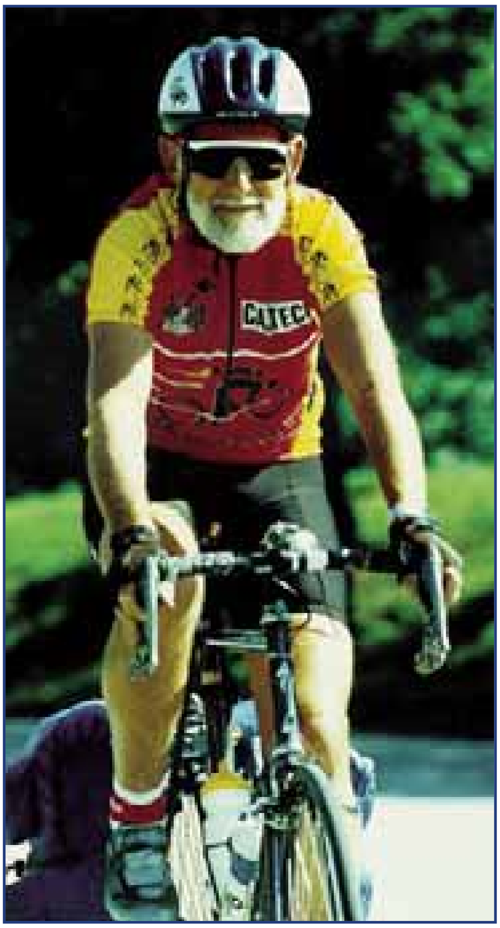
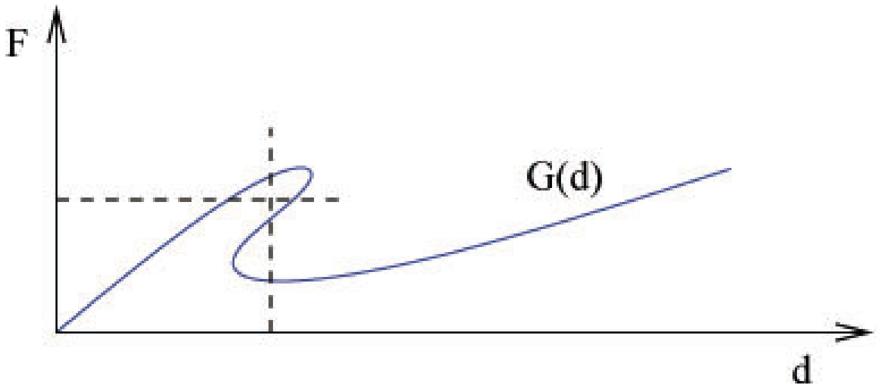


Figure 2:
Herb Keller

"While it is widely agreed that developing good algebraic solvers is extremely important, many of us who are interested in CM methods and FE formulations regard the algebraic solver as a "black box" in our research."

Figure 3:
Load-deflection curve for a single degree-of-freedom.



According to Crisfield [2], the arc-length method was originally introduced by Riks [3] and Wempner [4], in 1971. The first contribution by Keller [1] to the arc-length method (under the name "continuation method" or "arc-length continuation method") was published in 1978, and did not mention [3] and [4]. In the early 1980's additional important work was done in the CM community in developing arc-length methods [5,6]; it referred to [3] and [4] but not to [1].

As far as I could see from the reference lists in publications on arc-length methods, there was hardly any cross-referencing between the mechanics literature and applied mathematics literature. For example, the 1982 paper by Chan and Keller [7] includes 27 references; all of them belong to the applied mathematics literature, except one paper which was published in J. Computational Physics. According to ISI, Keller's paper [7] was cited 36 times; all 36 citing papers belong to the applied mathematics literature.

Weather Prediction

Semi-Lagrangian Methods

Semi-Lagrangian methods are time-stepping methods that are extremely popular in subareas of computational Geophysical Fluid Dynamics (GFD) like numerical weather prediction and computational oceanography; see, e.g., [8] and [9], Chapter 6. These methods are *explicit and unconditionally stable* – undoubtedly a very tempting combination.

To present the basics of semi-Lagrangian methods, let us consider the scalar one-dimensional advection equation

$$\frac{\partial u}{\partial t} + V\frac{\partial u}{\partial x} = f \qquad (2)$$

in the unbounded domain $-\infty < x < \infty$ (or in a bounded domain with periodic boundary conditions). Here $u(x,t)$ is the unknown wave field, $V(x,t)$ is a given velocity function and $f(x,t)$ is a given source function. To this equation we append the initial condition $u(x,0)=u_0(x)$. Let us discretize both space and time, and let u_j^n and f_j^n denote the approximation of u and the value of f at spatial location x_j (i.e. at node j) and time t_n (i.e. after n time-steps). Now suppose we have completed calculations up to time t_n , and we wish to calculate the solution u_j^{n+1}. In the semi-Lagrangian approach we first ask the following question:

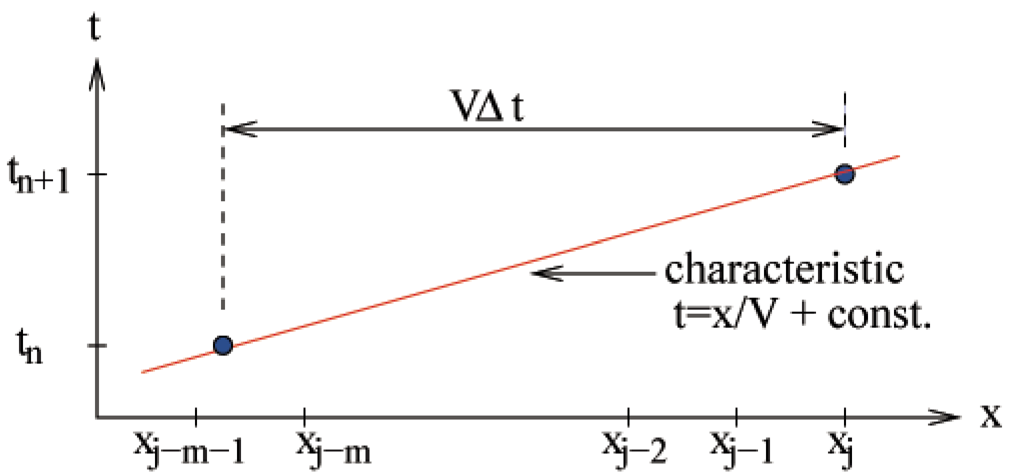
What is the location $\tilde{x}_j^n$ at the current time (t_n) of a "particle" that would reach location x_j at time t_{n+1} ?

Assuming that we know how to answer this question, a basic semi-Lagrangian scheme for (2) is given by

$$u_j^{n+1} = \tilde{u}_j^n + \frac{\Delta t}{2}\left(f_j^{n+1} + \tilde{f}_j^n\right) \qquad (3)$$

Here $\tilde{u}_j^n$ and $\tilde{f}_j^n$ are the estimated values of u and f at $\tilde{x}_j^n$. The formula (3) is obviously explicit.

Figure 4: Setup for the semi-Lagrangian time-stepping method



To understand what stands behind (3), let us consider the simplest case, in which $f \equiv 0$ (no sources) and $V > 0$ is constant. In this case, the solution u is constant along the characteristic $t = x/V +$ const. Then, the procedure to find the solution at a desired location at the next time level amounts to finding the solution on the same characteristic at the current time level. Also, in this case it is easy to see that

$$\tilde{x}_j^n = x_j - V\Delta t \tag{4}$$

This is illustrated in *Figure 4*.
Let m be the integer part of $V\Delta t / \Delta x$. Then $\tilde{x}_j^n$ lies in the interval $x_{j-m} \leq x \leq x_{j-m-1}$, as shown in the figure. Denoting

$$\alpha = (x_{j-m} - \tilde{x}_j^n) / \Delta x \tag{5}$$

and approximating $\tilde{u}_j^n$ by linear interpolation we get

$$u_j^{n+1} = (1-\alpha)u_{j-m}^n + \alpha u_{j-m-1}^n \tag{6}$$

Since the particle's estimated departure point always lies between the nodes j-m and j-m-1 we are guaranteed that $0 \leq \alpha \leq 1$, and thus (6) means that u_j^{n+1} is the weighted average between two previous solution values. This immediately establishes the unconditional stability of the scheme. Thus, although the scheme is explicit, it is possible to take arbitrarily large time steps without violating a CFL condition.

For a non-constant velocity $V(x,t)$ it is more difficult to estimate the particle's departure point $\tilde{x}_j^n$ but there are reasonable ways to do this [9].

The basic scheme (3) is only first-order accurate in space and time. However, semi-Lagrangian schemes with higher-order accuracy are also available [9].

Equipped with their explicitness and unconditional stability, semi-Lagrangian methods have become a key ingredient in computational GFD. So why are they almost unheard of in CM? The reason is probably related to the difficulties that occur when one wishes to use a semi-Lagrangian method in the presence of *physical boundaries,* with boundary conditions other than periodic. What do we do if we track a particle's departure point to lie outside of the computational domain? There are some ideas on how to go about this (mainly for artificial non-reflecting boundary conditions), but this difficulty significantly hampers the simplicity and attractiveness of semi-Lagrangian methods for most CM applications.

Mollification

Mollification is a tool in mathematical analysis which is familiar to mathematicians (especially those dealing with the theory of distributions) but is rarely encountered in the CM literature. One instance in which mollification is used in a CM-related context (but in the applied mathematics literature!) is the method of "moving finite elements"; see, e.g., [10]-[12]. Another application can be found in [13].

To present the concept of mollification in a simple setting, consider the one-dimensional finite element shape function $N_I(x)$ shown in *Fig. 5(a)*, which is the *"hat function"* associated with node I. This function is only C^0, namely it is continuous but its derivative is discontinuous. *Fig. 5(b)* shows this first derivative, $N_I'(x)$. The second derivative $N_I''(x)$ is thus singular. Normally (and almost by definition) the second derivative of a shape function would not appear in a C^0 finite element formulation. However, some special formulations have been proposed in the applied mathematics literature, e.g., "moving finite element" formulations with diffusion terms [10]-[12], that do involve $N_I''(x)$ for a C^0 shape function $N_I(x)$. For the hat function, $N_I''(x)$ can easily be expressed formally by using Dirac delta generalized-functions (or "Dirac distributions" as mathematicians call them). Alternatively, and more safely in some situations, one can resort to mollification. *Fig. 5(c)* shows the mollified first derivative of the hat function. Here the discontinuous function $N_I'(x)$ is approximated by

"Mollification is a tool in mathematical analysis which is familiar to mathematicians .... but is rarely encountered in the CM literature."

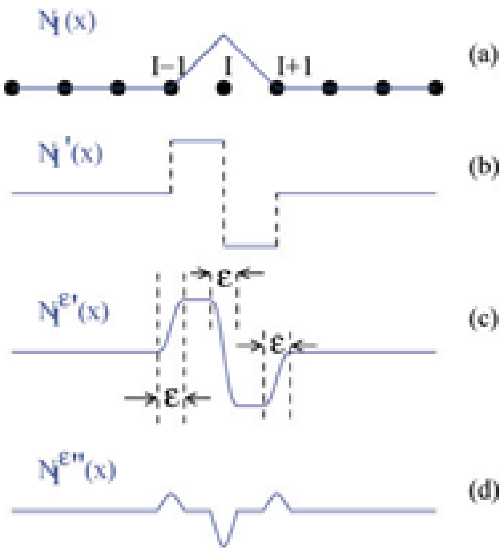
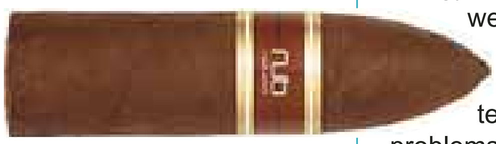


Figure 5:
Mollification of a shape function. Shown are
(a) the hat shape function,
(b) its first derivative,
(c) its mollified first derivative,
(d) its mollified second derivative

a continuous function, denoted $N_i^{\varepsilon}{}'(x)$, where each original jump is replaced by a smooth function defined over a layer of small thickness ε bridging the two values across the jump. Once we have such a smooth approximation for $N_i^{\varepsilon}{}'(x)$ we can take the second derivative and obtain a continuous function $N_i''(x)$, as shown in *Fig. 5(d)*. We can then perform the required operations using this function, and finally take the limit (provided that it exists!) $\varepsilon \to 0$. See [10]-[13] for more details.

Absorbing Boundaries

Underwater acoustics (a cigar-shaped object)



Many fields of application, like seismology, underwater acoustics and weather prediction, involve wave problems situated in unbounded domains. One common technique to approach such problems computationally is to introduce artificial boundaries which enclose a finite computational domain, and then use FEM or another volume method in this finite domain. The artificial boundaries are often called *absorbing* since they are supposed to "absorb" outgoing waves without giving rise to spurious reflections. *Fig. 6* shows a setup typical to seismology where the unbounded half-space domain is replaced by a finite domain which is bounded by the physical earth surface and three Absorbing Boundaries (AB).

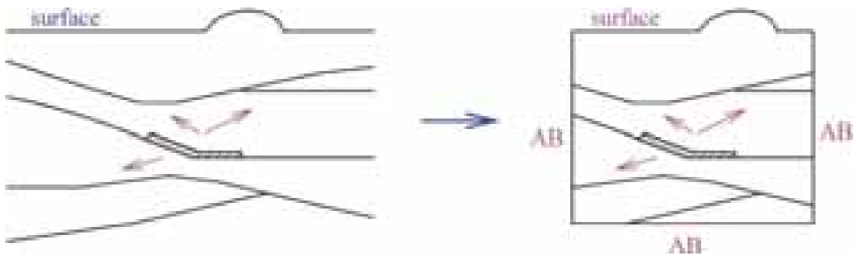


Figure 6: *Typical setup in seismology: replacing the unbounded domain by a finite computational domain bounded by the earth surface and three Absorbing Boundaries.*

Electro-magnetism

One popular AB treatment is the so-called Perfectly Matched Layer (PML), which was invented by Berenger in 1994 [14] for Maxwell's equations in Electro-Magnetism (EM). The basic idea is to enclose the computational domain with a thin layer, and modify the governing equations in the layer in a manner that is perfectly transparent to all outgoing waves. Upon its invention, PML was immediately embraced by the EM community, but it took three more years until the first paper on the use of PML in acoustics was published [15]. It is interesting to note that in this case the method was invented first for a complicated problem (governed by Maxwell's equations), and only then adapted to a simpler problem (governed by the Helmholtz equation). In terms of "educating" the readers of the scientific literature this is not the natural order of things; of course it is the result of the area of interest of the PML inventor and his community. Today, PML dominates AB treatment in the EM community, whereas in acoustics, while certainly being very popular, PML competes with other AB methods.

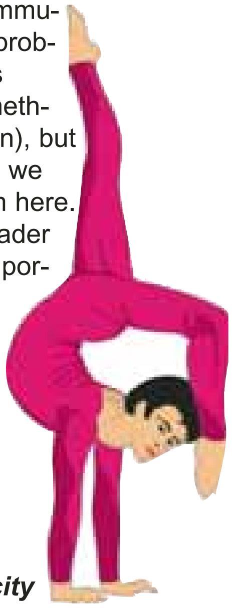
Another AB approach, which has much older roots, is the use of a special boundary condition on the artificial boundary. This approach has been developed for more than three decades in various application fields [16]. The lack of sufficient interaction among these fields is manifested by the fact that the special boundary conditions are called by various names in different communities: absorbing (mainly in acoustics), radiating (mainly in EM), silent, transmitting, transparent (mainly in geophysics), open (mainly in weather prediction), free-space, pulled-back, one-way and non-reflecting boundary conditions. (We remark that some of these terms – like "open" – carry special meanings which slightly distinguish them from the others.) The methods of construction of the AB conditions also differ in different communities. For example, in numerical weather prediction it is standard to use a zero-order condition – the simplest possible – but with a variable phase-velocity coefficient which is determined dynamically and adaptively during the solution process [8],[9].

Acoustics

On the other hand, in the acoustics, applied mathematics and CM literature the trend in recent years has been to use high-order AB conditions with constant coefficients [17]. There does not seem to be a good reason for this difference in approaches, other than a historical one.

Conclusion

We have given here only a few examples to demonstrate the lack of sufficient interaction among communities sharing similar problems. Other examples come to mind (e.g., methods of model reduction), but for the sake of brevity we shall not discuss them here. It is hoped that the reader is convinced of the importance of such interaction. The barriers mentioned above are real, but in many cases the efforts of overcoming them are worthwhile.



Elasticity

It should be remarked that the age of internet and open communication, as well as the recognition of the importance of multi-disciplinary research, has increased the interaction among communities significantly compared to the situation a few decades ago. This trend keeps developing as the scientific world is becoming more and more global, like everything else. ●

Aeroelasticity

Acknowledgment

I am indebted to my applied mathematician friends Eliane Bécache, Tom Hagstrom and Koby Rubinstein for the inspiration to this article.
I also thank my engineer friends Isaac Harari and Paul Barbone for their useful comments.

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Tomography-Assisted Modeling to reveal Full Three-Dimensional Crack Intimacy

by
Propavanfis team[1]

The "Graal" of fracture mechanics is to have access to the actual distribution of the three modal stress intensity factors all along the front of a three-dimensional crack. This goal is however a challenge for experimentalists, even when access to the three-dimensional geometry is granted by modern computerized micro-tomography techniques. This is also a challenge for numerical modeling, even with the help of recent multi-scale developments, as the question of the representativeness of the material constitutive law, the loading conditions or the precise crack geometry remains open. However, when these two approaches are combined, the goal is within reach. An attempt along those lines has just been completed to address fatigue crack propagation in a nodular graphite cast iron *(see Figure 1)*.

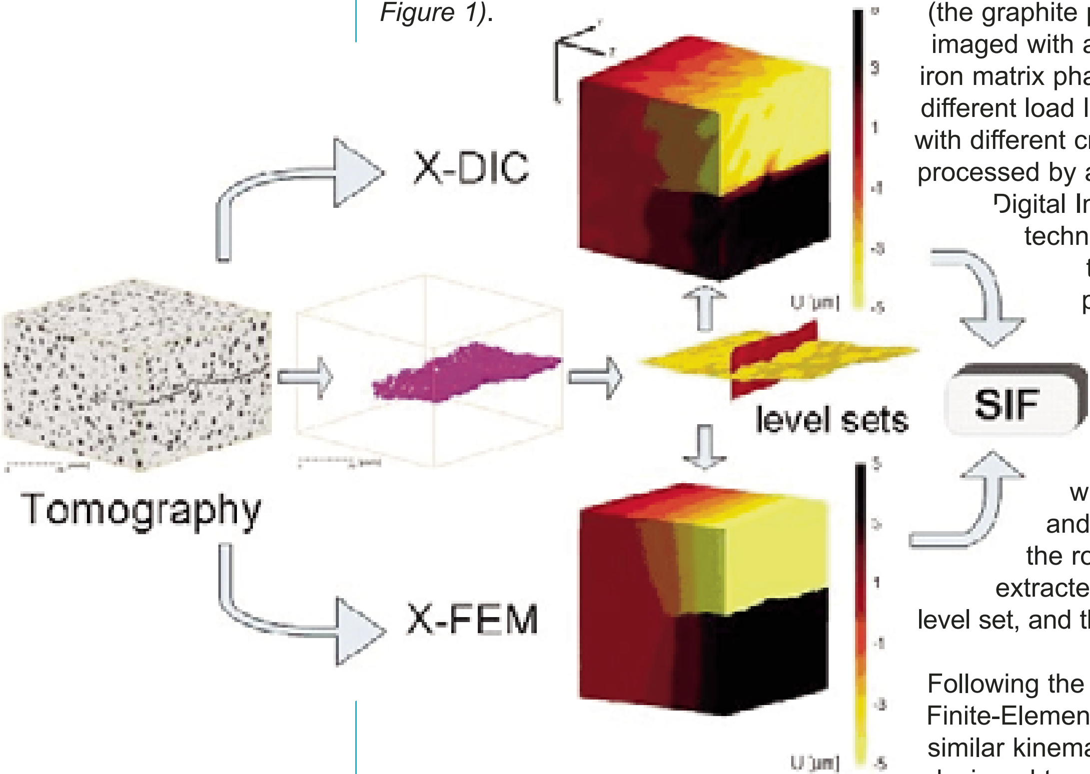

Figure 1: *Schematic view of the methods used for determining and comparing stress intensity factors along the front of a crack imaged by tomography.*

Sample preparation begins by a controlled stage of fatigue precracking of a large specimen where the sample geometry and cyclic loading are chosen so that confined crack front plasticity, and overall crack morphology meet the chosen requirements. From this large specimen, one or two samples are cut out to obtain a size compatible with attenuation of the X-Ray beam of the tomography. Selecting a side sub-specimen allows for the differential study of free edge and bulk propagation, which is one of the final goals of this type of study.

The sample is then subjected to a new fatigue in situ test, within a tomograph (either a lab-scale one, or that of a large facility, such as the European Synchrotron Radiation Facility in Grenoble, France in the present case). A nodular graphite cast iron has the great advantage of having a random microstructure (the graphite phase) that is easily imaged with a good contrast with the iron matrix phase. 3D images taken at different load levels during one cycle, with different crack openings, are further processed by a three-dimensional Digital Image Correlation, DIC, technique to reveal the full three-dimensional displacement field inside the entire specimen volume. The residual image registration error markedly reveals the crack even with subvoxel openings, and hence the geometry of the rough crack surface is extracted and described by a first level set, and the front by a second one.

Following the strategy of the eXtended Finite-Element Method, X-FEM, a similar kinematic enrichment is designed to account for displacement discontinuities supported by the actual crack geometry, within an eXtended-Digital Image Correlation, X-DIC, code. The displacement field is finally post-processed to measure the three-mode Stress Intensity Factors (SIF). Special care has however to be exercised here since the displacement fields are inevitably corrupted by a small amount of noise, and hence a specific noise-robust extraction strategy is called for. Consistently, within the same noise-robust approach, generalized super-singular SIFs are also estimated to position accurately the crack front on the crack surface.

To validate the entire procedure, a direct (numerical) modeling is also proposed based on the actual sample, crack surface and front geometry, kinematic boundary conditions for which X-DIC measured displacements are used. This last step is essential as the real loading prescribed onto the sample included slight deviations from the idealized one, presumably because of the dissymmetry of the crack geometry. This modeling involved a multi-scale strategy with X-FEM enrichments carried over several scales. Although the designed code could account for plasticity, a linear elastic behavior was shown to be sufficient for SIF evaluations. The numerical SIF estimates could finally be confronted to the experimental ones and a very good agreement was observed over the entire front for all modes and all load levels *(see Figure 2)*.

The synergy between multi-scale numerical modeling and refined experimental techniques through full-field measurements as a bridge is among the most stimulating and promising directions of progress, in particular to analyze three-dimensional aspects of crack propagation. ●

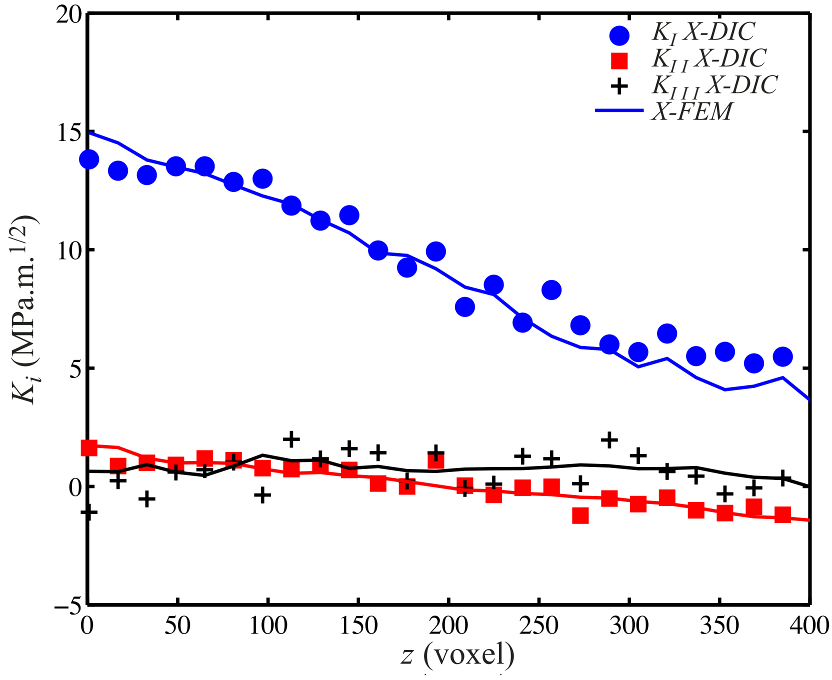

Figure 2:
X-FEM and X-DIC mode I, II and III stress intensity factors along the crack front after 45,000 cycles. Experimental results (symbols) are compared with numerical simulations (X-FEM) on the same mesh, same crack geometry and experimental boundary conditions.

Propavanfis[1] *is a research program funded by* ***CETIM foundation*** *and run by a team composed of N.* ***Limodin, J.-P. Tinnes, J.-Y. Buffière (MATEIS, INSA-Lyon), W. Ludwig (ESRF, Grenoble), F. Hild, S. Roux (LMT-Cachan), J. Rannou, J. Réthoré, A. Gravouil, M. C. Baietto-Dubourg, A. Combescure (LaMCoS, INSA-Lyon)***

Further reading:

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Computational Modeling of the Respiratory System

by
Wolfgang A. Wall,
Lena Wiechert,
Andrew Comerford
& Sophie Rausch
Institute for Computational Mechanics
TU München,
Germany

When compared to other areas in (computational) biomechanics like the circulatory or the muscosceletal system, research on the respiratory system is only at its infancy. This is quite astonishing, especially when considering the huge impact a better understanding of respiratory mechanics can offer. One reason might be the complexity of this system – but on the other hand it is exactly this complexity involving multiple fields and scales that makes research in this area so fascinating for experts in computational mechanics.

A sound standing "virtual lung model" could be a valuable tool for various applications ranging from the better understanding of lung diseases like for example asthma or Chronic Obstructive Pulmonary Disease (COPD) to progress on individual therapeutic approaches e.g. by improving drug delivery. Our current main motivation is to develop new protective mechanical ventilation strategies for patients suffering from Acute Respiratory Distress Syndrome (ARDS), i.e. a severe lung dysfunction with associated mortality rates around 40%.

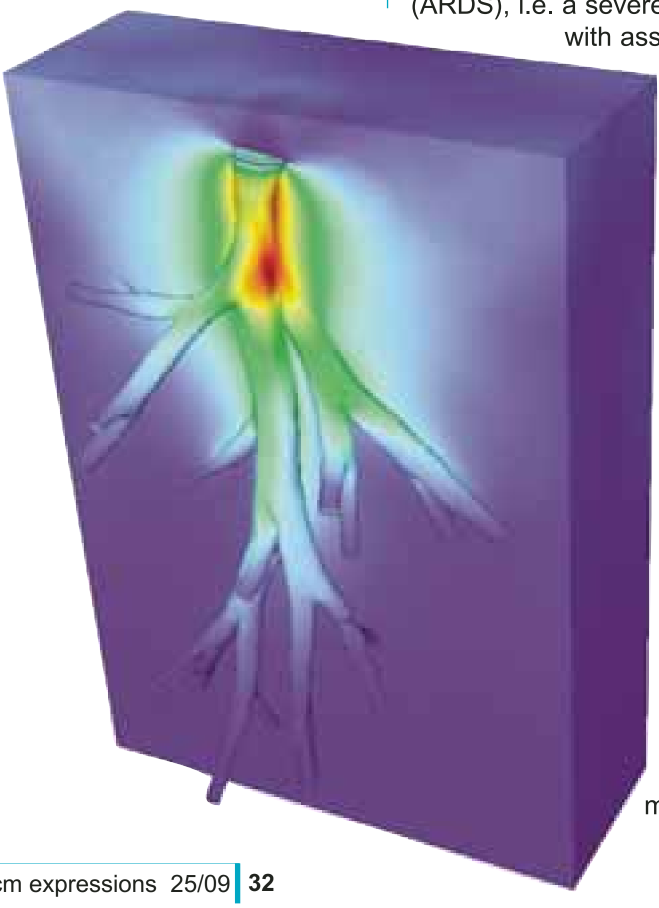


Figure 1: *Embedding of tracheo-bronchial model in simplified model of surrounding lung tissue taking into account fluid-structure interaction.*

Heterogeneity of the ARDS lung predisposes patients towards a number of further associated complications which are collectively termed ventilator induced lung injuries (VILI) and deemed one of the most important factors in the pathogenesis of ARDS. VILI mainly occurs at the alveolar level of the lungs in terms of local overexpansion or frequent recruitment and derecruitment of ventilatory units inducing high shear stresses. Since mechanical stimulation of cells can result in the release of proinflammatory mediators – a phenomenon commonly called mechanotransduction – secondary inflammatory injuries often directly follow, possibly starting a cascade of events leading to sepsis or multi-organ failure.

Computational models of the respiratory system can provide essential insights into the involved phenomena and open up new vistas towards improved patient-specific ventilation protocols. However, due to the complexity of the lung comprising 23 generations of dichotomously bifurcating airways ending in approximately 300 million alveoli, a direct numerical simulation resolving all levels of the respiratory system is impossible from the onset. Therefore, we first established detailed models for distinct parts of the lung being of particular interest with respect to VILI, i.e. the tracheo-bronchial and the alveolar region. In order to take into account the unresolved parts of the lung appropriately, novel multi-scale approaches were developed, yielding overall models for the respiratory zone as well as for the conducting airways as a whole.

Computational model of the conducting airways

Computational modeling of the airway tree can provide in-depth knowledge into how the human lung functions mechanically under artificial ventilation. We are particularly interested in investigating the influence of different protocols on pressure and flow distributions, hence revealing possible lung regions at risk of overdistension. Furthermore, we want to quantify stresses and strains in airway walls being also of direct relevance for the development of VILI.

We have shown that the consideration of specific geometric features is essential, i.e. severe differences in flow characteristics occur between artificial and CT-based models of the airways [1].

Therefore, we utilize patient-specific geometries usually up to around seven generations [2]. These geometries are extracted from standard CT-images (with a resolution of 0.6mm) that are routinely performed in the hospital. High quality meshes are generated, typically containing approximately 2 million tetrahedral elements equating to about 1.6 million degrees of freedom.

Compared with previous pure computational fluid dynamics (CFD) simulations, we found that the influence of FSI on normalized flow distributions and secondary flow intensities is moderate [1]. However, air flow patterns, both axial and in-plane, were quite different although the changes in cross sectional areas were only around 2%. Even more importantly, CFD simulations are not capable of capturing stresses in lung tissue. Hence, consideration of airway wall deformability is crucial for investigating mechanisms of VILI.

To enable such simulations, one has to couple incompressible flows and flexible airway walls, i.e. soft tissue, which is a very challenging task. Many existing approaches are either unstable or very inefficient in such situations. Therefore, we have developed new robust and efficient coupling schemes for fluid-structure interaction (FSI) simulations. For the complex simulations in the tracheo-bronchial region, our new monolithic schemes with block preconditioning have shown to be most suitable [3].

Obviously, airway walls are not free to move arbitrarily in vivo. Hence, as a next step towards an overall lung model, we embedded our FSI-models in a homogenized tissue block in order to consider the influence of surrounding parenchyma and also the interdependence of neighboring airways (see *Figure 1*). More realistic shapes of the lung lobes can be extracted from standard CT data sets in a straightforward manner.

To obtain correct pressure levels in the resolved tracheo-bronchial region, peripheral impedance of the unresolved parts of the lung must be taken into account.

For this purpose, we developed a fully coupled 3D-1D approach [2] based on a previously derived method for arterial impedance modeling [4]. Briefly, we attach artificial asymmetric airway trees made up of 1D flexible tubes to each outlet of the resolved 3D tracheo-bronchial model (confer *Figure 2*). The impedance of each individual branch is then summed in series and parallel in order to obtain the total impedance of a specific tree. The coupling of the 1D models to the 3D model is achieved utilizing a Dirichlet to Neumann approach introduced in [5] for arterial blood flow. Apart from being mathematically well posed and numerically stable, this method has the advantage that the solution of the 1D and 3D domain is achieved simultaneously. Simulation results shown in *Figure 3* confirm that the change in pressure distribution between traction free and impedance boundary conditions is significant.

Figure 2:
Schematic overview on 3D-1D approach for modeling the conducting airways as a whole.

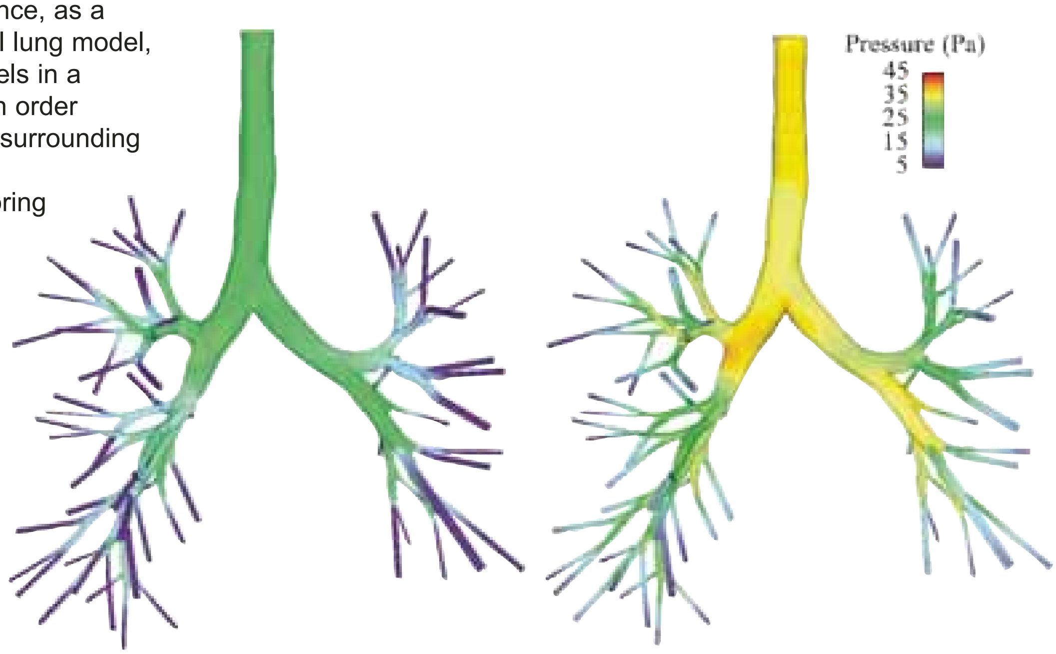


Figure 3:
Comparison of pressure contours at maximum inspiration with traction free (left) and impedance boundary conditions (right).

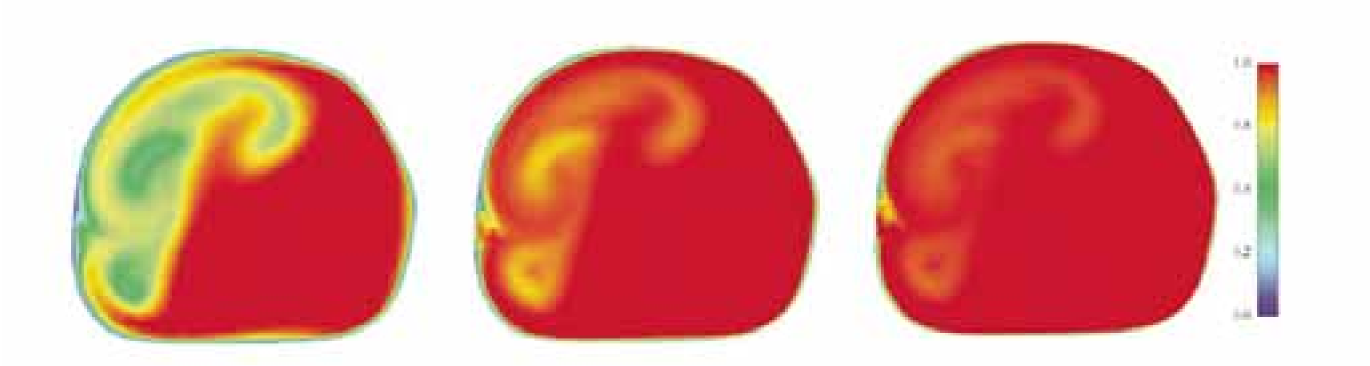


Figure 4:
Spatial concentration of nanoparticles for different non-dimensional mass transfer coefficients (from left to right: Sc = 10, 100 and 500).

Recently, we also incorporated nanoparticle mass transfer into our elaborate model and verified that surface deposition is affected by near wall airflow separation and attachment (see *Figure 4*).

Computational model of the respiratory zone

Since pulmonary alveoli are the main site of VILI, a detailed knowledge of all involved phenomena is necessary in order to obtain insights in the underlying mechanisms.

Recently, micro CT data for isolated fixed rat lung tissue became available [6], allowing us to investigate realistic alveolar assemblages for the first time in detail. In preliminary studies, we could demonstrate that resolving the realistic alveolar morphology is crucial when investigating local overstretching of lung tissue in case of VILI (confer *Figure 5*). However, we also developed and employ simpler artificial models of ventilatory units due to the persisting limited availability of CT-based geometries, particularly for species other than rats.

For modeling alveolar soft tissue behavior, approaches established originally for arterial tissue [7] were adapted to the specific characteristics of lung parenchyma [8]. Since reliable material parameters are crucial for a quantitative analysis of local stresses in the lung, we started to conduct uniaxial tension tests on precision-cut lung slices (PCLS) prepared from isolated rat lungs (see *Figure 6*). Our experiments are performed within 48 hours after dissection of the lung, hence tissue strips are still viable during testing [9]. As a first step, material parameters for lung parenchyma, i.e. the homogenized continuum of alveolar tissue and air, were obtained via an inverse analysis using the Levenberg - Marquardt algorithm [10]. In the future, this approach will be extended to identify reliable parameters for single alveolar walls by resolving the micro-geometry of the tested strips.

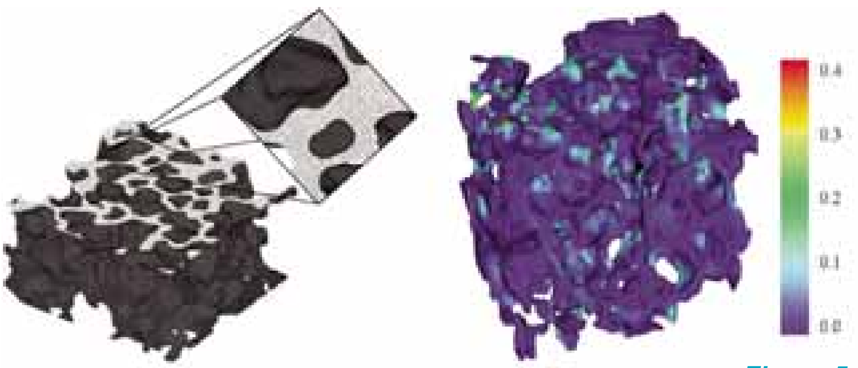


Figure 5:
***Left:** CT-based alveolar geometry with mesh.*
***Right:** First principal stretches for a global uniaxial stretch of 10%.*

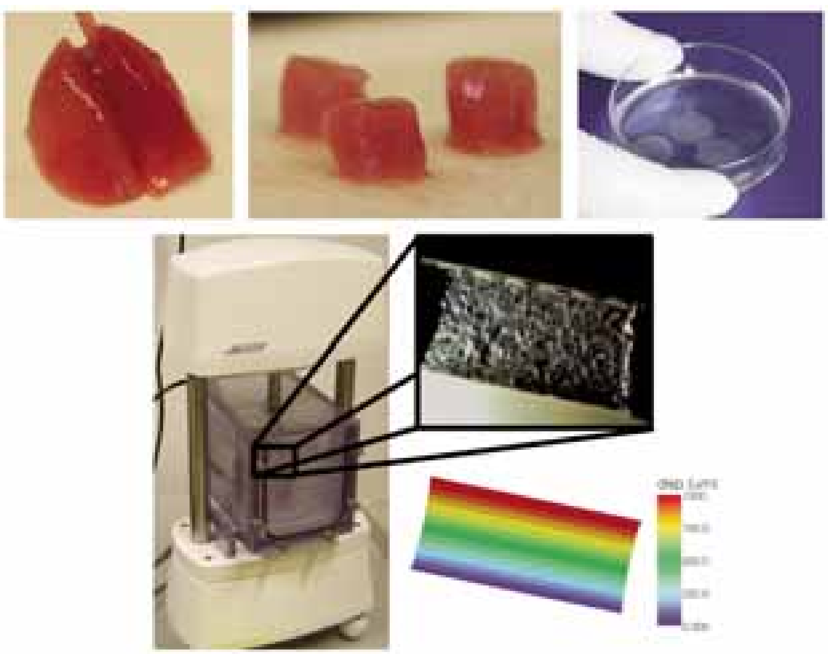
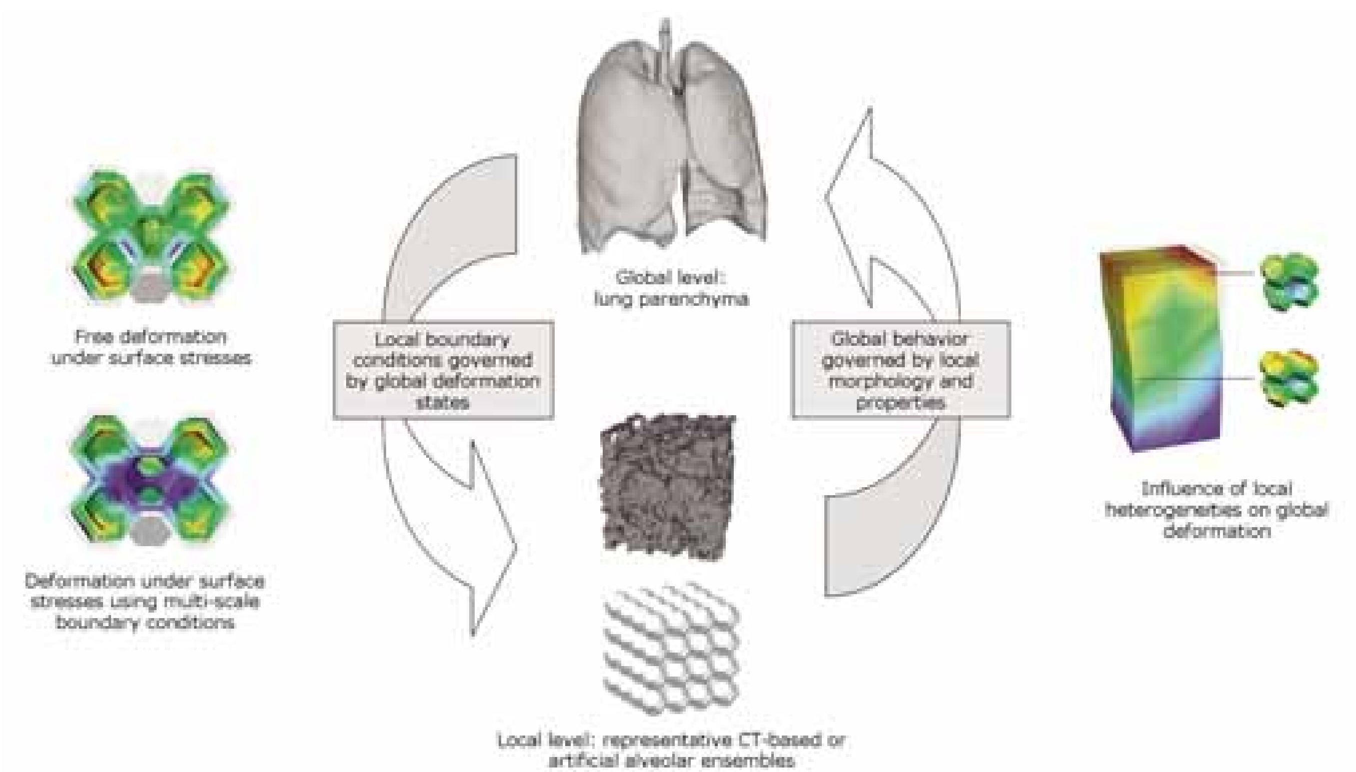


Figure 6:
***Top:** Preparation of PCLS from fixed rat lung.*
***Bottom:** Experimental determination of material parameters of PCLS in uniaxial tension tests using an inverse analysis technique.*

In the intact lung, pulmonary alveoli are covered by a continuous aqueous film with a monomolecular layer of surface active agents – the so-called surfactant – located on top of it. To model the influence of this liquid lining, we established a surface coupling of structural and interfacial mechanics by incorporating the additional surface energy of the surfactant layer into the underlying finite element formulation. In order to capture the highly non-linear and time-dependent behavior of the liquid lining, we employ a constitutive model that distinguishes three regimes of surfactant transport between bulk fluid and interface [11].

Although neighboring lung domains obviously influence each other, previous alveolar models dispensed with formulating physiologically reasonable boundary conditions considering the unresolved parts of the lung. Therefore, clinically relevant predictions of stresses and strains in parenchyma during mechanical ventilation were not feasible up to now. One promising possibility to overcome this problem is to embed alveolar ensembles into a global lung parenchyma model for which boundary conditions are known e.g. from CT scans. For this purpose, we developed a first-order computational multi-scale approach based on the nested solution of the boundary value problems on both parenchymal and the alveolar level [12]. It extends existing approaches (see e.g. [13,14]) to coupled and dynamic scenarios inherent to (mechanical) ventilation. This procedure enables us to investigate the time-dependent behavior of lung parenchyma as a whole and local alveolar ensembles simultaneously without necessitating to resolve the respiratory zone completely. Instead, representative volume elements (RVEs) of the underlying alveolar micro-structure including interfacial effects are defined and associated with selected macro-scale Gauss integration points. Since boundary conditions for the RVEs are prescribed by the corresponding macro-scale deformation state, the influence of surrounding tissue is inherently considered in an indirect way. A schematic representation of the dynamic multi-scale method along with some first simulation results can be seen in *Figure 7*. On the right hand side, the overall heterogeneous deformation of an idealized lung tissue strip due to locally different interfacial configurations is shown. A diseased state was modeled by assuming surfactant deficiency, i.e. a purely aqueous liquid lining, in some of the associated artificial alveolar micro-structures. Due to the fully coupled nature of the developed multi-scale approach, also the alveolar micro-structure is affected by the global parenchyma model by means of the prescribed

Figure 7:
Schematic overview on nested dynamic multi-scale method with illustrative first simulation results.



"... models can promote further understanding of the lung under healthy and diseased conditions ..."

boundary conditions. In order to investigate this effect, a comparative simulation of the chosen alveolar micro-structure alone without specified boundary conditions was conducted. On the left hand side of *Figure 7*, considerable differences in the resulting deformation states under surface tension of water are depicted. Although imposed multiscale boundary conditions are still very simple, alveolar deformation can be simulated more realistically than in the comparative simulation neglecting the influence of surrounding tissue completely.

Accompanying biomedical investigations

In this article, we obviously concentrated on the computational aspects of our lung projects only. Clearly, these efforts are accompanied by a large number of investigations linking them to pure biological and medical questions. This is absolutely essential to achieve real clinical impact. In collaboration with different medical partners, we were able to develop and apply new experimental techniques and tools. This includes a new alveolar endoscope and a bioreactor which allows studying inflammation processes during realistic straining of lung tissue.

Next steps

Currently, we are developing an approach to couple the presented models for the conducting airways and the respiratory zone - albeit concerned with quite dissimilar mechanical phenomena on different length scales - to one single "virtual" lung model. In addition, we further extend our scale range down to the cellular level.

Although developed against the background of VILI, our approaches are mainly built up from "first principles" and are therefore by no means restricted to this particular application. Thus, we believe that our models can promote further understanding of the lung under healthy and diseased conditions and will be valuable for investigating a number of interesting problems. ●

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Effective Stress Approach to Computational Modelling of Unsaturated Soils

by
Nasser Khalili

The engineering behaviour of unsaturated soils is complex and influenced by many factors including externally applied stresses, soil type, structure, density, and suction. Most notably, suction increases soil strength and stiffness. Upon wetting, however, an unsaturated soil can weaken drastically and may exhibit large volumetric collapse damaging infrastructure, roads and buildings (*Fig. 1*), and induce land instability with significant potential for loss of life (*Fig. 2*). In the United States alone, damage due to shrinking and swelling of unsaturated soils is estimated to be in excess of $20 billion per year, which is greater than the combined damage from natural disasters such as floods, hurricanes, earthquakes, and tornadoes. Over the past two decades, the study of flow and deformation in unsaturated porous media and the development of strategies for the prediction of its behaviour subject to external excitation has indeed been a key area of research in modern geomechanics. Many attempts have been made to develop predictive capabilities associated with topics such as the storage of nuclear wastes, slope instability, foundation engineering and ground movement, reservoir engineering, contaminant migration, among others.

Notable contributions have been made by several investigators [1-6] including the seminal work of Alonso et al [1], and Wheeler & Sivakumar [2] based on the concept of "independent stress state variables", in which the total stress tensor, the water and air pressures are considered as independent. These models capture many of the fundamental aspects of the behaviour of unsaturated soils such as collapse, but often fail to reproduce some characteristic features such as the plastic expansion at low confining pressures, and the plastic behaviour followed by an elastic behaviour at increasing suctions for normally consolidated soils [6]. In addition, they also require a considerable amount of laboratory testing to identify model parameters, rendering their practical application time consuming and cost prohibitive. Furthermore, they prescribe different plasticity models for saturated and unsaturated soils.

Figure 1:
Damage induced due to shrink-swell in unsaturated soils

In contrast, the approach adopted at the University of New South Wales (UNSW) is reliant on the effective stress concept in which the characterisation of the mechanical response of the system is expressed in terms of a single "effective" stress rather than two or three independent stress variables. In this context, suction enters the constitutive equations of the solid skeleton as a hardening parameter rather than an independent stress variable [6,7]. This significantly simplifies the constitutive model and reduces the model parameters. Using the effective stress approach the quantitative predictions of unsaturated soil deformation are made using exactly the same model parameters as those for saturated soils, except for two entities (i.e. the air entry value, and the stiffening of the soil matrix with suction) which can be determined in any soil physics laboratory. In essence, the effective stress approach reduces, to a large extent, the required amount of soil testing in an unsaturated state. In addition, it provides a consistent platform for coupling deformation of the solid skeleton to the volume change of the water and air constituents [6,8]. Finally, adopting an effective stress based model both saturated and unsaturated states of a soil can be considered using a single unified model, with a single set of constitutive equations. This is important particularly when considering the mechanical response of variably saturated media subject to fluctuating zones of saturation and unsaturation.

Figure 2: *Rainfall induced La-Conchita slope instability, 1995 - Courtesy of USGS*

Using the effective stress approach, the Geomechanics Group at UNSW has to date made several contributions of a fundamental nature to mechanics of unsaturated soils including: (i) formulation of an effective stress model for fully coupled analysis of flow and deformation in unsaturated soils [8]; (ii) formulation of an effective stress based model for shear strength determination of unsaturated soils [10]; (iii) application of effective stress to volume change in unsaturated soils [11], (iv) formulation of a unique relationship for the effective stress parameter for unsaturated soils [10,11], (v) formulation of an effective stress based plasticity model for unsaturated soils [6,7], (vi) formulation of a non-isothermal model of fully coupled thermo-hydro-mechanical analysis of unsaturated soils [12], (vii) formulation of cavity expansion theory for modelling cone penetration in unsaturated soils [13], (viii) formulation of a bounding surface plasticity model for cyclic analysis of unsaturated soils taking into account mechanical and hydraulic hysteresis [9,14], (ix) derivation of the effective stress expression and formulation of a fully coupled flow deformation model for unsaturated porous media exhibiting double porosity [15-17], and (x) formulation of a hypo-plasticity model for unsaturated soils [18]. A brief outline of some of these projects is provided below:

- **A Three Phase Effective Stress Based Plasticity Model for Unsaturated Soils:**

The mechanics of unsaturated soils is complex and involves simultaneous flow of air and water and strongly non-linear deformation behaviour of the soil matrix. In this project, a three-phase elasto-plasticity model based on the theory of mixtures and within the general framework of the effective stress concept is developed for rigorous analysis of the behaviour in unsaturated soils [6] including mechanical and hydraulic hysteretic effects [8,14]. The work is implemented into a numerical code which can be applied to a range boundary and initial value problems.

- **Experimental Investigation and Constitutive modelling of Thermo-Mechanical Coupling Effects in Unsaturated Soils:**

Thermo-hydro-mechanical response in porous media has been the subject of great interest in many engineering disciplines. Typical applications include: utilisation of geothermal energy, tertiary enhancement of oil production, remediation of contaminated sites using air sparging, steam drive/steam flooding, in situ combustion, thermal desorption and disposal of hazardous wastes. The aim of this project is to experimentally investigate influences of temperature and suction on critical state parameters, yield surface, preconsolidation pressure, strength properties, and water retention characteristics of the soil, and capture the results in a comprehensive computational framework. Baseline experimental data are performed using a host of constant temperature and constant suction tests including: (i) temperature controlled soaking and desaturation tests, (ii) temperature and suction controlled isotropic consolidation tests, (iii) suction controlled thermal loading and unloading tests, (iv) constant water content thermal loading tests, and (v) temperature and suction controlled shear strength tests along compression and unloading stress paths, at different over consolidation ratios. The work conducted is the most complete in the field and the results are summarised in Uchaipichat & Khalili [19]. The constitutive trends arising form the experimental results are incorporated into a thermo-hydro-mechanical model for unsaturated soils detailed in Khalili & Loret [12].

- **Fully Coupled Elasto-Plastic Analysis of Cyclic Response in Unsaturated Soils:**

This research is concerned with an important and, as yet, largely unexplored class of problems in geomechanics dealing with cyclic analysis of unsaturated soils. The work has applications in seismic stability assessment of dams and embankments, soil liquefaction and pavement engineering. The aim of the project is to develop a simple and yet rigorous constitutive model for unsaturated soils subject to cyclic loading. The model is based on the bounding surface plasticity, within the general framework of critical state soil mechanics. The results are summarised in a number of recent publications [8,14,18].

- **Effective Stress and Coupled Flow Deformation in Unsaturated Porous Continua with Double Porosity:**

Natural and made geomaterials frequently exhibit two scales of porosity, with micro pores surrounded by macro pores such as those in fractured rock formations. In soils, double porositiness arises due to root holes, worm holes and cracks, or the aggregated nature of the medium. Fissuring and cracking are most commonly observed in heavily overconsolidated and desiccated clays, whereas aggregation occurs in agricultural soils and compacted soils, particularly when the soil is compacted on the dry side of the optimum moisture content. In addition to showing two scales of porosity, the void space in natural soils is frequently filled with more than one fluid implying the need for a multi-phase constitutive modelling approach. To tackle this challenging problem a two-step approach is adopted. Firstly, the effective stress expression of the problem is derived and validated [15,16], and then the fully coupled flow deformation of the medium is formulated [17] using a systematic macroscopic approach. Particular attention is given to the cross-coupling effects between the various phases within the system. All model parameters are identified in terms of measurable physical entities.

- **In Situ Determination of Unsaturated Soils using Cone Penetrometer Testing and Theory of Cavity Expansion:**

Laboratory characterization of unsaturated soils is time consuming, requiring specialised equipment, and advanced knowledge of soil engineering. In this project, an investigation is undertaken to develop relationships between

Figure 3:
UNSW suction controlled calibration chamber

Figure 4:
Desiccation induced cracking

"... an investigation is undertaken to develop relationships between engineering properties of unsaturated soils and cone penetrometer test results."

engineering properties of unsaturated soils and cone penetrometer test results. The work involves computational, laboratory as well as field investigations. The experimental work is conducted using the state-of-the-art UNSW calibration chamber capable of measurement and control of suction within large samples (*Fig. 3*). The computational work is conducted based on the theory of cavity expansion developed by Russell and Khalili [13] for unsaturated soils. The work is of particular current interest as a vast majority of cone penetration tests in engineering practice are performed in unsaturated soils but the results are interpreted using correlations developed for saturated soils leading to unknown misrepresentations in estimated soil properties.

Other projects currently conducted at UNSW include:

(i) investigation of the effect of unsaturation on the chemical compatibility of clay liners,
(ii) influence of suction on erosion characteristics of clayey soils,
(iii) formulation of a computational model for prediction of pattern, spacing and depth of desiccation induced cracking (*Fig. 4*) with particular reference to dam engineering, and
(iv) investigation of the effect of moisture on the mechanical response of bound and unbound pavement materials subject to traffic loading. ●

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Figure 1: *Prof. Qian and his students, Prof. H. C. Hu (left) & Prof. W. X. Zhong, in front of the Dalian petroleum port bridge that was designed by Qian (1984).*

Mourn for the loss of Professor L. X. Qian

Qian Ling-xi, a professor of DUT (Dalian University of Technology), a veteran academician of CAS (Chinese Academy of Sciences) and the founder of CACM (Chinese Association on Computational Mechanics), died on April 20, 2009 in Dalian, China, at the age of 93.

Figure 2: *Prof. L. X. Qian*

Professor Qian was born on July 16, 1916 in Wu-Xi County of Jiang-Su Province, China. He undertook his degree studies at The Free University of Brussels from 1936 to 1938 and within five years of graduating was invited to become a full professor at Zhe-Jiang University, where he subsequently in 1950 became head of the Department of Civil Engineering. In 1951, he moved to Dalian Institute of Technology (renamed Dalian University of Technology in 1988) and remained there until 2009. He was elected to CAS in 1954 and became one of its founding Academicians. Within DUT he established the Department of Engineering Mechanics in 1958, the Research Institute of Engineering Mechanics in 1978 and served as the president of DUT between 1981 and 1985. He was further honoured in 1982 when, on the recommendation of Prof. Qian Xue-Sen (i.e. H. S. Tsien), the first Chairman of CSTAM (The Chinese Society of Theoretical and Applied Mechanics), he was elected Chairman for the period 1983 to 1987. During his chairmanship, Qian founded CACM (The Chinese Association for Computational Mechanics) in 1985 and became one of the sponsors of IACM in 1986.

Professor Qian published two textbooks on structural mechanics in 1951. They were widely adopted by Chinese universities and this significantly enhanced his reputation throughout the Chinese civil engineering community. In 1950, he published a paper entitled *'Theory of Complimentary Energy'* in the top Chinese Journal *'Science in China'*, which was widely credited with "starting a tidal wave of research on the variational principle in China". This led his student Mr. H. C. Hu (later Professor Hu) to derive and publish in 1954 the elasticity variational theory with three independent variables, i.e. the well-known Hu-Washizu theory. During the early 1960s, Professor Qian and his research assistant, Mr. W. X. Zhong, published two papers in *'Science in China'* and *'Acta Mechanica Sinica'* on the general variational theory of limit analysis and plasticity. Their research achievements on the stability of combined cone-cylinder shells were successfully used in the design of submarines and their work was recognised by the award of prestigious national prizes. Over the next decade, Qian designed and guided the construction of the principal part of the first modern Chinese petroleum port located in Dalian, which has played a very important role in Chinese oil supply right up to the present day. In 1973, Qian instigated a movement within CAS to encourage research on structural optimization design, its theory and methodology. This call was taken up enthusiastically by the Chinese mechanics community and until the early 1980s, Qian and his team in DUT, including Professor W. X. Zhong and Professor G. D. Cheng, published many innovative papers and developed a powerful computer system for structural optimization design known as DDDU. The system was used successfully in many important engineering projects and its value was recognised by awards from the Chinese Government on more than one occasion.

Figure 3: *Prof.O. C. Zienkiewicz accepted Qian's invitation to become an honorary professor of DUT (1982).*

Over the last thirty years, Professor Qian developed a very close working relationship with Professor O. C. Zienkiewicz, who visited DUT three times, gave lectures and accepted Qian's invitation to become an honorary professor of DUT. Qian also accepted Zienkiewicz's invitation to visit Swansea, UK in 1981.

During his lifetime, Professor Qian became extremely pre-eminent in his field, contributing beyond measure to the development of science and education in China. Owing to his extremely pre-eminent contributions to the development of science and education and his noble moral spirits in China, on news of his death, thousands of people publicly expressed their grief and heartfelt condolence on the DUT website or to his family. At his funeral, top leaders within the Chinese Government, including Mr. Hu Jin-Tao, Mr. Wen Jia-Bao, Mr. Jiang Ze-Min, Mr. Li Peng and many others, placed wreaths in respectful memory of this gifted Chinese scientist and educator.

by
Hong-Wu Zhang & Jia-Hao Lin
Dalian University of Technology China

The Japan Society for Computational Engineering and Science

For all inclusion please contact

Kenjiro Terada
Tohoku University, JAPAN

Tel: +81-22-795-7422
Fax: +81-22-795-7423
tei@civil.tohoku.ac.jp
http://www.jsces.org/

FEF09

The 15th International Conference on Finite Elements in Flow Problems

The 15th International Conference on Finite Elements in Flow Problems (FEF09) was held on **April 1-3, 2009**, at The Surugadai Memorial Hall of **Chuo University** in Tokyo, Japan.

Following the first international conference held in Swansea, UK in 1974, the conference was held every two or three years: Italy (St. Margarita Ligure 1976, Venice 1995), Canada (Calgary 1980), Japan (Tokyo 1982, Nagoya 2003), USA (Austin 1984, Huntsville 1989,

Figure 1:
Conference banquet at Tolyo Dome Hotel

Fourteenth Conference on Computational Engineering and Science

The Japan Society for Computational Engineering and Science (JSCES) hosted the **Fourteenth Conference on Computational Engineering and Science**, which was held on **May 12-14, 2009**, at The Institute of Industrial Science (IIS) of **The University of Tokyo** (Komaba, Tokyo, Japan). The conference lasted three days and was attended by about 480 delegates. About 320 papers with full lectures were presented by researchers as well as graduate students and practitioners in the conference composed of 6 tracks and 35 minisymposia, each of which was organized by prominent researchers in each field of computational engineering and science. A special session that collected papers on specific activities by CAE vendors and distributors in Japan was also organized to exchange opinions and views.

The plenary lecturer for this year was Prof. Eugenio Oñate (International Center for Numerical Methods in Engineering (CIMNE), Technical University of Catalonia, Barcelona Spain) who gave a talk about the paper "Advances in the Particle Finite Element Method (PFEM) for Problems in Sea, Earth and Fire" written by E. Oñate, S.R. Idelsohn and R. Rossi *(Figure 2)*. The conference also invited a keynote lecturer, Prof. In Lee (KAIST) from Korea, who presented "Computational Aeroelastic Analysis of Advanced Flight Vehicles" and held a special symposium in memory of Prof. H. Noguchi, in where researchers and practitioners who had been friendly with him presented their recent scientific research results. In addition,

Figure 1:
Group shot of recipients of The JSCES Grand Prize, The JSCES Award, Kawai Medal, Shoji Medal, Outstanding Paper Award and Young Researcher Award (at the award presentation ceremony just before the convivial party on 12 May, 2009).

Figure 2:
Plenary lecture by Prof. Eugenio Oñate (12 May, 2009)

Tucson 1998, Austin 2000 and Santa Fe 2007), France (Antibes 1986), Spain (Barcelona 1993) and UK (Swansea 2005). The conference series has recently been designated as one of the IACM thematic conferences.

The conference lasted three days and was attended by about 200 delegates from 20 countries. About 180 papers with full lectures were presented in 14 minisymposia, each of which was organized by prominent researchers in each field of computational fluid dynamics, and 6 general sessions, using 5 parallel sessions. Furthermore, 2 plenary lectures and 8 semi-plenary lectures were presented by the distinguished researchers. The plenary lecturers of FEF09 were Prof. Thomas J.R. Hughes (University of Texas at Austin, USA) who gave a talk entitled "Variational multiscale residual-based turbulence modeling for large eddy simulation of incompressible flows" *(Figure 2)* and Prof. Kozo Fujii (JAXA, JAPAN) who presented "Toward accurate simulation and analysis of strong acoustic waves". A number of mini-symposia were dedicated to the celebration of the 65th birthday of Thomas J.R. Hughes and the celebration was performed at the banquet held at Tokyo Dome Hotel *(Figure 1)*.

Figure 2:
Plenary lecture by Prof. Thomas J.R. Hughes

The financial support received from The Japan Society for Computational Engineering and Science (JSCES), The Computational Mechanics Division of The Japan Society of Mechanical Engineers (CMD, JSME), Chuo University, The University of Tokyo, and other societies and companies.

All the events in this conference were quite successful, which we welcomed lots of enthusiastic participants as well as high-standard presentations. The next FEF conference will be held at Munich, Germany, in 2011. ●

by
Kazuo Kashiyama
kaz@civil.chuo-u.ac.jp
*and **Hiroshi Okuda***
okuda@race.u-tokyo.ac.jp

we had a panel discussion, "Quality of simulations and applications to practical problems: Why quality of analysis now?", in which researchers and practitioners exchanged the ideas and discussed the modality of operation for "Computational Engineering for Manufacturing" that has recently been founded as a study group in the JSCES.

Prior to the banquet held on the first day of the conference, we held the award ceremony, where the JSCES awarded various kinds of JSCES prizes to senior and young researchers, and practitioners; this year's recipients are Profs. M. Kawahara, S. Kobayashi and T. Kobayashi (The JSCES Award), Prof. S. Obayashi (Kawai Medal), Dr. N. Iwai (Shoji Medal), Dr. G. Hashimoto, and Profs. T. Saito, T. Fukui and S. Hirose (Outstanding Paper Award), Dr. T. Yamada (Young Researcher Award) and Prof. Y. Hayase (Testimonial). Also, this year's "The JSCES Grand Prize" was awarded to Prof. Eugenio Oñate, who gave a plenary talk in the conference, for his outstanding contributions in the field of computational engineering and sciences. *Figure 1* shows the recipients together with the founding president T. Kawai as well as former presidents M. Shoji and the current president N. Takeuchi.

The conference was accompanied with "Visualization Contest" to make honorable recognition of attractive figures printed in the conference proceedings and "Best Paper Award" to honor the authors who presented papers with significant achievements. On the day after the conference, the JSCES organizes a short course named "Useful Visualization Techniques" given by Prof. S. Shirayama.

All the events in this conference were quite successful, which we welcomed lots of enthusiastic participants as well as high-standard presentations. The significance of JSCES's annual meeting has been determined as an established setting for the exchange of ideas in the field of computational engineering and science, and for the enlightenment of state of the art in this field. The effort will continue to have another conference in Fukuoka, May 2010.

At present, the JSCES (the current president Prof. N. Takeuchi) has about 850 members, all of who are registered as international members of the IACM. The JSCES periodically publishes both quarterly magazines (http://www.jsces.org/Issue/Journal/journal.html) and internet journals (http://www.jstage.jst.go.jp/browse/jsces).
Also, the JSCES and the Computational Mechanics Division of the Japan Society of Mechanical Engineers are planning to organize the 2nd International Workshops on Advances in Computational Mechanics (IWACOM-II) on March 30 and 31 at the Conference Center at PACIFICO Yokohama, Japan, which is composed of nine workshops with specific themes and will invite young researchers from home and abroad (http://www.jsces.org/IWACOM/).
Finally, as an IACM affiliated society in Japan, the JSCES has continuously supported and will continue to support the IACM activities, such as WCCM's, APCOM's and other regional and national congresses.
Please visit our website (**http://www.jsces.org/index_e.html**) for the details of our activities. ●

ENIEF 2009

XVII Congress on Numerical Methods and their Applications

Tandil, Argentina, November 3-6, 2009

For all inclusions under AMCA please contact:

Victorio Sonzogni
Güemes 3450
3000 Santa Fe
Argentina

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

This congress is being organized by the PLADEMA Institute at the National University of the Center of Buenos Aires (UNCPBA), Argentina.

Important Dates

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

Location

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

Further Information

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

AMCA Awards

The AMCA Awards have been instituted in 2000 as recognition of scientific careers in the field of computational mechanics. They are granted in three categories:

1. ***Young Researchers***
This award is intended for researchers up to 40 years, in recognition of their research work, specially for works performed in Argentina.

2. ***Scientific, Professional and Teaching Career.***
Aimed to recognize outstanding careers in computational mechanics. Not only scientific contributions are taken into account, but also teaching and training young researchers, and professional activities in this area, performed in Argentina.

3. ***International Scientific Career.***
Intended to recognize the scientific career in the field of computational mechanics, for international scientists, prioritizing their interaction with research centers of Argentina.

Figure 1: *AMCA Awards statuette*

These awards are delivered every two years, and since 2000 the awardees have been:

For Young Researchers: Gustavo Buscaglia, Enzo Dari, Adrian Cisilino, Victor Fachinotti and Javier Signorelli.

For their Scientific, Professional and Teaching Career: Alberto Cardona, Gustavo Sánchez Sarmiento, Ángel Menéndez, Guillermo Etse, Juan C. Ferreri, Sergio Idelsohn, Fernando Basombrio and Guillermo Marshall.

In the International Scientific Career: Eugenio Oñate, Michel Géradin, Raul Feijoo and Xavier Oliver.

Online Access to the "MECANICA COMPUTACIONAL" Series Published by AMCA

Mecánica Computacional is a book series edited by AMCA since 1985, collecting the proceedings of AMCA Congresses ENIEF and MECOM. This represents at this moment more than 3,000 articles.

Since 2005 this series is available online at AMCA's web page (http://www.amcaonline.org.ar/ojs/index.php/mc) through the Open Journal System (OJS) developed by the Public Knowledge Project (PKP, http://pkp.sfu.ca), an initiative developed among several Universities and public institutions, including the University of British Columbia, Canada.

This system gives the users a friendly access to the article repository, but its main benefit is to export the repository to automated harvesters of scientific articles like Google Scholar, OAISTER (a large harvester at the University of Michigan, **http://oaister.umdl.umich.edu/**), or Scientific Commons (University of St.Gallen: **http://www.scientificcommons.org**), and others. This access is performed through the Open Access Initiativa (OAI) protocol.

Currently, all volumes of Mecánica Computacional published since 1999 in electronic form are available online, representing nearly 1500 articles. Previous volumes that were published originally in print form only will be scanned, converted to digital form, and uploaded to the site in the near future. Even if a large part of the articles is written in spanish, there is a significant part in english, and some in portuguese

With this initiative a large amount of scientific articles is made freely available to the world Computational Mechanics community. AMCA invites the IACM members to visit the site and enjoy an interesting collection of articles in the area. ●

by ***Mario Storti***

AMCA Awards 2008

During the Congress Banquet of ENIEF 2008, the ceremony of the AMCA Awards 2008 took place.

The award for Young Researchers was granted to Javier Signorelli, from the Universidad Nacional de Rosario, Argentina.

In the category of Scientific, Professional and Teaching Career two awards have been delivered. One to Fernando Basombrio, from Bariloche Atomic Centre, and the other to Guillermo Marshall, from Universidad de Buenos Aires.

Finally, the award to the International Scientific Career, was for Xavier Oliver, from the Universidad Politécnica de Catalunya, Spain.

The jury for the AMCA Awards 2008 was integrated by: A. Cisilino, G. Etse, J. C. Ferreri, V. Fachinotti, R. Feijoo, S. Idelsohn and V. Sonzogni. ●

Figure 2: *AMCA Awards 2008 for Senior Researcher: Fernando Basombrio*

Figure 3: *AMCA Awards 2008 for Senior Researcher: Guillermo Marshall*

Figure 4: *AMCA Awards 2008 for International Researcher: Xavier Oliver*

Figure 5: *AMCA Awards 2008 for Young Researcher: Javier Signorelli*

Professor Genki Yagawa

awarded the

Japan Academy Prize

Professor Genki Yagawa, Emeritus Professor of **University of Tokyo** and currently Professor of **Toyo University**, was awarded the **Japan Academy Prize** at the 99th Award Ceremony, which took place with their Majesties the Emperor and Empress at the **Japan Academy in Tokyo** on **June 1, 2009**. An Award Ceremony has been held every year since 1911, with 2009 marking the 99th such Ceremony. Their Majesties the Emperor and Empress invited Professor Yagawa and other winners of the Prize to the Imperial Palace for dinner after the Ceremony.

The Japan Academy Prize is the highest prize awarded to about 10 individuals who have achieved notable research landmarks in a discipline of humanities and natural sciences. This criterion certainly meets his achievement on the computational mechanics and applied mechanics.

Figure 1: *Professor Genki Yagawa*

Genki has developed a new massively parallel computing method. It has been proved that the method can solve huge problems with high accuracy and high performance when applied to computational solid mechanics problems such as probabilistic fracture mechanics of nuclear pressure vessels. He has also created a new method called the Free Mesh Method. These methods, being quite suitable for massively parallel environments and embedded within the internationally well-known codes, has been employed by many researchers and engineers worldwide. He has published more than 370 journal papers and authored or edited 60 text books or special issues of journals.

In addition to these achievements, his current and past activities include: General Chair of First International Conference on Computational Mechanics(1986), General Chair of 3rd Asia-Pacific Congress on Computational Mechanics (2007), Honorary Member of Executive Council of International Association for Computational Mechanics, Founding Member and Secretary General of Asia-Pacific Association for Computational Mechanics, Council Member of Science Council of Japan (appointed by Prime Minister), President of Japan Society for Industrial and Applied Mathematics, Founding Chair of Computational Mechanics Division of Japan Society of Mechanical Engineers, Founding Editor-in-Chief of International Journal for Computational Mechanics (Springer), and Associate Editor or Editorial Board Member of 14 major international journals.

Figure 2: *Their Majesties the Emperor and Empress at the Japan Academy in Tokyo*

Amongst his many awards and honors are the Toray Science and Technology Prize (2009), the IACM Award (2008), the APACM Zienkiewicz Medal (2007), the Prime Minister Award (2007), the Minister of Science and Technology Award (1998), ASME Fellow (1993), the JSME Computational Mechanics Award (1992), the Gigaflop Performance Award of Cray Research (1990).

New Executive Council

for JACM

The Japan Association for Computational Mechanics (JACM) elected a new executive council in March 2009. After six years as president of JACM, Prof. Takashi Yabe, Tokyo Institute of Technology left the board.

The new president is

Prof. Noriyuki Miyazaki : *Kyoto University*

e-mail address **miyazaki@mech.kyoto-u.account.jp**

URL http://solid.me.kyoto-u.account.jp/English/English-frame.html

Vice-presidents are as follows:

Prof. Takayuki Aoki : *Tokyo Institute of Technology*

e-mail address **taoki@gsic.titech.account.jp**

URL http://www.sim.gsic.titech.account.jp/English/Member/taoki.html

Prof. Shinobu Yoshimura (Secretary General) : *University of Tokyo*

e-mail address **yoshi@sys.t.u-tokyo.account.jp**

URL http://save.sys.t.u-tokyo.account.jp/prof/index.html

The JACM has officially started on December 17, 2002. The purpose of JACM is to establish the communication network over the scientists related to computational mechanics. The first president was Prof. Takashi Yabe and he contributed very much to establish the JACM.

The JACM differs from ordinary societies, but is rather a loosely coupled union of 23 societies related to computational mechanics at present. Please visit the web-site at **http://www.sim.gsic.titech.account.jp/jacm/** to see the societies affiliated with the JACM.

These societies have their own members related to computational mechanics but in different areas. Among them, the computational mechanics division (CMD) of JSME (The Japan Society of Mechanical Engineers) is one of the largest organizations and 5300 members are registered.

Prof. Noriyuki Miyazaki

Prof. Takayuki Aoki

Prof. Shinobu Yoshimura

ADVENTUREcluster received the Award

The team of the development of **ADVENTUREcluster** received the Award by **Minister of Education, Culture, Sports, Science and Technology**, Japan

On **April 14, 2009**, a prestigious award by Minister of Education, Culture, Sports, Science and Technology, Japan was given to a team of Dr. Hiroshi Akiba (Allied Eng. Corp.), Professor Shinobu Yoshimura (University of Tokyo and Vice President of JACM), Dr. Tomonobu Ohyama (Allied Eng. Corp.) and Professor Takashi Kawakami (Toyama Prefecture University) for the development of Large Scale Parallel Finite Element Analysis System, ADVENTUREcluster. The system was successfully applied to perform a large scale drop impact analysis of mobile phone with 300 million DOFs mesh on Blue Gene/L with 8192 processes. The system has been widely used in various engineering fields such as automobile, electronics, heavy, steel and energy industries. The open source version, ADVENTURE can be freely downloaded at :
http://adventure.sys.t.u-tokyo.ac.jp

From left to right
Professor Takashi Kawakami from Toyama Prefecture University
Dr. Hiroshi Akiba from Allied Eng. Corp.
Professor Shinobu Yoshimura from University of Tokyo
Dr. Tomonobu Ohyama from Allied Eng. Corp.

The World Class University (WCU) Project

in the School of Mechanical Engineering

at Sungkyunkwan University

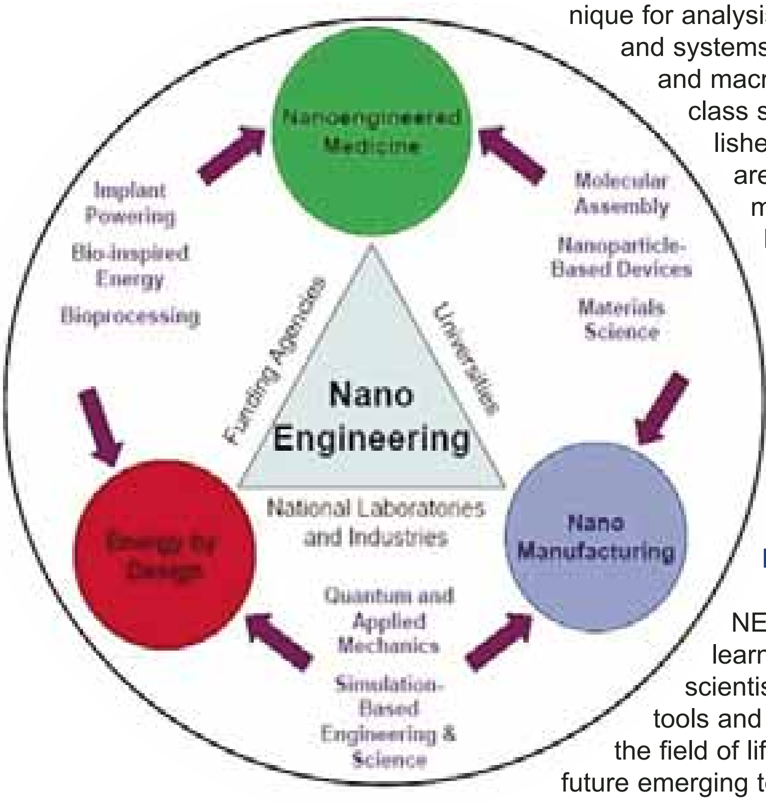
(ME@SKKU),

South Korea

The **WCU** project was recently launched by the **Korean Ministry of Education, Science and Technology**. By recruiting and retaining world-class scholars through three project types (Type1: Establishing new academic departments or specialized majors, Type2: Employing foreign scholars at existing academic program, Type3: inviting distinguished world-class scholars like Nobel Prize laureate), the Korean Government intends to bring innovation to the education and research environment of Korean universities, leading to the creation of top-notch research-oriented institutions of higher education in Korea. ME@SKKU has received two Type3 grants for the next five years ($1M per grant) in the area of "Simulation based Engineering & Science (SBE&S)" as follows:

Project I: Development of Multi-Scale Simulation Technique for Nano & Bio Enabling Material Design

Dr. Moon Ki Kim (PI, SKKU) & Dr. Wing Kam Liu (Co-PI, Northwestern University) have proposed to develop a general multi-scale multi-physics simulation technique for analysis and design of new nano and bio materials, devices, and systems by bridging scales from nano (atomistic) to micro and macro (continuum) systems. Dr. Liu is one of the world-class scholars in computational mechanics. He has published more than 340 peer-reviewed journal articles in the areas of, but not limited to, nonlinear finite element method, immersed finite element method, reproducing kernel particle method, and multi-resolution continuum theory. He also served as the General Chairman of World Congress on Computational Mechanics in Los Angeles CA, 2006. As the Chair of the ASME Nano Council, he proposed and developed the ASME 1st Global Congress on NanoEngineering for Medicine and Biology (NEMB2010), advancing healthcare through nanoengineering and computing, to be held at the JW Marriott in Houston, TX on February 20-24th, 2010, http://www.asmeconferences.org/nemb2010/.



NEMB2010 provides a forum for idea exchange and learning to members of the engineering community, scientists and clinicians involved in the development of new tools and materials in nanomedicine, experts from industry in the field of life sciences and all those investigating the potential of future emerging technologies. NEMB2010 will focus on the integration of engineering sciences, mechanical engineering and nanotechnology to aid in addressing fundamental problems in biology and medicine and in developing devices for the early detection, imaging and cure of diseases. Two Nobel Laureates, Robert F. Curl (Nobel Prize in Chemistry (1996) - for the discovery of fullerenes) and Ferid Murad (Nobel Prize in Physiology or Medicine (1998) - for the discoveries concerning "nitric oxide as a signaling molecule in the cardiovascular system"), and Eiji Osawa (the first scientist who conceived C60 molecule before its discovery by Kroto-Smalley-Curl in 1985) will feature three of the nine plenary speakers at NEMB2010.

Dr. Kim has worked on elastic network Modelling (ENM), a mechanical engineering based atomistic Modelling technique applied to protein dynamics study, for the last 10 years leading to a new inter-disciplinary research field in computational structural biology. PI & Co-PI will co-teach newly-created graduate-level courses including Advanced Nanomechanics and Multi-scale System Analysis at SKKU, co-advise M.S. and Ph.D. students, and collaborate on 3D Multi-Scale Simulation, Therapeutic and Diagnostic Application of Nanodiamond, Human Conformational Disease, and Protein-Protein Interaction.

For any inquiry, please contact

Dr. Moon Ki Kim

mkkim@me.skku.account.kr

Project II: Application of Interdisciplinary Simulation Technologies for Environmental Friendly Artificial Structure Design

Dr. Jaeboong Choi (PI, SKKU), Dr. Doosam Song (Co-PI, SKKU), and Dr. Genki Yagawa (Co-PI, Toyo University) have launched an interdisciplinary research team to develop large scale simulation technique for sustainable, low-energy design against global warming and urbanization, prediction of environmental change to minimize and prevent disaster and contamination, and convergence system design based on ecological environment. Dr. Yagawa is also a world-famous scholar in computational mechanics publishing more than 380 journal papers on structural engineering, fracture mechanics, fluid-structure interaction, and structural optimization. He is a leader of multi-scale multi-physics phenomena's simulation project of Japan, a member of the Engineering Academy of Japan, the Executive Council of International Association for Computational Mechanics, and a Fellow of ASME. He also served as the first Chairman of the JSME Computational Mechanics Division, the first Editor-in-Chief of International Journal for Computational Mechanics, and the chairman of the first International Conference on Computational Mechanics. Dr. Choi's research interest is an interdisciplinary convergence system design based on ecological imitation and IT technology while Dr. Song has focused on CFD based outdoor environmental design for comfort and energy saving. As a part of collaborative education and research, a large-scale parallel analysis system called ADVENTURE as well as earth simulator will be introduced through this project.

The synergic outcome of these two WCU projects will be annually disseminated to Computational Mechanics communities through an international workshop for SBE&S convened by ME@SKKU. As a result of the WCU projects, it is strongly anticipated that SKKU will be one of the world-class institutions in SBE&S by not only nurturing cutting-edge researches but also acting as a hub institution of global network on Computational Mechanics. ●

- ICCMS09 -

3rd International Congress on Computational Mechanics and Simulation

IIT-Bombay, Mumbai- INDIA , 1-5 December 2009

Tarun Kant
Chair,
ICCMS09

More detailed information about the congress will be available at ***www.civil.iitb.account.in/iccms09*** *after 15 August 2009.*

IndACM

ICCMS09 is being organised by the **Indian Association for Computational Mechanics (IndACM)** and the **Indian Institute of Technology Bombay (IITB)** from **01 to 05 December 2009** [*The 1st and the 2nd congresses were held very successfully at IITK and IITG, respectively*]

Themes

Computational Solid Mechanics
- Composite structures
- Fracture and damage mechanics
- Geomechanics
- Vibration and control
- Smart structures
- Micro and nano-mechanics
- Robotics
- Bridge structures
- Material modeling
- Tribology
- Multibody dynamics

Computational Fluid Dynamics
- Flows with moving boundaries
- Turbulence modeling
- Free surface flows
- Biological fluid dynamics
- Hydrodynamics
- Multi-phase flow
- Pipe flow
- Weather forecasting

Computational Multi-Physics/-Scale Problems
- Fluid-structure interaction
- Electro-mechanics/magnetic
- Porous media mechanics
- New computational techniques
- High performance computing
- Transient dynamic problems
- Nonlinear mechanics
- Piezoelectric mechanics

Important Dates

31 Jul 2009:
Last date for receipt of 1-A4 page abstract
1-A4page (300 words, Ariel Narrow, 10pt)
15 Aug 2009:
Notification of acceptance of paper
1-5 Dec 2009: Congress at IIT-Bombay

iccms09@civil.iitb.account.in

iacm news

Inauguration of the O. C. Zienkiewicz Seminar Room at CIMNE

The International Center for Numerical Methods in Engineering (CIMNE) of Barcelona (Spain) has recognized the support and many contributions of Prof. O. C. Zienkiewicz (Olek), who was a regular visitor to CIMNE at the Technical University of Catalonia (UPC), together with his wife Helen for yearly periods of 2 - 3 months since 1987.

The recognition was expressed by naming the CIMNE Seminar Room under the name of **O. C. Zienkiewicz Seminar Room**. It is precisely in this room where Olek had given a large number of seminars and lectures over the many years that he visited CIMNE. It is quite extraordinary how Olek gradually shifted from using the blackboard to overhead transparencies and power point presentations, to oral presentations free of any projection equipment mainly on historical aspects of the finite element method. These lectures attracted much interest of colleagues and students who were fascinated by Olek's ability to grasp the attention of the audience without any multimedia support. Many of Olek's lectures were delivered jointly with Prof. Robert (Bob) L. Taylor from Univ. of California at Berkeley. Bob was a regular visitor of CIMNE during many years, as a friend and companion of Olek and Helen.

The O. C. Zienkiewicz Seminar Room at CIMNE will remind us vividly and with deep gratitude of this unique period when Olek, Helen and Bob were regular visitors in CIMNE, and of the many opportunities they gave us to share intense moments of science and friendship with them.

Figure 1: *Helen Zienkiewicz uncovering the plaque of the O. C. Zienkiewicz Seminar Room at CIMNE in presence of E. Oñate and A. Huerta (6 May 2009)*

Figure 2: *Helen Zienkiewicz, E. Oñate, Krisha Zienkiewicz and her husband*

iacm news news news news news news

Ling-xi Qian

It is with great sadness that we inform you that **Prof. Qian**, **Ling-xi** passed away on 20th April 2009 at 10.01 a.m. at Dalian Xing-Hai Hospital in Dalian, China. Prof. Qian was one of the founders of the International Association of Computational Mechanics (IACM) and was recognised as one of the pioneers in Computational Mechanics community, particularly the founder of computational mechanics in China.
Prof. Qian's passing is a great loss not only to Dalian University of Technology, but also to Chinese and international communities of computational mechanics. Prof. Qian will be sorely missed by his colleagues, friends and students.
Prof. Qian's memory and legacy will remain vivid in our minds for ever.

D.R.J. Owen

Prof. Roger Owen of the University College of Swansea, Wales, has been nominated a **Fellow of the Royal Society (UK)**. This prestigious nomination acknowledges his dedicated work and many contributions in Computational Mechanics.

Bernhard A. Schrefler

The Maurice A. Biot Medal was established to recognise the lifetime achievement of Dr. Maurice A. Biot and is awarded to an individual who has made outstanding research contributions to the mechanics of porous materials. The recipient of the 2009 Maurice A. Biot Medal is **Prof. Bernhard A. Schrefler**, Ph.D., University of Padua, for his outstanding contributions in the constitutive Modelling and numerical implementation of multi-phase, thermo-hydro-chemo-mechanical coupling in porous media, with applications to land subsidence, concrete subject to high temperature, and other geo-environmental problems.

Thomas J.R. Hughes

The Theodore von Karman Medal is presented to an individual in recognition of distinguished achievements in engineering mechanics that are applicable to any branch of civil engineering. The winner of the 2009 Theodore von Karman Medal is **Prof. Thomas J.R. Hughes**, Ph.D., F.ASCE, University of Texas at Austin, for his outstanding contributions to computational solid mechanics, particularly in computational plasticity and finite element methods. Professor Hughes has been selected to receive the 2009 Theodore von Karman Medal in recognition of a number of outstanding contributions to theoretical and applied mechanics over his distinguished career as a university professor, author, and researcher. The many articles written by Professor Hughes have been cited extensively in engineering, computer science, and the physical sciences, and he has had a profound impact on the way engineering is applied in a number of industries. Professor Hughes is given this high recognition for outstanding theoretical and applied contributions during a long and continuing scholarly career.

Figure 3: *Prof. Afonso Barbosa (Vice-President of Cientific Council of IST), Prof. Fernando Ramôa Ribeiro (Rector of UTL), Prof. J.N. Reddy (Texas A&M University, USA) and Prof. C.A. Mota Soares (President of APMTAC).*

J.N. Reddy

The Technical University of Lisbon (UTL) on the 16th of February 2009 awarded a **Doctor Honoris Causa Degree** to **Professor J.N. Reddy** of Texas A&M University, USA for his scientific achievements in Computational Mechanics and his research collaboration with staff of Instituto Superior Técnico (IST).

O.C. Zienkiewicz Medal

Profs. E. Oñate, E. Stein, J. Orkisz and Z. Waszczyszyn received the O.C. Zienkiewicz Medal of the Polish Association for Computational Mechanics. The award was presented during the PACM Conference held in Zielona-Gora (Poland) on 18 - 21 May 2009.

Genki Yagawa

Prof. Genki Yagawa has received the **Japan Academy Prize** on June 1, 2009, which is the highest prize bestowed by the Japan Academy. He also received the **Toray Science and Technology Prize** on March 18, 2009, which is known to recognize outstanding achievement in the field of science and technology.

Eugenio Oñate

The Japan Society for Computational Engineering and Science (JSCES) awarded **The JSCES Grand Prize** to **Prof. Eugenio Oñate** for his outstanding contributions in the field of computational engineering and sciences. The award ceremony took place during the 14th Conference on Computational Engineering and Science in Tokyo, Japan, 12- 14 May, where he gave a plenary talk.

WCCM
APCOM 2010

19- 23 July | sydney | australia

9th world congress on computational mechanics and 4th asian pacific congress on computational mechanics

The Joint 9th World Congress on Computational Mechanics and 3rd Asian Pacific Congress on Computational Mechanics will be held in Sydney, Australia during July 19-23, 2010 under the auspices of Australian Association for Computational Mechanics (AACM), Asian Pacific Association for Computational Mechanics (APACM) and International Association for Computational Mechanics (IACM).

The format of the congress will be based on the previous congresses in the sense that a number of Mini-Symposia will be organized by leading academics and researchers on latest developments in computational mechanics applied to various fields of engineering, science and applied mathematics. All members of IACM and APCOM are invited to contribute to the program by proposing a minisymposium. In addition to mini-symposia, Plenary and Semi-Plenary lectures on important, recent developments in computational mechanics will be delivered by leading authorities in these fields.

The congress themes will include:

Computational solid and structural mechanics
Computational fluid mechanics
Computational materials science
Computational biomechanics
Computational nanotechnology
Computational MEMS and bio-MEMS
Computational engineering sciences and physics
Computational nonlinear dynamics
Computational adaptive materials systems, structures and smart materials
Computational advances in composite machining
Computational geomechanics
Computational inverse problems and optimization
Computational environmental science
Computer simulation of processes and manufacturing
Computational damage mechanics
Computational dynamic failure and fracture
Computational ice mechanics
Computational NDE and wave propagation
Computational infrastructures and aging structures
Computational polymers and polymer composites
Computational microtribology and micromechanics
CAD, CAM and CAE
Scientific visualization
Data and signal processing
Parallel computing
Artificial intelligence and expert systems
Meshless and wavelet methods
Multiple-scale physics and computation

Key deadlines are:

Minisymposium proposals:	June 30, 2009
Submission of abstracts:	September 30, 2009
Acceptance of abstracts:	November 15, 2009
Submission of final papers:	March 31, 2010

For further information, please contact
Conference Secretariat at **www.wccm2010.com**

conference diary planner

16 - 19 July 2009	**USNCCM X - 10th U.S: National Congress on Computational Mechanics** *Venue:* Columbus, Ohio USA *Contact:* http://usnccm-10.eng-ohio-state.edu
20 - 22 July 2009	**SMART 2009 - International Conference on Smart Structures and Materials** *Venue:* Porto, Portugal *Contact:* www.eccomas.org
27 - 31 July 2009	**ICCM 17 - 17th International Conference on Composite Materials** *Venue:* Edinburgh, UK *Contact:* www.iccm17.org
26 July - 01 Aug 2009	**ICCE 17 - 17th International Conference on Composite or Nono Engineering** *Venue:* Honolulu, Hawaii *Contact:* www.uno.edu/~engr/composite
02 - 04 September 2009	**COMPLAS 2009 - X International Conference on Computational Plasticity** *Venue:* Barcelona, Spain *Contact:* http://congress.cimne.upc.es/complas09/
03- 04 September 2009	**JMC 2009 - VIII Workshop on Computational Mechanics** *Venue:* Pucón, Chile *Contact:* www.scmc.cl
15- 17 September 2009	**1st International Conference on Material Modelling** *Venue:* Dortmund, Germany *Contact:* http://www.icmm1.de
21 - 23 September 2009	**3rd GACM Colloquium on Computational Mechanics** *Venue:* Hannover, Germany *Contact:* http://www.ikm.uni-hannover.de/gacm09.html
23- 25 September 2009	**MAS 2009 - Modelling & Applied Simulation** *Venue:* Tenerife, Canary Islands *Contact:* www.msc-les.org/conf/MAS2009
28 - 30 September 2009	**XFEM 2009 -Extended Finite Element Methods** *Venue:* Aachen, Germany *Contact:* http://www.xfem2009.rwth-aachen.de/
05 - 07 October 2009	**MEMBRANES 2009 - International Conference on Textile Composites & Inflatable Structures** *Venue:* Stuttgart, Germany *Contact:* http://congress.cimne.upc.es/membranes09
03 - 06 November 2009	**ENIEF 2009 - XVII Congress on Numerical Methods & their Applications** *Venue:* Tandil, Argentina *Contact:* http://amcaonline.org.ar
08 - 11 November 2009	**CLIMAMCE 2009 - Iberian-Latin-American Congress on Computational Methods in Eng.** *Venue:* Buzios, Brazil *Contact:* http://eventos.nacad.ufrj.br/
25 - 27 November 2009	**Int. Conf. Particle-Based Methods Fundamentals and Application** *Venue:* Barcelona, Spain *Contact:* http://congress.cimne.upc.es/particles2009
04 - 08 January 2010	**PACAM XI - Congresso Pan-Americano de Mecanica Aplicada** *Venue:* Foz do Iguazu, Brazil *Contact:* http://www.set.eesc.usp.br/docentes/aguiarar
07 - 10 February 2010	**NEMB2010 - 1st Global Congress on NanoEngineering for Medicine and Biology** *Venue:* Houston, Texas Contact: http://www.asmeconferences.org/nemb2010/
03 - 05 March 2010	**REC2010 - Workshop on Reliable Engineering Computing** *Venue:* Singapore Contact: http://www.eng.nus.edu.sg/civil/REC2010
16 - 21 May 2010	**ECCM 2010- 4th European Conference on Computational Mechanics** *Venue:* Paris, France *Contact:* www.eccm2010.org
14 - 17 June 2010	**CFD 2010 - 5th European Conference on Computational Fluid Dynamics,** *Venue:* Lisbon, Portugal *Contact:* http://www-ext.lnec.pt/APMTAC
19 - 23 July 2010	**IX World Congress on Computational Mechanics** **III Asian Pacific Congress on Computational Mechanics** *Venue:* Sydney, Australia *Contact:* http://www.wccm2010.com.au
19 - 24 September 2010	**ICAS 2010 - International Council for the Aeronautical Science Congress** *Venue:* Nice, France *Contact:* http://www.icas.org/

9th world congress on computational mechanics

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