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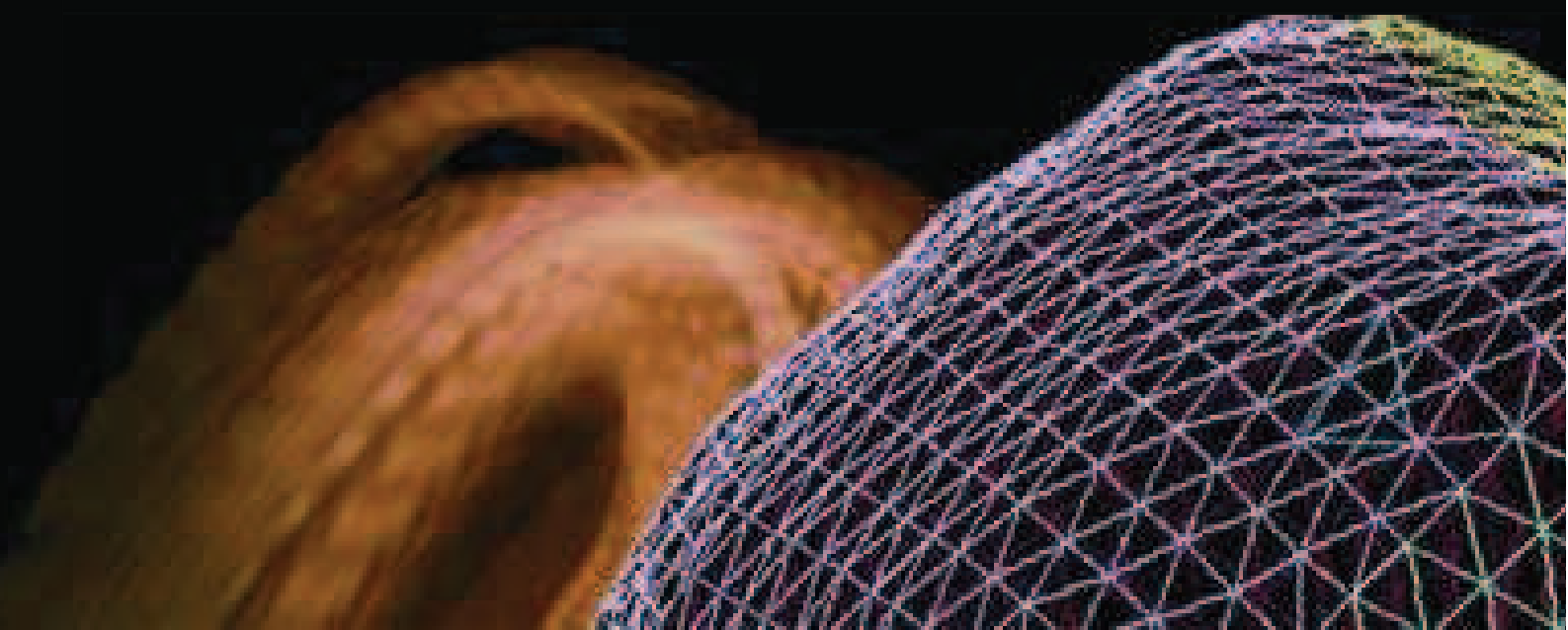
MULTIPHYSICS 2012

13 - 14 December 2012
Lisbon, Portugal



MULTIPHYSICS 2012

13-14 December 2012
Lisbon, Portugal

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General Information

Scope of Conference

Understanding real physics and performing multiphysics simulation are extremely important to analyse complex systems in order to better design and manufacture engineering products.

The objective of the conference is to share and explore findings on mathematical advances, numerical modelling and experimental validation of theoretical and practical systems in a wide range of applications.

The scope of the conference is to address the latest advances in theoretical developments, numerical modelling and industrial application which will promote the concept of simultaneous engineering. Typical combinations would involve a selection from subject disciplines such as Acoustics, Electrics, Explosives, Fire, Fluids, Magnetic, Soil, Structures and Thermodynamics.

Registration Pack – Collection Hours

Registration packs should be collected from the Registration Desk. Collection Hours are as follows:

Thursday, 13th December	09:30-17:30
Friday, 14th December	09:30-17:30

Special Events

- Thursday 19:30
  Conference Banquet

Timing of Presentations

Each paper will be allocated 20 minutes. A good guide is 15 minutes for presentation with 5 minutes left for questions at the end.
Good timekeeping is essential, speakers are asked to keep strictly to 20 minutes per presentation.

Language

The official language of the conference is English.

Audiovisual

The lecture room will be equipped with the following:
One laptop, one LCD projection and cables, one screen, and one microphone.
Delegates are requested to bring presentations on a memory stick.

Paper Publication

Selected papers will be reviewed and published in
'The International Journal of Multiphysics'.

Sponsorship

The Conference Board would like to thank the sponsors for their support.

Keynote Speaker

Dr Young W Kwon
Professor of Mechanical & Aerospace Engineering
Department of Naval Postgraduate School
Monterey, California, USA

BIOGRAPHY

Dr. Kwon is Distinguished Professor of Mechanical and Aerospace Engineering Department of Naval Postgraduate School. His research interests include experimental as well as computational analyses for multiscale and multiphysics problems such as fluid-structure interaction and ship shock modeling and simulation; composite materials; nanotechnology; and biomechanics. He published extensively on those topics, many of which appeared in archived, refereed publications. He wrote textbooks, *Finite Element Method using MATLAB* and edited a book, *Multiscale Modeling and Simulation of Composite Materials and Structures*. Prof. Kwon received various awards including the Cedric K. Ferguson Medal from Society of Petroleum Engineers, Menneken Faculty Award, and Excellent Research Award from American Orthopedic Society of Sports Medicines, NPS Outstanding Instruction and Research Awards, NPS GSEAS Faculty award for Research, ASME PVPD Outstanding Service Award, ASME Dedicated Service Award, ASME Board of Governors Award, etc. He is a fellow of ASME. Dr. Kwon is the editor-in-chief of the journal, Materials Sciences and Applications. He has served as an Associate Editor in large for ASME Journal of Pressure Vessel Technology. He will be the Technical Editor of the journal since 2013. He was also the ASME PVP Division Chair. He is an honorary theme editor of *Pressure Vessels and Piping Systems* of ELOSS (Encyclopedia of Life Support Systems) under the auspices of UNESCO.

MULTIPHYSICS 2012

PROGRAMME

TIME	Thursday 13 December 2012	Friday 14 December 2012
09:30 - 11:00	**Registration & Keynote Address**	**Session 2.1** *Micromechanics*
11:00 - 11:30	**Coffee Break**	
11:30 - 13:00	**Session 1.2** *Aeroelasticity & Fluid Structure Interaction*	**Session 2.2** *Electromagnetics & Wave Mechanics*
13:00 - 14:00	**Lunch**	
14:00 - 15:30	**Session 1.3** *Impacts & Explosions*	**Session 2.3** *Advanced Modelling Techniques*
15:30 - 16:00	**Tea Break**	
16:00 - 17:30	**Session 1.4** *Heat Transfer & Thermodynamics*	**Session 2.1** *Posters*
19:30	**Conference Banquet**	

Full Programme

Thursday 13 December 2012

09:30 – 11:00 Registration / Keynote Address

Keynote Address

Analysis of Fluid-Structure Interaction: Experiments and Modeling
Young W Kwon, Naval Postgraduate School, USA

Chair: M Moatamedi, Narvik University College, Norway

11:00-11:30 Coffee Break

Thursday 13 December 2012

11:30-13:00 Session 1.2
Aeroelasticity and Fluid Structure Interaction

Chair: J J Grácio*, University of Aveiro, Portugal*

Coupled Fluid-dynamical and Structural Analysis of a mono-axial MEMS Accelerometer

Cammarata Alessandro, Lizzio Giovanni, Petrone Giuseppe, University of Catania, Italy

Estimation of hydraulic anisotropy of unconsolidated granular packs using finite element methods

Lateef T. Akanji, Ghasem G. Nasr, University of Salford, UK
Stephan K.Matthai, Montan University of Leoben, Austria

Numerical simulation for cracks detection using the finite elements method (application on aeronautical parts)

Salim Bennoud, Zergoug Mourad, Saad Dahlab University, Blida, Algeria

Aeroelastic predictions using a CFD based harmonic balance solver

Richard Hayes, Simão Marques, Queen's University Belfast, UK

13:00-14:00 Lunch

Thursday 13 December 2012

14:00-15:30 Session 1.3
Impacts and Explosions

Chair: L T Dechevsky, Narvik University College, Norway

Shock loading for pre-processing of marine products freeze-drying
Toshiaki Watanabe, National Fisheries University, Japan
Hironori Maehara, Kumamoto University, Japan
Shigeru Itoh, Okinawa National College of Technology, Japan

Improvement of efficiency of manufacturing rice powder using under water shock wave
Kazuyuki Naha, Osamu Higa, Katsuya Higa , Yoshikazu Higa, Shigeru Itoh, Okinawa National College of Technology, Japan

A computational simulation on the characteristics of shock wave propagation in fruits
Yoshikazu Higa (1), Hirofumi Iyama (2), Tatsuhiro Tamaki (1), Shigeru Itoh (1),
(1) Okinawa National College of Technology, Japan
(2) Kumamoto National College of Technology, Japan

Effect of improving impedance of discharge circuit on the underwater shock wave
Osamu Higa, Takumi Matsui, Ryo Matsubara, Katsuya Higa and Shigeru Itoh, Okinawa National College of Technology, Japan

15:30-16:00 Coffee Break

Thursday 13 December 2012

16:00-17:30 Session 1.4
Heat Transfer and Thermodynamics

Chair: B Alzahabi, Kettering University, USA

A steady state solution for thermoelastic sliding bodies using numerical technique
Essam A. Al-Bahkali, King Saud University, Saudi Arabia

The importance of interface modelling in density-based topology optimisation for fluid-thermal interaction problems
Tadayoshi Matsumori, TOYOTA Central R&D Labs, Japan

H-adaptivity in coupled heat and moisture transport
J. Kruis, L. Svoboda, J. Madera, Czech Technical University in Prague, Czech Republic

Cooling of pressing device in glass industry
Petr Salač, Technical University of Liberec, Czech Republic

19:30 Conference Banquet

Friday 14 December 2012

09:30-11:00 Session 2.1
Micromechanics

Chair: Y Kwon, Naval Postgraduate School, USA

Generation, growth and collapse of microbubbles during the initial stages of breakdown in dielectric liquids
Henrik Frid, Marley Becerra. Royal Institute of Technology, Sweden

A microstructure-based model for describing softening of polycrystals during severe plastic deformation : application to Al-Zn alloys
M. Borodachenkova (1), K. Kitayama (1), J.J Gracio (1), F. Barlat (1,2)
(1) University of Aveiro, Portugal
(2) Pohang University of Science and Technology, South Korea

Molecular dynamic calculations on the bulk properties of bcc iron
Emre Guler, Melek Guler, Hitit University, Turkey

Design & optimization of micro and nano refrigeration devices through numerical simulations : from magnetic to thermoelectric refrigeration
A.M. Pereira1,, D.J. Silva (1), R.F.A. Silva1, B.D. Bordalo (1), J. Ventura1, J.C.R.E. Oliveira (2) and J.P. Araújo (1)*
(1) IFIMUP and IN, Universidade do Porto, Portugal
(2) CFP and Department of Physics Engineering, FEUP, Portugal

11:00-11:30 Coffee Break

Friday 14 December 2012

11:30 – 13:00 Session 2.2
Electromagnetics and Wave Mechanics

Chair: E A Al-Bahkali, King Saud University, Saudi Arabia

Evaluation of 3D mapping experimental non-intrusive methods for multiphase flows
Christopher Poette and Philippe Reynier, Ingénierie et Systèmes Avancés, France

Application of a TVA with electrodynamic shunt damping for increasing sound transmission loss of panels in the frequency range around their first natural frequency
Karel Ruber, Sangarapillai Kanapathipillai and Robert Randall, The University of New South Wales (UNSW), Australia

Accurate solution of the Eigenvalue problem for some systems of ode for calculating holes states in polynomial quantum wells
A.F. Polupanov and S.N. Evdochenko, Kotel'nikov Institute for Radio-Engineering and Electronics of the Russian Academy of Sciences, and Moscow City Pedagogic-Phsyhologic University, Moscow, Russia

Matching mother and calf reindeer using wireless sensor networks
Mohamad Y. Mustafa, Inger Hansen, Svein M. Eilertsen, Egil Pettersen, Amund Kronen. Narvik University College, Bioforsk Nord Theta, and Telespor, Norway

13:00-15:00 Lunch

Friday 14 December 2012

14:00-15:30 Session 2.3
Advanced Modelling Techniques

Chair: T Rahulan, University of Salford, UK

Ceramic powder compaction via elastoplasticity theory
D. Bigoni, F. Dal Corso, A. Gajo, A. Piccolroaz, University of Trento, Italy

Dynamics of macroscopic rotation during equal channel multiple angular extrusion of viscous material through the die with a movable wall
Alexander V. Perig (1), Nikolai N. Golodenko (2), Iaroslav G. Zhbankov (1)
(1) Donbass State Engineering Academy, Kramatorsk, Ukraine
(2) Donbass National Academy of Civil Engineering and Architecture, Makeyevka, Ukraine

Finite Elements Generating Smooth Resolution of Unity over Simplicalization of Multidiminsional Polygonal Domains
Lubomir T. Dechevsky, Narvik University College, Norway

Mindlin plate modelling by the spectral element method
Nivaldo Campos, UNICAMP - State University of Campinas, Brazil

15:30-16:00 Coffee Break

Friday 14 December 2012

16:00-17:30 Session 2.4 Posters

A Modified ball vertex grid deformation method

Gaëtan LOUPY, ENSEEIHT; Simão Marques, *Queen's University Belfast, UK*

Analysis of rain fields motion in radar images using different methods of optical flow

Raaf Ouarda, University of Science and Technology of Algiers, Algeria

Automation of extension line no. 1 of the subway of Algiers

Moufid Mansour, Kenza Mazer, Souhila Hachemi, USTHB University, Algeria

Computed Tomography images to assess the dose in irradiated chestnut fruits

Amilcar L. Antonio (1,2,3), Mauro Trindade (4), Albino Bento(1), M. Luisa Botelho (2), Begoña Quintana (3)

(1) Polytechnic Institute of Bragança, Portugal , (2) Nuclear and Technological Institute, Portugal, (3) University of Salamanca, Spain , (4) Centro Hospitalar de Trás-os-Montes e Alto, Portugal

Effects of gamma irradiation on physical parameters of lactarius deliciosus wild edible mushroom

Ângela Fernandes (1,2), Amilcar L. Antonio (1,3), M. Beatriz P.P. Oliveira (2), Anabela Martins (1), Isabel C.F.R. Ferreira (1)

(1) CIMO/ESA, Instituto Politécnico de Bragança, Portugal, (2) REQUIMTE, Faculdade de Farmácia, Portugal, (3) IST/ITN Instituto Tecnológico e Nuclear, Sacavém. Portugal

Evaluation of the diffusivity and susceptibility to hydrogen embrittlement of API 5L X80 steel welded joints

Bruno Allison Ara jo, Theophilo Moura Maciel, Jorge Palma Carrasco, Eud sio Oliveira Vilar, Antonio Almeida Silva, UFCG, Brazil

Experimental characterization of hydrogen trapping the API 5CY P110 steel

Jorge Palma Carrasco, Bruno Allison Ara jo, Eud sio Oliveira Vilar, Marco Antonio dos Santos, Antonio Almeida Silva, UFCG, Brazil

Fluid-structure interaction analysis of a darrieus water turbine
Matjaž Fleisinger, Matej Vesenjak, Matjaž Hriberšek, Karli Udovièiè, Zoran Ren, University of Maribor, Slovenia

Long Terms Persistence in Daily wind speed series using fractal dimension
Samia Harrouni, Université des Sciences et de la Technologie, Houari Boumediene (USTHB), Algeria

Multimodal Piezoelectric devices optimization for energy harvesting
G. Acciani, A. Dimucci, L. Lorusso, G. Fornarelli , Politecnico di Bari, Italy

Numerical simulation of hydrogen trapping effect on crack propagation in API 5CT P110 steel under cathodic overprotection
Jorge Palma Carrasco, Edjan Tomaz da Silva, Diego David Silva Diniz, Jos Maria Andrade Barbosa, Antonio Almeida Silva, UFCG, Brazil

Numerical study of the water flow through microfiltration ceramic membranes by CFD
Acto L. Cunha , Josedite. S. de Souza, Iliana. O. Guimarães, Severino R. Farias Neto, Antonio Gilson B. Lima, Federal University of Campina Grande, Brazil

Output Power control of two coupled wind generators
Akkila Boukhelifa and Abderrahmene Mesri, University of Sciences and Technologie of Algiers, Algeria

Phase transitions and functional properties of shape memory alloys
Osman Adiguzel, Firat University, Turkey

Three dimensional visualization of multiphysics problems of thermal diffusion and shock wave propagation
H. A. Khawaja (1), J. Yao (2), T. Fernando (2), M. Moatamedi (1)
(1) Narvik University College, Norway, (2) University of Salford, UK

Vulnerability curves for reinforced concrete buildings in Algeria
F I Belheouane, M Bensaibi, University Saad Dahlab, Algeria

17:30 Close of Conference

SESSION 1.1

KEYNOTE ADDRESS

THURSDAY, 13 DECEMBER 2012
10:00 – 11:00

CHAIR

M Moatamedi
Narvik University College
Norway

Thursday, 13 December 2012

10:00 – 11:00

Keynote Address

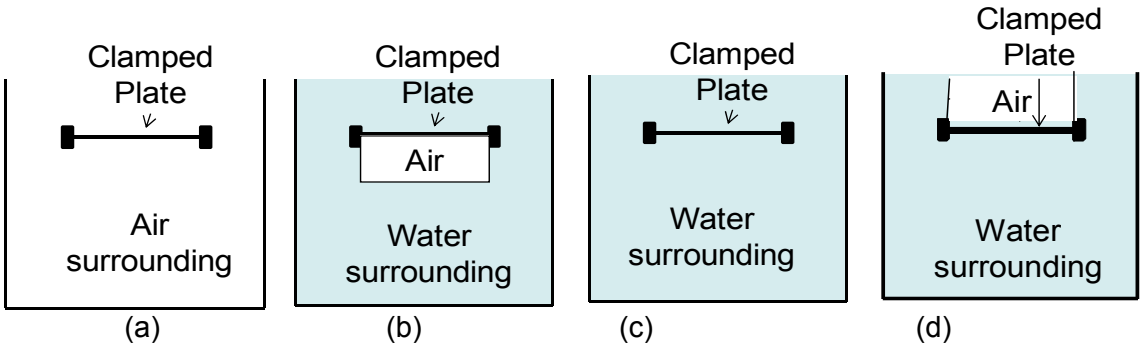
Analysis of Fluid-Structure Interaction: Experiments and Modeling

Young W. Kwon
Dept. of Mechanical & Aerospace Engineering
Naval Postgraduate School, Monterey, California, USA

Fluid-Structure Interaction (FSI) is common in engineering systems as well as in nature. Structures in marine applications are subjected to FSI with surrounding fluid media. The effect of FSI is especially important for polymer composite structures as they have been used increasingly for marine applications. The densities of polymer composite structures are very comparable to that of water. Sandwich structures with light core materials may be lighter than the water.

In order to investigate the effect of FSI on composite structures, low velocity impact testing was conducted for laminated or sandwich composite plates under four different surrounding environments as sketched in the figure. Dynamic responses and progressive failure of polymer composite plates were compared to assess the FSI effect. The test results suggested that the FSI effect is significant such that neglecting the effect for composite structures can result in non-conservative designs of those structures.

Furthermore, computational modeling and simulation techniques were developed so as to understand and to predict the FSI behavior. Both continuous and discontinuous Galerkin finite element formulations were used to derive a new shell element which contains only displacement degrees of freedom and is geometrically identical to 3-d solid elements. These shell elements can easily model any stacked layer of laminated or sandwich composite structures including very thin resin or adhesive layers through which delamination can occur. Fluid medium was analyzed using either the lattice Boltzmann method or the cellular automata. Then, coupling techniques were developed for the fluid and solid interface.



Comparison of different impact conditions with impact on the top side of composite plate: (a) air-backed air impact (or simply dry impact), (b) air-backed wet impact, (c) water-backed wet impact, (d) water-backed dry impact

SESSION 1.2

AEROELASTICITY AND FLUID STRUCTURE INTERACTION

THURSDAY 13 DECEMBER 2012
11:30 – 13:00

CHAIR

J J Gracio
University of Aveiro
Portugal

COUPLED FLUID-DYNAMICAL AND STRUCTURAL ANALYSIS OF A MONO-AXIAL MEMS

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Authors and Affiliations
Cammarata Alessandro, Lizzio Giovanni, Petrone Giuseppe Department of Industrial Engineering, University of Catania (Italy)

This study is aimed to numerically investigate the elastodynamical behavior of a mono axial MEMS accelerometer. The vibrating part of the device is dipped into a fluid micro-channel and made of a proof mass connected to the frame by two flexible legs.
The adopted mathematical model lies on a linearized motion equations system, where the mass matrix is obtained by means of both lumped and distributed approach. The stiffness matrix is otherwise derived through FEA, in which the proof mass and the compliant legs are modeled as rigid and flexible bodies, respectively. The squeezed-film damping effect is evaluated by a fluid-dynamical FE model based on a modified Reynolds formulation.
The ensuing analyses are carried-out for three pressure levels of the narrow gas film surrounding the device, by applying a logarithmic decrement method for evaluating the damping ratio. Numerical results, in terms of acceleration, frequency range and noise disturbance, are successfully compared to analytical and experimental ones previously published in literature. Our model completely characterizes the accelerometer dynamics in space, allowing in addition to assess translational motion errors along directions apart the working one.

Keywords: Elastodynamics, squeezed-film damping, micro-channel

ESTIMATION OF HYDRAULIC ANISOTROPY OF UNCONSOLIDATED GRANULAR PACKS USING FINITE ELEMENT METHODS

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Authors and Affiliations
Lateef T. Akanji, Ghasem G. Nasr (Division of Petroleum and Gas Engineering, University of Salford Manchester, United Kingdom); Stephan K.Matthai (Montan University of Leoben, Austria)

We investigate the effect of particle shape and heterogeneity on hydraulic anisotropy of unconsolidated granular packs. Direct simulation was carried out on micro-CT scanned images of sand pack and synthetically generated spherical, aspherical and ellipsoidal (aspect ratio of 2 and 3) samples. Single phase Stokes equation was solved on models discretised on finite element geometries and hydraulic permeability computed in the horizontal and vertical directions to estimate the degree of anisotropy.

The spherical and aspherical packs with varying degrees of particle shapes and heterogeneities are virtually isotropic. Ellipses with aspect ratios 2 and 3 have higher anisotropic ratios compared to the spherical and aspherical geometries. This is attributable to the the preferential alignment of the grains in the horizontal flow direction.

Keywords: hydraulic anisotropy, finite element methods, permeability, granular packs

NUMERICAL SIMULATION FOR CRACKS DETECTION USING THE FINITE ELEMENTS METHOD (APPLICATION ON AERONAUTICAL PARTS)

Corresponding Author

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Aircrafts, that be exposed to strong forces, to moisture and to changing temperatures, have to be checked regularly for cracks and corrosion.

The means of detection must ensure controls either during initial construction, or at the time of exploitation of all the parts. The Non destructive testing gathers the most widespread methods for detecting defects of a part or review the integrity of a structure.

The Non-destructive testing falls under the general concept of quality assurance, it plays a key role in all the applications claiming a maximum of safety and reliability. In the areas of advanced industry (aeronautics, aerospace, nuclear), Assessing the damage of materials is a key point for controlling the durability and reliability of parts and materials in service. In this context, it is necessary to quantify the damage and identify the different mechanisms responsible for this damage. It is therefore essential to characterize materials and identify the most sensitive indicators to the presence of damage to prevent their destruction and use them optimally. We therefore have developed a simple model for calculating the optimum excitation frequencies for cracks in different depths of tested parts. By 3D- finite elements method (FEM) simulations we can get values of the current density at both sides of the crack and compared there with calculated values for the case with no crack. In this work, simulation by finite elements method is realized with aim to calculate the electromagnetic energy of interaction: probe and piece (or fissured part). From calculated energy, we deduce the real and imaginary components from the simpedance of the sensor, which makes it possible to determine the characteristic
parameters of a crack in various metallic parts.

Keywords: Eddy current, Non-destructive testing (NDT), Cracks, Finite Element Method

AEROELASTIC PREDICTIONS USING A CFD BASED HARMONIC BALANCE SOLVER

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The computation of transonic unsteady aerodynamics can require significant computational resources. Nevertheless, the prediction of shock-induced Limit-Cycle Oscillations (LCOs) or the computation of dynamic derivatives requires increasingly require such large simulations.

The harmonic balance method is an attractive solution for the computation of periodic flows and can be used instead of classical time-marching methods, at a reduced computational cost. This work couples an existing fully implicit formulation of the harmonic balance equations with a structural model. For periodic flows it is advantageous to express the CFD equation in the frequency domain and expand the CFD unknowns in a truncated Fourier series, at the latest approximation the solution is reconstructed in the time domain. It is possible to modify this approach by recasting the nonlinear frequency domain equation back in the time domain, where the solution can be reconstructed from a small number of points belonging to the cycle. The current paper investigates using the Harmonic Balance
(HB) method for aero-structural simulations by coupling an implicit CFD HB method to a modal FEM solver, resulting in an arbitrary Lagrangian Eulerian formulation of the Euler/Reynolds-averaged Navier?Stokes equations. This paper will present a theoretical formulation of the
CFD HB and FEM solver and describe the integration and solution of the CFD/CSD system. The final paper will present results comparing the HB method against classical time-marching methods for aeroelastic problems.

Keywords: harmonic balance, aeroelasticity, cfd, csd, transonic

SESSION 1.3

IMPACTS AND EXPLOSIONS

THURSDAY 13 DECEMBER 2012
14:00 - 15:30

CHAIR

L T Dechevsky
Narvik University College
Norway

SHOCK LOADING FOR PRE-PROCESSING OF MARINE PRODUCTS FREEZE-DRYING

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Authors and Affiliations
Toshiaki WATANABE: Dept. of Ocean Mech. Eng., National Fisheries Univ., Japan. Hironori MAEHARA: Shock Wave and Condensed Matter Research Center, Kumamoto Univ., Japan. Shigeru ITOH: Okinawa National College of Tech., Japan

In the food industry, it is hoping high value-aided product and the increase in efficiency of food processing. On the other hand, we get an experimental result that the load of the shock wave improves an extraction of food, and soften food. We tried to examine the effectivity of the shock wave as pre-processing for freeze-drying from the result in permeation character seen in the radish and so on. In the case of freeze-drying , the object tends to be limited to the small or thin one with size, from the sublimability in processing, the performance in case of the restoration and the viewpoint of the cost performance ratio. Therefore, we used comparatively large beheaded shrimps and attempted to review the effectivity of the shock wave processing about being freeze- drying. The improvement of the sublimation speed was gotten from the result that the pressure change during freeze-drying processing and the improvement of the reconstitution was gotten from the result using hot water. It was expected that the reconstitution of the freeze-dried food is improved and that a processing time is abridged, by shock wave loading as pre-processing for freeze-drying. This phenomenon will be modeled, and it will be compared with a result of an experiment.

Keywords: Freeze-drying, Shock Loading, Pre-processing

IMPROVEMENT OF EFFICIENCY OF MANUFACTURING RICE POWDER USING UNDER WATER SHOCK WAVE

Corresponding Author

Ken Shimojima

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Authors and Affiliations

Kazuyuki Naha, Osamu higa , Katsuya Higa , Yoshikazu Higa, Shigeru Itoh, Okinawa National College of Technology, Japan

Self-sufficiency in food is very low (about 40%) in Japan. Therefore, the rice powder is paid to attention, because it can be processed to the udon(noodle) and bread etc. On the other hand, energy is very necessary for manufacturing the rice-powder with immersing, crushing, and dryness. Therefore, we developed low energy rice-powder manufacturing device. This device is the disintegrator for manufacturing the rice-powder using the underwater shock wave by the electrode. But the manufacturing efficiency has not been cleared. The purpose of this study is to investigate the most suitable configuration of the disintegrator for manufacturing the rice-powder using the underwater shock wave. Experimental conditions to manufacture the rice-powder (particle size is 100??m) is clarified using this device.

Moreover, the manufacturing efficiency of the rice-powder, the relation between the number of the shock wave generation and the grain degree of rice-powder is clarified. To improve efficiency of manufacturing rice powder, the relation between the distance of the electrode and rice and the amount of the milling flour is clarified.

Keywords: underwater shock wave, rice; powder, disintegrator

A COMPUTATIONAL SIMULATION ON THE CHARACTERISTICS OF SHOCK WAVE PROPAGATION IN FRUITS

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A shock wave induced by an underwater pulse electrical gap discharge method can generate a momentary very high pressure power, and also achieve non-heating process for a very short time. Therefore, it is expected very much as a novel food processing technology. On the other hand, it is necessary to optimize a lot of design parameters such as a vessel shape, a power and gap length of electric discharge, the distribution between a source of shock wave and a food medium in the processing. In order to clarify the characteristics of the shock wave propagation in pome fruits such as apples or pears, the computational models of the fruits, surrounding water and source of high-pressure were developed base on the finite element code HyperWorks and RADIOSS solver ((R)altair). By conducting a series of numerical simulations, it has been observed the pressure distribution in the fruits depending on its microstructure such as exocarp (skin), mesocarp (flesh) and a stiff endocarp containing pip (or seed).

Keywords: Shock Wave Propagation, Computational Simulation, Fruits, Microscopic Structure

EFFECT OF IMPROVING IMPEDANCE OF DISCHARGE CIRCUIT ON THE UNDERWATER SHOCK WAVE

Corresponding Author

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Authors and Affiliations

Osamu Higa, Takumi Matsui, Ryo Matsubara, Katsuya Higa and Shigeru Itoh, Okinawa National College of Technology, Japan

We have been developing the rice powder manufacturing system using an underwater shock wave. The rice powder obtained by the shock wave shows advantage of low damaged starch and stable particle size. In order to enhance the strength of the shock wave, we have been researching the mechanisms of the shock wave generation. It was recognized that the shock wave was generated at the time from breakdown of discharge to first peak of damped oscillation. We consider that to release much energy at this time is effective for enhancing strength of the shock wave. Therefore, the aim of this research is to develop a system for releasing much energy until first peak of damped oscillation. We improved impedance of the discharge circuits.
In the result, we increased the energy of discharge by decreasing phase angle difference between voltage and current of discharge. In this paper, we clear that the effects of improving impedance increase energy of discharge using high speed camera and voltage current characteristics.

Keywords: Underwater shock wave, Pulse power, Circuit impedance, Food processing

SESSION 1.4

HEAT TRANSFER AND THERMODYNAMICS

THURSDAY 13 DECEMBER 2012
16:00 – 17:30

CHAIR

B Alzahabi
Kettering University
USA

A STEADY STATE SOLUTION FOR THERMOELASTIC SLIDING BODIES USING NUMERICAL TECHNIQUE

Corresponding Author
Essam A. Al-Bahkali
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Authors and Affiliations
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Frictional heating generated in sliding systems causes thermoelastic distortion.
This tends to modify the shape of the components, and hence the pressure distribution in the system is changed. When the sliding speed is high enough, the system becomes unstable and hot spots appear on the surfaces of the bodies where the pressure and the temperature are higher. The sliding speed above which the system is unstable is called the critical speed.

A two-dimensional finite element model is developed for determining the nonlinear steady state configuration of a thermoelastic body involving sliding speed in the direction of plane with frictional heat generation. The model is based on thermo-mechanical coupling, and it is requires separate algorithms for the thermal and the elastic analyses. The results are coupled through an iterative method.
Solving the problem requires a convective term in the heat conduction equation due to the relative sliding speed between bodies. In addition, the solution of such problem introduces a migration speed of perturbation for each body, with an independent moving frame relative to the reference frame of the entire system. The results of the algorithm were validated by comparison with the long-time behaviour of a transient simulation algorithm. It also demonstrated that the system always converges to a unique steady state solution whether the sliding speed is below or above the critical speed. When the system operates below the critical speed, the system converges to steady state with a uniform full contact pressure. When the system operates above the critical speed, the system tends to some steady state in which the nominal contact area remains in contact. Furthermore, at high sliding speed above the critical speed, the size of the hot spot becomes smaller and the migration is very slow.

Keywords: Heat Generated, Thermoelastic Instability, Critical Speed, Hot Spot

THE IMPORTANCE OF INTERFACE MODELING IN DENSITY-BASED TOPOLOGY OPTIMIZATION FOR FLUID-THERMAL INTERACTION PROBLEMS

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Topology optimization has been applied to not only single-physics but also multi-physics problems including fluid-thermal interaction problems. In these applications, the density approach, where a material distribution is used as the design, has been widely used for its simplicity. The formulation of the fluid field problems using this approach has been commonly based on the Brinkman penalization. However the density approach essentially generates gray transition areas, which appear around interfaces between different phases. The gray areas may affect numerical results and lead to undesirable optimized results.

In this paper we propose a density-based topology optimization for fluid-thermal interaction problems under a given input power. The solid object in the flow field is expressed by the Brinkman penalization. Distribution of fluid fraction, which is the design variable in the optimization, represents the topology of solid and fluid domains. For the heat transport equation, a single governing equation is defined for
modeling both the solid and the fluid parts simultaneously using the fluid fraction.

Optimization problems with different heat conditions are formulated for the maximization of the heat transfer. With this formulation, flow channels in heat exchangers are designed. The optimized results show that the Reynolds number and the heat source conditions are responsible for the topology of the optimized flow channels and their complexity. Through the numerical results, we discuss the effects of different ways of interface modeling in the density-based topology optimization.

Keywords: Topology optimization, Fluid-thermal interaction problem, Heat transfer

H-ADAPTIVITY IN COUPLED HEAT AND MOISTURE TRANSPORT

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Coupled heat and moisture transfer has strong influence on behaviour of concrete, especially on creep. In civil engineering, the Kunzel model of coupled heat and moisture transfer is very popular because its material parameters can be determined from experiments relatively easily.

The Kunzel model is based on the temperature and relative humidity which can be replaced by the water content. The material relationships used in the model are nonlinear and therefore the finite element method (FEM) has to be applied if real world engineering problem is solved.

In the case of rapid changes of boundary conditions, very fine mesh has to be used in order to describe steep gradients of the temperature and relative humidity. It is connected with many degrees of freedom and large demands on hardware. The solution takes an unacceptable computer time.

One possible remedy is based on application of h-adaptivity. There are many variants of h-adaptivity of FEM but this contribution is devoted to superconvergent patch recovery technique applied to the coupled heat and moisture transfer.

Numerical results show efficiency of h-adaptivity applied to transport processes. At this moment, the same finite element meshes are used for the heat and moisture transfer and both of them are simultaneously modified with respect to the estimated error of the solution.

Results from the transport processes are used in mechanical analysis.

It is a one-way coupling. In future, fully coupled hydro-thermo-mechanical analysis will be taken into account.

Keywords: heat and moisture transfer, h-adaptivity, Kunzel model

COOLING OF PRESSING DEVICE IN GLASS INDUSTRY

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In the contribution we present the problem of shape optimization of cooling cavity of the plunger, which is used in forming process in glass industry.
Two main problems appear during glass pressing on the surface of a moulded piece. If the surface of the plunger is too hot at the moment of separation of the moulded piece and the plunger, then the glass melt adheres to the device and deformation of the moulded piece follows. Conversely, if the surface of the plunger is too cold, then small fire cracks appear on the surface of the moulded piece, which means poorer quality of production. For these reasons, it is convenient to achieve a constant distribution of temperature across the surface of the moulding device at the moment of separation of the plunger from the moulded piece.
Mathematical model is a strong idealization of non-stationary periodical problem of heat conduction. We study the problem of stationary conduction of heat for mean values of this periodical process with cooling by stationary flowing water.
An axisymmetric system of mould, glass piece, plunger and plunger cavity is considered. The state problem is given as a stationary head conduction process. The system has given heat source representing glass piece and is cooled by flowing water inside the plunger cavity and outside by environment of the mould. The design variable is taken to be the shape of inner surface of the plunger cavity.
The cost functional is the second power of the norm in the weighted space L_r^2 of difference of trace of temperature from given constant, which is evaluated on the outward boundary of the plunger.

Keywords: Shape optimization, heat-conducting fluid, energy transfer

SESSION 2.1

MICROMECHANICS

FRIDAY 14 DECEMBER 2012
09:30 – 11:00

CHAIR

Y Kwon
Naval Postgraduate School
USA

GENERATION, GROWTH AND COLLAPSE OF MICROBUBBLES DURING THE INITIAL STAGES OF BREAKDOWN IN DIELECTRIC LIQUIDS

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The formation of a vapor microbubble has previously been suggested to be the initial mechanism in the process of dielectric failure of dielectric liquids. The microbubble is generated by a rapid, highly localized heating of a volume close to a highly stressed electrode, caused by electric currents in the liquid at high voltages. In this study, a numerical model is presented and the life of a single vapor bubble is simulated from generation to collapse. Computational Fluid Dynamics of two-phase flow with phase transition is coupled with a model of the charge carrier injection and heating of the liquid while considering the electrostatic forces on the liquid-vapor interface. The lifetime and maximum size of bubbles are compared for dielectric liquids with different viscosity and thermal conductivity.
In agreement with experimental results, the model has been used to show that the electric forces on the dielectric will cause a bubble formed close to a needlepoint electrode to depart from the needle tip.

Keywords: Bubble dynamics, Two-phase flow with phase transition, Electrostatic force, Dielectric breakdown, Streamer initiation

A MICROSTRUCTURE-BASED MODEL FOR DESCRIBING SOFTENING OF POLYCRYSTALS DURING SEVERE PLASTIC DEFORMATION: APPLICATION TO AL-ZN ALLOYS

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The strength and the ductility of metals and alloys depend on the physical processes that are involved during their plastic deformation which, for cold forming, are essentially related to the motion and the interactions of dislocations. In the particular case of Al-Zn alloys microindentation experiments confirmed that hardness decreases with increasing plastic deformation. Detailed microstructural observations have shown that the Hall-Petch hardening due to the grain refinement is compensated by the softening due to decomposition of the Al-based supersaturated solid solution.
It should be noticed that the initial grain size was 15μm and 600 nm for Al and Zn, respectively, and saturates at about 370 nm for Al and 170nm for Zn after a plastic deformation of $\varepsilon \sim 5$. In the present work we present a microstructure-based model where the lost of strength resulting from microstructure decomposition prevails under the additional strength gained with the Hall-Petch effect. The results are compared to experimental data and highlight the role of the initial microstructure.

Keywords: modeling; mechanical behavior; microstructure; grain refinement

MOLECULAR DYNAMIC CALCULATIONS ON THE BULK PROPERTIES OF BBC IRON

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Some bulk properties of bcc iron were calculated via molecular dynamics. Structural properties such as equilibrium lattice parameter, cohesive energy, bulk modulus, typical elastic constants and vacancy formation energy were calculated directly from molecular dynamics for zero Kelvin. All obtained results during the study were compared with the both previous experimental and theoretical results. Obtained results for the present study display well agreement with literature.

Keywords: bcc, EAM, molecular dynamics, LAMMPS, iron.

Design & Optimization of Micro and Nano Refrigeration Devices through Numerical Simulations: from Magnetic to Thermoelectric Refrigeration

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The use of numerical simulation on physics, chemistry and engineering assume nowadays a leading role on the design/optimization of novel devices. These simulations allow a substantial reduction of the prototypes production and/or the elaboration of new experiences, thus reducing the costs and time consuming. With this purpose, our group has been developing numerical simulations on the area of refrigeration namely on optimization/design of micro/nano devices for being incorporated in several different applications. Two types of cooling technologies have been addressed in these studies: thermoelectric and magnetic refrigeration.
On magnetic refrigeration, we will discuss the numerical simulations on two magnetic micro-refrigeration systems: one constituted by two micro-channels array and the other a new solid state device. Simulations of the micro-channels system showed that magnetic refrigeration could limit the temperature of Integrated Circuits beyond the limitation imposed by simple room temperature water flow. Furthermore, we show that the microchannels design and the magnetic material used for this method are of tremendous importance for optimize refrigeration device performance. The magnetic solid state refrigerator is a novel concept based on the combination of materials displaying the magnetocaloric effect and of materials whose thermal conductivities are controlled by an external magnetic ﬁeld. This architecture allows the switching of the heat ﬂow direction in sync with the temperature variation of the magnetocaloric material, removing the necessity to use ﬂuids which has for long hindered the implementation of magnetic refrigeration. Through numerical simulations we have proven that the concept operated and discovery the optimize physic parameters, such as thickness of magnetocaloric and thermoconducters, operation frequency, etc.

Keywords: Refrigeration, Heat Transfer, magnetocaloric, thermoelectric

SESSION 2.2

ELECTROMAGNETCS AND WAVE MECHANICS

FRIDAY 14 DECEMBER 2012
11:30 – 13:00

CHAIR

E Albahkali
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EVALUATION OF 3D MAPPING EXPERIMENTAL NON-INTRUSIVE METHODS FOR MULTIPHASE FLOWS

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The present contribution focuses on the evaluation of non-intrusive 3D mapping experimental methods for the investigation of multiphase flows during tank sloshing.
This problem is a key issue for launchers and satellites since the feeding in propellants has to be ensured during flight and maneuvers. In a first part, an extensive survey of non-intrusive experimental techniques of interest for multiphase flows has been carried out. This task has accounted for new innovative methods developed for space and non-space applications with a focus on the methods used in medicine and other fields such as ultrasound methods. A particular care has been given to electrical and ultrasonic tomography techniques since they are both non-intrusive, non-invasive, low cost, fast and simple to operate, and suitable for real time measurements. Electrical tomography techniques are developed to provide 2D/3D distributions of physical characteristics through penetrating electrical waves. Electrical Capacitance Tomography (ECT) and Electrical Capacitance Volume Tomography (ECVT) have demonstrated convincing capabilities for multiphase flow visualization and present numerous advantages for industrial processes and multiphase flow measurements.
Ultrasound experimental techniques are extensively used in medicine for a wide range of investigations (surgery, anesthesia, cardiology...). They have the advantage to be simple to handle for the caregivers. They are also largely used for material analysis and fluid mechanics. As a consequence since several years, ultrasound tomography has been applied to multiphase flows. Application of the method to annular, sludge, slug and bubbly flows has demonstrated the potential of this technique for multiphase flow investigations. Additionally, in the context of launchers this technique presents an advantage in term of safety. Finally, using the available experimental results obtained using ultrasound tomography for the 3D mapping of multiphase flows, numerical simulations have been performed using OpenFoam a computational fluid dynamics solver. Multiphase flows have been simulated for a wide range of conditions (stratified, annular, bubbly and slug) for assessing the potential of the ultrasonic tomography for sloshing encountered in space applications.

Keywords: CFD - Tomography - Sloshing - Ultrasonic - Launchers

APPLICATION OF A TVA WITH ELECTRODYNAMIC SHUNT DAMPING FOR INCREASING SOUND TRANSMISSION LOSS OF PANELS IN THE FREQUENCY RANGE AROUND THEIR FIRST NATURAL FREQUENCY.

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As it is widely known the Sound Transmission Loss (TL) of an acoustic panel at its first natural frequency is strongly influenced by its mechanical impedance. Studies have demonstrated that increasing panel impedance by adding a tuned vibration absorber (TVA) at the point of maximum panel movement can significantly reduce boththe panel maximum velocity and the sound transmission through the panel. This paper investigates the effect on the Sound TL of a panel with a TVA tunned to minimise panel acceleration or minimise panel velocity.Various electromagnetic shunt damping networks are investigated in order to increase the impedance of the TVA over a wider frequency range. A numerical model was developed to study the effect of adding these various TVA configurations, on the Sound TL of the panel and validated.

Keywords: Sound Transmission Loss, Tuned Vibration Absorber, electromagnetic shunt damping

ACCURATE SOLUTION OF THE EIGENVALUE PROBLEM FOR SOME SYSTEMS OF ODE FOR CALCULATING HOLES STATES IN POLYNOMIAL QUANTUM WELLS

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We demonstrate an explicit numerical method for accurate solving of the eigenvalue problem for some systems of ordinary differential equations, in particular, describing holes confined states in quantum wells with polynomial potential profile. Holes states are described by the Luttinger Hamiltonian matrix. For solving the eigenvalue problem we use the recurrent sequences procedure. Holes confined energies, (i.e the dispersion law),and wave functions are calculated as functions of the lateral quasimomentum component and parameters of the potential. The nature of the so called ?spurious? solutions is discussed. Accuracy of the method is discussed.

Keywords: numerical methods, ordinary differential equations, eigenvalue problem, hole states, wave functions

MATCHING MOTHER AND CALF REINDEER USING WIRELESS SENSOR NETWORKS

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The major traditional economic activity of the Sami people is reindeer herding, which roam freely over wide areas of northern Norway. The semi-domestic reindeer are left most of the time on their own to graze in the outfields most of the year. They are gathered only few times each year. In late summer they are gathered for earmarking the calves and pre rut slaughtering of male reindeer. In each reindeer herd, there are several reindeer owners. Unique earmarks for each herd are used.

Until these days, the reindeer have been marked with different cuts in the ear, each pattern representing one owner. Some reindeer owners are planning to use plastic ear-tags in the future.

Recognising and matching the reindeer calves to the different mothers is a two-step process. First all the animals are caught in a small pen. All female reindeer get individual numbers sprayed on the skin at each side of the animal. Each owner uses one specific colour. Calves get a collar each around their neck, with a unique number plate hanging on it. This procedure is stressful for the animals.

Thereafter, the animals are released to larger pens to calm down. Several reindeerowners and herders start observing the reindeer with binoculars in order to identify/match which reindeer calf (number plate) is following which mothers (sprayed number). Thereafter, the reindeer owners compare the different observations to guaranty that the correct mother is matching the calf.

The next step is to gather the reindeer herd again in a small pen, catch the calves, remove the number plate and replace it by an ear cutting or a tag. This handling procedure is also stressful to the animals. The process of identifying to which mothers, and hence to which owner the calves belong is a painstaking process which demands a considerable amount of man hours, and requires long periods of observation of the herd.

Keywords: Wireless sensor network, animal sensor network, RFID tag, GPRS collar, UHF nodes, reindeer

SESSION 2.3

ADVANCED MODELLING TECHNIQUES

FRIDAY 14 DECEMBER 2012
14:00 – 15:30

CHAIR

T Rahulan
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CERAMIC POWDER COMPACTION VIA ELASTOPLASTICITY THEORY

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The mechanical description of the transition of a material from a granular to a fully dense state during cold compaction is a scientific challenge, still unsolved from many points of view.
A step forward has been made by Bigoni and Piccolroaz (2004) and Piccoloraz et al. (2006 a,b) in terms of plasticity theory through an innovative use of elastoplastic concept.
We will present a new model with a series of transitions law, involving specific rules for: the (i.) gain in cohesion, (ii.) density and (iii.) increase in elastic stiffness and anisotropy with the forming pressure.
The modelling is based on specifically designed experiments and validated with simulations and subsequent realization of ceramic pieces.

Keywords: Cold compaction process, elastoplacticity, ceramic powders

DYNAMICS OF MACROSCOPIC ROTATION DURING EQUAL CHANNEL MULTIPLE ANGULAR EXTRUSION OF VISCOUS MATERIAL THROUGH THE DIE WITH A MOVABLE WALL

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Technological processes of Equal Channel Multiple Angular Extrusion (ECMAE) have contemporary applications in many fields of solid state physics and materials science. ECMAE dynamics essentially depends on rheology of processed materials but there has been insufficient study of viscous polymer flows in dies with movable walls, which the present research addresses.

In the first approximation the mathematical description of plane viscous Newtonian flow during ECMAE is based on the introduction of the curl transfer equation (CTE).

The numerical integration of CTE is implemented using a finite-difference approximation with an alternating-direction implicit method. The presence of a movable entrance wall of the ECMAE die, moving parallel to the extrusion direction, was taken into account through the introduction of an appropriate boundary condition (BC) for the curl function, defined for the nodes of the movable wall. The proposed difference form of the BC includes the dimensionless velocity of the movable entrance wall. Derived numerical solutions show that the movable entrance wall of the die, which determines the transportation motion in the system, has a major influence on the viscous material flow features near the movable die wall. It was found that in the case when the wall moves toward the viscous flow, the streamline nearest the movable wall "accelerates" in comparison with the case of the fixed die wall. From a hydrodynamic point of view, the observable effect is that the polymer flow rate remains constant, because the average punching velocity is the same. The layer of viscous material adjacent to the movable wall moves with near die wall velocity in the punching direction. Therefore, the area of effective cross-section decreases and the flow rate increases.

Keywords: equal channel multiple angular extrusion, movable wall, curl transfer equation, finite difference solution, macroscopic rotation, polymer

FINITE ELEMENTS GENERATING SMOOTH RESOLUTION OF UNITY OVER SIMPLICIALIZATIONS OF MULTIDIMENSIONAL POLYGONAL DOMAINS

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In the properties of a recently introduced type of finite elements/volumes (FE/FV) on general partitions of n-dimensional domains, n=2,3,..., were discussed.
In particular, it was shown using the theory developed in [2] that these FE generate smooth (possibly even infinitely smooth) resolution of unity associated with the domain partition, that is, the FE connected smoothly together on the boundaries of the partition sub-domains, even when these boundaries were very irregular and non-smooth. One of the remarkable features of the construction in [1] was that it was based on a collection of relatively very simple smooth function bases (namely, radial and/or tensor-product ones). However, there was a price to pay for the simplicity of smooth bases used: for relatively coarse partitions the FE induced by the method tended to have a relatively wiggly behaviour near the boundaries of the sub-domains. This behaviour improves with the refining of the partition, but it would nevertheless be of interest to find an upgrade of the method with better performance on coarse partitions. For example, this upgrade would be useful on the first several coarsest steps of a multigrid FE method (FEM) and may contribute to improving sparsity of the matrices in the later steps of the multigrid method.
In the present communication I shall announce new results about an upgrade of the method from for the special case of simplicializations of n-dimensional polygonal domains. In this case the resulting smooth resolution of unity involves smooth basis functions whose supports coincide with the respective star-1 neighbourhoods of the vertices in the simplicialization (i.e., they have the same supports as the standard piecewise-affine B-splines but are everywhere smooth). The respective FE are free of wiggling near the boundaries of the sub-domains even for very coarse partitions. In the exposition I intend to use also graphical visualization for the case of triangulation (n=2).

Keywords: finiteelement, finite volume, spline, B-spline, exponential, rational, expo-rational

MINDLIN PLATE MODELING BY THE SPECTRAL ELEMENT METHOD

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At low frequency ranges there are well established numerical methods, such as the Finite Element Method (FEM) and Boundary Element Method (BEM) that can be successfully used in structural modeling. Both are based on the discretization of the structure into small elements, in which the dynamic field variables are expressed in terms of approximated shape functions. As a consequence of this characteristic, the modeling for medium and high frequencies using these techniques will require that the size of the elements becomes smaller as the frequency increases, while its number needs to be increased. For structures that are usual in some areas, like the aerospace industry, this will be possible only with an unreasonable computational effort, which is responsible for restricting the use of these methods practically to low-frequency applications. Wave based methods, such as the spectral element method (SEM), do not need mesh refinement at medium and high frequencies, and can model a continuous domain with just one element because it is based on a matrix formulation of the general solution for the partial differential equation of the problem. In this work, starting from the three differential equations of Mindlin plate theory, the direct separation of variables is used to obtain the characteristic equation of the problem and its six roots which allow obtaining a Fourier series solution of the plate. Using this solution to express the displacements and forces at the boundaries of the plate, the dynamic stiffness matrix of the Mindlin plate is obtained and its dynamic behavior can be described. Numerical results are presented and compared with those obtained from FEM, showing good accuracy even at medium and high frequency ranges.

Keywords: vibrations, mid-frequencies, plates

SESSION 2.4

POSTERS

FRIDAY 14 DECEMBER 2012
16:00 – 17:30

A MODIFIED BALL VERTEX GRID DEFORMATION METHOD

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Mesh generation still represents a bottle neck int the numeric simulation process, being that in generating high quality grids or adapting them to changing conditions.
This poster describes a compressible code flow solver accelerated by GPU, so computations can be 5-10 times faster than conventional codes. The final goal of this program will be to simulate aeroelastic instabilities, so it will be the coupling between a fluid simulation and a continuum mechanics simulation. Therefore this solver will also need deformable, high-quality meshes. In this work we generate triangular, quadrilateral or hybrid 2D grids. Whenever a force motion is prescribed, a modified ball vertex method is used to deform the grid to accommodate the motion.
The poster will detail and demonstrate improvements made to this mesh deformation algorithm, based on a stiffness field formulations.

Keywords: mesh deformation, ball vertex method, spring analogy

ANALYSIS OF RAIN FIELDS MOTION IN RADAR IMAGES USING DIFFERENT METHODS OF OPTICAL FLOW

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Motion estimation from an image sequence can be used in several applications. In robotics, it can identify and anticipate changes in objects positions. In video compression, it allows the fullest possible understanding where the temporal redundancy of the sequence and information describing an image using the surrounding images. In meteorology, it allows the detection and forecasting of rainy clouds including those which are dangerous and also to predict their motion. In this paper, we apply optical flow techniques on radar images to extract velocity fields of rainy clouds. We will therefore explore the problem of motion estimation from photometric invariant change such as the intensity of the image luminance for two artificial sequences: 'Cube' and Taxi, in the first part and reflectivity for rain isolated cell of radar images sequence. For this, we possess images recorded by weather radar every 5 minutes with a resolution of 1 km / pixel in 64 levels of reflectivity. All images constituting our database underwent a pre-treatment to remove ground echoes using the masking method. The optical flow methods used are: the global motion model of
'Horn & Schunck and the local estimation using a fractional variation model, the Lucas and Kanade method and that based on Gabor filters. The application of the differential methods on a cell isolated from a rainy cell and the two artificial sequences, gave as a result, the velocity field for representing the contour pixels and pixels which a reflectivity value has changed. This analysis allowed us to detect the overall meaning of moving objects. We also found that the method based on Gabor filters gives a less dense optical flow with a lack of precision of the estimated field near the borders compared to the method of Lucas and Kanade. It is also illustrated that the fractional variation approach is costly in computation time compared to the Horn & Schunck method, however it provides better results as it is more accurate and gives a dense velocity field. All results presented in this section highlight the possibility of detection and extraction of the velocity of the rain from radar images using optical flow.

Keywords: Fractional variation, Horn & Schunck, Optical Flow,Velocity fields, Radar image, Rainy clouds

AUTOMATION OF EXTENSION LINE NO 1 OF THE SUBWAY OF ALGIERS

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The Algiers subway is a rail network of urban transport serving the city of Algiers.
The existing line is composed of nine stations along 9 Km. The works on the first part of the extension of this line has began in August 2008, and serves 4 new stations. This new transit infrastructure is actively involved in the modernization of the city.
In this paper, we propose an automation structure based on the earlier architecture to assure full compatibility with the existing structure. This structure is formed around the Centralized Control Station (CCS: located at El-Anasser) in charge of the control, supervision and remote monitoring of the trains together with the energy distribution. The CCS communicates with the trains through several PLCs located at each station via a wireless protocol system. The trains are equipped with an autopilot system to control their movements. They are also equipped with two embedded display systems (DOT/ TMC) for the control and supervision of the trains.
The CCS is responsible for train operations by choosing an operating program (CBTC/ NO CBTC). The proposed structure is based on equipments from the Siemens Company to assure compatibility with the old system. The automation program was performed using the STEP7 software and implemented and tested via simulations. The simulation results showed that the new extension can be successfully automated using this structure.

Keywords: CCS, CBTC, PLC, automatic train control, autopilot, TEP7, WinCC.

COMPUTED TOMOGRAPHY IMAGES TO ASSESS THE DOSE IN IRRADIATED CHESTNUT FRUITS

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Food irradiation is an industrial process used for several purposes: decontamination, sterilization, disinfestation or to increase products shelf-life.
In chestnut fruits, irradiation appears as possible alternative for quarantine post-harvest treatment, due to recently being prohibited the use of methyl bromide, a toxic agent for the operators and for the environment [UNEP, 1995; EU, 2008]; The use of this technology is regulated by national and international food safety authorities, concerning the type of radiation used and, mainly, the dose applied to the product. The typical recommended doses for food processing are lower than 10 kGy but each product, due to its particular characteristics and inhomogeneities, must be submitted to a validation process. Chestnut fruits irradiation studies were done mainly in Asian varieties and only recently in European varieties (Castanea sativa Mill.) [Antonio et al., 2012]. Computed Tomography (CT) images are currently used to give support to clinical dosimetry for a better planning in radiotherapy. In this preliminary study we used CT images to characterize the density of the inhomogeneous fruit and to validate the effective dose in irradiated chestnuts. The absorbed dose was measured in fruits phantoms using two types of dosimeters, a reference dosimeter, Fricke solution, and a routine dosimeter, Amber Perspex. We present the densities for outer shell, inner skin, and fruits flesh, obtained from the CT images, and compare the results of the two dosimetric systems. Using these procedures, we could conclude that the absorbed doses are well characterized and guarantee that the dose validation in an irradiation process respects the recommended food irradiation regulations.

Keywords: food irradiation, chestnut fruits, computed tomagraphy, dosimetry

EFFECTS OF GAMMA IRRADIATION ON PHYSICAL PARAMETERS OF LACTARIUS DELICIOSUS WILD EDIBLE MUSHROOM

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Studies evaluating the effects of ionizing radiation in mushrooms are mostly available in cultivated species, being scarce reports on wild species, considered add-value foods. In the present work, the effects of gamma radiation dose (0, 0.5 and 1 kGy; at a dose rate of 2.3 kGy/h using a gamma camera with Co-60 sources) and storage time (0 to 8 days at 5 C) on the physical parameters (colour, cap diameter and weight) of the wild edible mushroom Lactarius deliciosus were evaluated. The results were submitted to an analysis of variance (ANOVA) with Type III sums of squares, performed using the GLM (General Linear Model) procedure of the SPSS software, and a hierarchical cluster analysis (HCA) was used as an unsupervised learning method.
It was observed a slight decrease in redness (a, Hunter s colour) with irradiation dose and a slight decrease in the cap diameter with storage time. Regarding the weight loss profiles along the 8 days of storage, the results were very similar for irradiated and non-irradiated samples. Despite the particular tendencies previously described, the results obtained for the assayed parameters seemed to indicate that neither irradiation nor cold storage, exerted significant influence. The interaction among the two factors (Irradiation dose Storage time) was only significant ($p < 0.05$) for L (lightness) parameter. The HCA indicated high similarity among the assayed samples; nevertheless, the well defined evolution that some Hunter s colour parameters showed with irradiation dose should not be neglected.
Overall, this study demonstrated that up to 1 kGy, gamma irradiation and cold storage did not affect significantly the assayed physical properties, and can be considered an alternative storage methodology for mushrooms in dose values considered.

Keywords: Gamma irradiation; Wild mushrooms; Lactarius deliciosus; Physical parameters

EVALUATION OF THE DIFFUSIVITY AND SUSCEPTIBILITY TO HYDROGEN EMBRITTLEMENT OF API 5L X80 STEEL WELDED JOINTS

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The sulfides present in oil and gas transported by pipeline can induce the hydrogen formation and intensifies their penetration in the pipeline wall, which can results in embrittlement processes. Additionally, during pipe production and welding processes, the hydrogen can also penetrate and promote an initiation of the well-known cold cracking. This paper presents a study of susceptibility to hydrogen embrittlement of API 5L X80 steel welded joints used in oil and gas pipelines. The welds were performed by GTAW and SMAW welding processes, varying the consumables used and the welding parameters, thus obtaining three different welds. The root passes were performed using the SMAW process using the electrode AWS E6010, and the GTAW process using the rod electrode AWS ER70S. Hydrogen permeation tests were performed to evaluate the diffusivity in accordance with ASTM G148-97-R11. Hydrogen embrittlement tests were performed according to ASTM G129-2006 with the use of solution A of NACE TM0177/2005 standard, in which was placed sodium thiosulfate (Na2S2O3) in substitution of H2S bubbling. In the hydrogen permeation tests was observed a slight difference between the parameters found which was attributed to the different electrodes and welding conditions used. From the values of elongation and area reduction was possible to observe that all joints were susceptible to the phenomenon of hydrogen embrittlement. For joints obtained using the process GTAW in the root pass no significant variations in hydrogen embrittlement tests were observed. In the hydrogen embrittlement tests all joints showed distinct change in fracture mode and showed secondary cracking.

Keywords: Hydrogen Embrittlement; Steel Welded Joints; Hydrogen Permeation in Welded Joints.

EXPERIMENTAL CHARACTERIZATION OF HYDROGEN TRAPPING IN THE API 5CT P110 STEEL

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Cathodic protection systems are commonly used in subsea pipelines, however, their intensive use can lead to hydrogen production on coating defects and to absorption into the steel. The absorbed hydrogen could cause hydrogen embrittlement processes.
The hydrogen atoms that diffuse in lattice can be trapped by microstructural heterogeneities, known as traps. This attraction leads to hydrogen atoms be temporarily or permanently trapped in these sites. It is well known that the trapping level can modify the steel susceptibility to hydrogen embrittlement; therefore, the harmful or beneficial effect of trapping in the studied steel should be investigated. This paper presents experimental data about the influence of hydrogen trapping on hydrogen embrittlement susceptibility of API 5CT P110 steel.
This steel is currently used in pipes fabrication for casing wells and tubing risers in the offshore oil industry. Samples for electrochemical and mechanical tests were extracted from pipe wall of API 5CT P110 steel in as-received conditions, and one half of them were tempered. Hydrogen permeation tests were performed at room temperature using the bipotentiostat methodology. The apparent and effective diffusivity were calculated based on the elapsed time (tlag) from two consecutives hydrogen permeation curves plotted for each sample, according to ASTM G148-97-R11. The hydrogen trapping was characterized by superposition of normalized transients, and the trapping density has been calculated through the equations of model of McNabb & Foster. The samples of as-received and tempered steel, with and without hydrogen, were subjected to uniaxial tensile tests until fracture at room temperature, and hydrogen embrittlement susceptibility was evaluated. The tempered steel showed less susceptibility to hydrogen action than the as-received steel. The production of carbides due to heat-treatment form irreversible traps, which are more effective in delaying the transport of hydrogen. This led to an increase in incubation times and failure.

Keywords: Hydrogen Embrittlement; Hydrogen Trapping; Hydrogen Permeation in Steels.

FLUID-STRUCTURE INTERACTION ANALYSIS OF A DARRIEUS WATER TURBINE

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The paper reports on developed computational procedure for predicting important design parameters of a Darrieus water turbine regarding structural integrity due to hydrodynamic loading in the mechanical part, as well as performance change due to deformation of that structure in the fluid dynamics part. The broader scope of this work is to determine design guidelines for water Darrieus turbine with horizontal axis, which would exploit large part of a flat riverbed cross-section. Thus the turbine would require very long and thin slender hydrofoils, which has to be carefully designed and supported to withstand hydrodynamic loads during operation.

The modern numerical simulations of fully coupled fluid-structure interaction (FSI) enable inclusion of numerous influential factors into a single coupled simulation. Such approach corresponds better to real operating conditions where all the influential factors determine the behaviour of a structure simultaneously.

Keywords: fluid-structure interaction, Darrieus turbine, computer simulation

LONG TERM PERSISTENCE IN DAILY WIND SPEED SERIES USING FRACTAL DIMENSION

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In the assessment of wind turbines installations efficiency long series of wind speed data are necessary. Such data are not usually available it is then important to generate them. In this paper we examine the long-term persistence of daily wind speed data with many years of record using the fractal dimension. The persistence measures the correlation between adjacent values within the time series. Values of a time series can affect other values in the time series that are not only nearby in time but also far away in time. For this purpose, a new method to measure the fractal dimension of temporal discrete signals is presented. The fractal dimension is then used as criterion in an approach we have elaborated to detect the long term correlation in wind speed series. The results show that daily wind speed are anti-persistent.
In fact, by using the fractal approach we conducted an investigation on the long-term persistence of the daily wind speed over two scales: One year and more than six years.
All data series studied show strong anti-persistence, exemplified by fractal dimension values superior than 1.90. This means that values of wind speed series are negatively correlated, the increase of the variable tends to be followed by its decrease and vice-versa.
These results suggest that the wind speed data are predictable at long-term. This is very important in meteorology since it allows establishing typical meteorological
days and in energetic area in view of the fact that it is the source of wind turbines.

Keywords: fractal dimension, rectangular covering method, least squares estimation, wind speed, correlation, long-term persistence

MULTIMODAL PIEZOELECTRIC DEVICES OPTIMIZATION FOR ENERGY HARVESTING

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One of the most studied areas in Energy Harvesting (EH) research is the use of the piezoelectric effect to convert ambient vibration into useful electrical energy.
This paper presents a typical cantilevered Energy Harvester device, which easily related the electrical outputs to the vibration mode shape. The dynamic strain induced in the piezoceramic layer results in an alternating voltage output.
The aim of our study is the optimization of the EH device, optimizing the design of the piezoelectric layer, which allows to maximize the voltage generation, using the d_31effect. The device consists of two layers with the following dimensions: length=31mm, width=9.5mm, the bottom layer of stainless steel (height=0.05mm) and the top layer of piezoelectric material PMN28 (height=0.127mm). There are two set of boundary conditions: mechanical conditions that constrain the two vertical surfaces on the left side of the beam with zero movement, while all other are free, and electrical conditions that set the bottom surface of the piezoelectric layer as Ground and top as Zero Charge.
Using the MEMS modules of the COMSOL Multiphysic v3.5a to perform the Finite Element Analysis of the model, we can carry out the first six modes of frequencies and the deformation pattern of the beam using the eigenfrequency analysis and then, according to the design of a Multimodal EH Skin proposed by Lee and Youn, we cut the piezoelectric material around the inflection points to minimize the voltage cancellation effect that occurs when the sign changes in the material.
This study shows as the voltage produced by the device, increases in function of the dimensions of the cuts in the piezoelectric layer, to reach the optimum amount of piezoelectric material and cuts positioning, so we can demonstrate that the optimized piezoelectric layer is 16% more efficient than the whole piezoelectric layer.

Keywords: Energy Harvesting devices, Multimodal skin, piezoelectric materials.

NUMERICAL SIMULATION OF HYDROGEN TRAPPING EFFECT ON CRACK PROPAGATION IN API 5CT P110 STEEL UNDER CATHODIC OVERPROTECTION

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The possibility of development of hydrogen embrittlement processes increases as more hydrogen is available to be solubilized into the steel. Often, this problem occurs in the cathodic protection systems, commonly used in subsea pipelines, because their intensive use can lead to hydrogen production on coating defects and to absorption into the steel. It is well known that the hydrogen embrittlement susceptibility of steel depends on diffusivity, solubility and other microstructural characteristics of the hydrogen transport, as the hydrogen trapping. Furthermore, the trapping level can modify the steel susceptibility to hydrogen embrittlement. This paper presents a numerical simulation of the trapping hydrogen effect on crack propagation in the API 5CT P110 steel using the damage model proposed by Bolotin & Shipkov. The trapping term at the diffusion equation of damage model was replaced by the equivalent term of McNab & Foster's model. Was simulated an C(T) specimen loaded in the tensile opening mode, in linear elastic regime, in plane strain state, and under the action of a static mechanical loading and hydrogen effect. The non-lineal system of ordinary differential equations that describes the evolution of variables at the crack tip was solved through the 4th order Runge-Kutta method. The problem of diffusion and trapping of hydrogen in the solid phase was solved by the finite difference method. The simulations showed that the material degradation ahead of crack tip, due to hydrogen, decreases with decreasing in concentration at the crack tip by the trapping effect. Additionally, the process of crack evolution is slower than in the material free of traps. These results show a good correlation and consistency with macroscopic observations of the trapping effect, providing a better understanding of the hydrogen embrittlement in structural steels.

Keywords: Continuum Damage Mechanics; Hydrogen Trapping; Hydrogen Embrittlement

NUMERICAL STUDY OF THE WATER FLOW THROUGH MICROFILTRATION CERAMIC MEMBRANES BY CFD

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In this paper, we present an experimental and numerical study of the water permeation process though ceramic membranes. A mathematical model to predict the behavior of water flow in the porous media (microfiltration) was developed. Experimental tests were performed by using two ceramic membranes. In on numerical modeling consider constant porosity and permeability as a function of the flow resistance within porous medium. The numerical study considering a three-dimensional computational domain was performed using the commercial package ANSYS CFX 12 using the full momentum and continuity equations and RNG k-turbulence model. The numerical results were compared to the experimental data, and good agreement was obtained (deviation less than 5%) we conclude that the increased resistance of the porous medium to flow due to hydration of the ceramic membrane was higher than 1000%, the pressure and velocity profiles shown a tendency of symmetry flow relative to the tangential component, similar to that observed in tubes.

Keywords: Microfiltration, Ceramic Membranes, Numeric Simulation, CFX-3D.

OUTPUT POWER CONTROL OF TWO COUPLED WIND GENERATORS

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In our work we are interested to the power control of two wind generators coupled to the network through power converters. Every energy chain conversion is composed of a wind turbine, a gearbox, a Double Fed Induction Generator (DFIG), two PWM converters and a DC bus. The power exchange and the DC voltage are controlled by the use of proportional integral correctors.
For our study, initially we have modeled all the components of the one system energy conversion, and then we have simulated its behavior using Mallab/Simulink. In another part of this paper we present the analysis of the interaction and the power flow between the two aerogenerators following a disturbance due to wind speed on every turbine. Also we have considered a connection fault to the DC bus. In each case the assessment of power brought into play is checked. Simulation tests are established.

Keywords: wind energy, power control, energy conversion, DC bus, Converters

PHASE TRANSITIONS AND FUNCTIONAL PROPERTIES OF SHAPE MEMORY ALLOYS

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Shape-memory alloys are a new class of functional materials with a peculiar property known as shape memory effect. These alloys have an ability to recover a particular shape. This ability arises from the characteristic microstructure that they form. These alloys involve the repeated recovery of macroscopic shape of material at different temperatures. This behavior is called thermo-elasticity, as well. Shape memory effect is based on martensitic transformation, and the origin of this phenomenon lies in the fact that the material changes its internal crystalline structure with changing temperature.

The functional behavior of shape memory alloys, as thermoelastic and pseudoelastic effects, is related to the first-order martensitic transition, between a high temperature beta phase and a low temperature product phase.

Copper based ternary alloys exhibit shape memory effect in beta- phase field, and they serve as an economical alternative to NiTi alloys, and they are widely used as a shape memory element in devices. These alloys are metastable at beta-phase field and undergo two ordered transitions on cooling, and bcc structures turn into B2 (CsCl) or DO3(Fe3Al) - type ordered structures. These ordered structures martensitically undergo the non-conventional structures on further cooling from high temperatures.

Martensitic transformations occur by two or more lattice invariant shears on a {110}-type plane of austenite matrix called basal plane or stacking plane for martensite. The martensitic transformations basically have the diffusionless character and exhibit the order of parent existing prior to the transformation.

Martensite phase has also the unusual layered structures called as 3R, 9R or 18R martensites depending on the stacking sequences on the close-packed planes of the matrix. On the basis of austenite-martensite relation, it is experimentally determined that the basal plane of 9R (or 18R) martensite originates from one of the {110}-planes of the parent on which a homogenous shear occurs in two opposite directions during the transformation.

Keywords: Shape memory effect, martensite, atom sizes, layered structures, hexagonal distortion

THREE DIMENSIONAL VISUALIZATION OF MULTIPHYSICS PROBLEMS OF THERMAL DIFFUSION AND SHOCK WAVE PROPAGATION

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All problems arising from natural phenomena are in three dimensions of space and one dimension of time or at least our senses perceive information in these dimensions. It happens often in Multiphysics simulations that results are visualized in two dimensions for easier interpretation. This sometimes results in concealing vital information which may be the key to explain the physical phenomenon.

This work is an attempt to utilise three dimensional visualization techniques to study the Multiphysics simulation data. In this work, two different visualisation methods were applied to visualise the physical phenomenon. First method is the point cloud interpretation of the Multiphysics data in three dimensions. This method requires physical data with its geometrical information. In this method, a scale is needed to be defined to colour code the points according to their physical values.

Using this technique a three dimension animation can be developed for better understanding of the physical problem. The second method implied was to build colour contours from the data in three dimensions. This study not only requires geometric and physical data but also the arrangement of the data points. This method specifies three dimension surfaces of constant values. This method is also found to be very useful in interpretation of the physics of the Multiphysics problem.

In this study, two Multiphysics phenomena were studied namely: thermal diffusion in three dimension solid medium and propagation of shock wave in fluid medium. The results revealed the features of the physics which is difficult to be foreseen by two dimension visualisation. Also visualisation method proved to give better understanding of the physics of the problems.

Keywords: visualisation, multiphysics, thermal diffusion, shock propagation

VULNERABILITY CURVES FOR REINFORCED CONCRETE BUILDINGS IN ALGERIA

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The seismic experiences in Algeria have shown higher percentage of damages for non-code conforming reinforced concrete (RC) buildings. Furthermore, the vulnerability of these buildings was further aggravated due to presence of many factors (e.g. weak the seismic capacity of these buildings, shorts columns, Pounding effect, etc.).

Consequently Seismic risk assessments were carried out on populations of buildings to identify the buildings most likely to undergo losses during an earthquake. The results of such studies are important in the mitigation of losses under future seismic events as they allow strengthening intervention and disaster management plans to be drawn up.

The amount of damage which a building in reinforced concrete can undertake in a case of a seismic event with a given intensity can be estimated using the vulnerability curves. The latest are of a major importance before any technical decision is taken, such as reinforcement or demolition. For this purpose, vulnerability curves for reinforced concrete structures using vulnerability index were developed. Within this paper, the state of the existing structures is assessed using "the vulnerability index method. This method allows the classification of RC constructions taking into account both, structural and non structural parameters, considered to be ones of the main parameters governing the vulnerability of the structure. Based on this index a DPM (damage probability matrices) were developed, this let us to define the mean damage grade which lead to semi-empirical vulnerability curves.

These vulnerability curves were adapted to Algerian context, especially the north of Algeria which is an area prone to seismicity.

Keywords: Vulnerability index, RC Building, Algeria, Vulnerability curves, Earthquake, DPM

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