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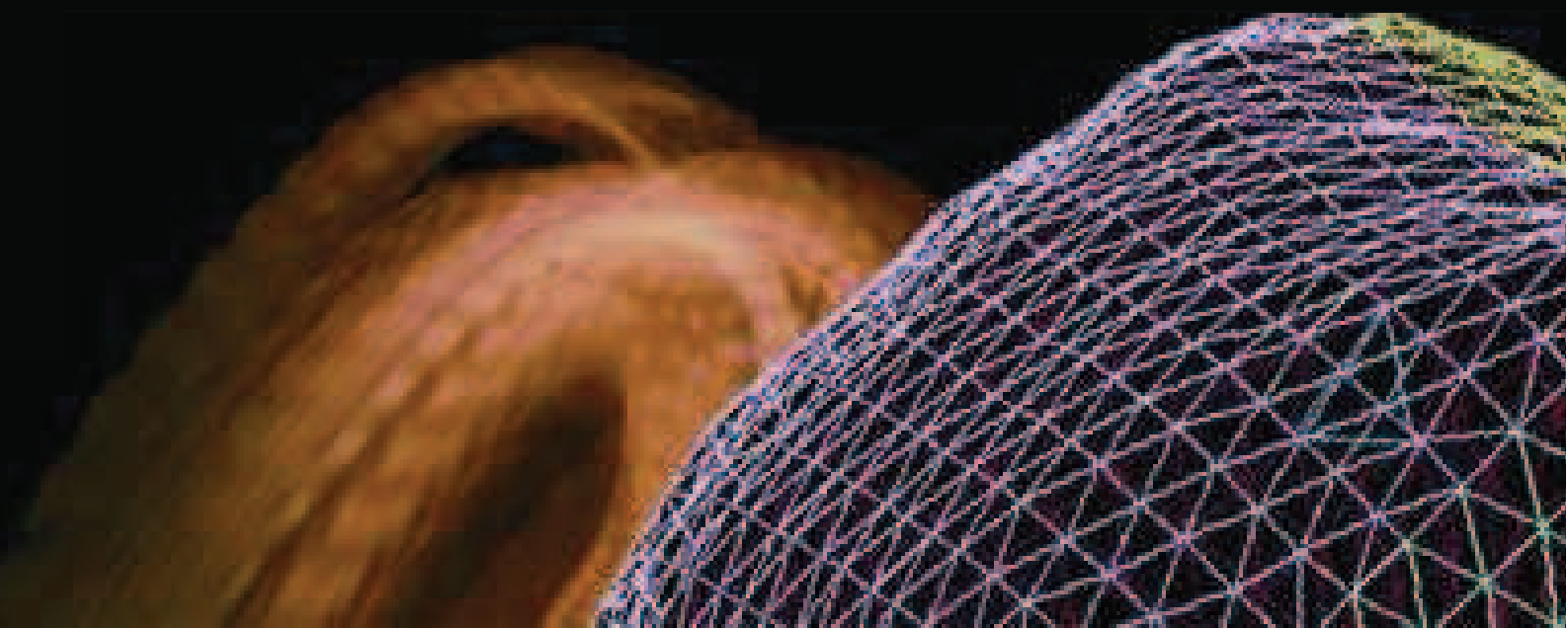
MULTIPHYSICS 2013

12 - 13 December 2013
Amsterdam, The Netherlands



MULTIPHYSICS 2013

12-13 December 2013
Amsterdam, The Netherlands

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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, 12th December	09:30-17:30
Friday, 13th December	09:30-17:30

Special Events

- Thursday 19:30
  Conference Banquet

Timing of Presentations

Each paper will be allocated 18 minutes. A good guide is 14 minutes for presentation with 4 minutes left for questions at the end.

Good timekeeping is essential, speakers are asked to keep strictly to 18 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

Costas Soutis
Professor of Aerospace Engineering
Director of the Aerospace Research Institute
The University of Manchester
United Kingdom

BIOGRAPHY

Professor Soutis is a graduate of the University of London (Queen Mary College and Imperial College London, Aeronautics) and Cambridge University (Department of Engineering, PhD). He has taught and performed research in the areas of mechanics of aerospace composite materials and structures at the University of Cambridge (1986-1991), University of Leicester (1991-1994), Massachusetts Institute of Technology (MIT) in the United States of America (2000-2001) as a Visiting Professor in the Department of Aeronautics & Astronautics), Imperial College London (1994-2002), where he held a personal chair in composite structures in the department of Aeronautics. Professor Soutis was the first Professor of Aerospace Engineering at the University of Sheffield where he served as Head of Aerospace and Head of the Composite Systems Innovation Centre (Founding Director) until September 2012. In October 2012, he was appointed at the University of Manchester as Chair of Aerospace Engineering, Director of the Aerospace Research Institute and Director of The Northwest Composites Centre.

MULTIPHYSICS 2013

PROGRAMME

TIME	Thursday 12 December 2013	Friday 13 December 2013
09:30 - 11:00	**Registration & Keynote Address**	**Session 2.1** *Aerospace & Multiphysics*
11:00 - 11:30	**Coffee Break**	
11:30 - 13:00	**Session 1.2** *Heat Transfer & Thermodynamics*	**Session 2.2** *Impacts & Explosions*
13:00 - 14:00	**Lunch**	
14:00 - 15:30	**Session 1.3** *Advanced Modelling Techniques*	**Session 2.3** *Materials & Nano-Technology*
15:30 - 16:00	**Tea Break**	
16:00 - 17:30	**Session 1.4** *Developments in Multiphysics*	**Session 2.1** *Posters*
19:30	**Conference Banquet**	

Full Programme

Thursday 12 December 2013

09:30 – 11:00 Registration / Keynote Address

Keynote Address

Multiphysics, Composites and Aerospace
Costas Soutis, The University of Manchester, UK

Chair: M Moatamedi, Narvik University College, Norway

11:00-11:30 Coffee Break

Thursday 12 December 2013

11:30-13:00 Session 1.2
Heat Transfer & Thermodynamics

Chair: B Alzahabi, Kettering University, USA

Continuous Hot Dip Galvanizing Modelling and Simulation of significant physical phenomena using zinc based alloys based on ANSYS FLUENT

M. Mataln, Materials Center Leoben Forschung GmbH
C. Pfeiler, Materials Center Leoben Forschung GmbH
J. Strutzenberger, voestalpine Stahl GmbH
C. K. Riener, voestalpine Stahl GmbH

Theoretical Analysis for a Multilayer Thermoelastic Contact Problem

Essam A. Al-Bahkali, Mechanical Engineering Department, King Saud University

Modelling Phase Change in a 3D Thermal Transient Analysis

P. R. Hampson, E. E. U. Haque, University of Salford

A 1D thermo- fluid dynamic model of wood particle gasification- and combustion processes

Gernot Boiger and Christoph Meier; ICP Institute of Computational Physics, School of Engineering, Zurich University of Applied Sciences, Switzerland

Towards to the numerical investigation of natural convection and radiation in a tilted cavity using an MRT-Lattice Boltzmann method combined with finite volume and discrete ordinates methods

A. Mezrhab Laboratoire de Mécanique et Energétique, Département de Physique Facutés des Sciences d'Oujda, Maroc
H. Naji Laboratoire Génie Civil & géo-Environnement, Université Lille, France; UArtois/FSA Béthune, Technoparc Futura, France.

13:00-14:00 Lunch

Thursday 12 December 2013

14:00-15:30 Session 1.3
Advanced Modelling Techniques

Chair: T. Watanabe, National Fisheries University, Japan

On the design of SPH schemes for hypervelocity impacts into laminates
Iason Zisis, Materials Innovation Institute and Eindhoven University of Technology
Bas van der Linden, Laboratory for Industrial Mathematics Eindhoven and Eindhoven University of Technology
Christina Giannopapa, ESA and Eindhoven University of Technology

Fully Coupled Computational Simulations of Closed-Cell Cellular Materials with Gaseous Pore Filer under Multiaxial Dynamic Loading
Matej Vesenjak and Zoran Ren, Faculty of Mechanical Engineering, University of Maribor, Slovenia

Random Vibration and Fatigue Analysis Using Modal Analysis
Essam Al-Bahkali, Hisham Elkenani, Mhamed Souli

On the accurate numerical solutions of the radial Schroedinger equation
(1, 2) A.F. Polupanov and (2) T.Yu. Balykova
(1) Kotel'nikov Institute of Radio-Engineering and Electronics of the Russian Academy of Sciences, Moscow, Russia
(2) Moscow City University of Psychology and Education, Moscow, Russia

Numerical investigation of cavitation effects in nuclear power plant pipes
Ramzi Messahel (Univ. Lille France), Mhamed Souli (Univ. Lille France), Bernard Cohen (EDF France), Moji Moatamedi (Univ. Narvik Norway)

15:30-16:00 Coffee Break

Thursday 12 December 2013

16:00-17:30 **Session 1.4**
Development in Multiphysics
(Sponsored by CD-Adapco)

Chair: M. Souli, University of Lille, France

STAR-CCM+ a Multi-discipline Finite Volume Code: Introduction
Ashkan Davoodi, CD-Adapco

STAR-CCM+ a Multi-discipline Finite Volume Code: Live Demonstration
Ashkan Davoodi, CD-Adapco

19:30 **Conference Banquet**

Friday 13 December 2013

09:30-11:00 Session 2.1
Aerospace & Multiphysics
(Sponsored by Association of Aerospace Universities)

Chair: C. Soutis, The University of Manchester, UK

Automotive Wind Noise using Computational Fluid Dynamics
Basem Alzahabi, Kettering University, USA

Numerical modeling of Coanda effect in a Novel Propulsive System
Shyam S. Das, M. Abdollahzadeh, Jose .C. Pascoa (Department of Electromechanical Engineering, Center for Aerospace Sciences and Technology University of Beira Interior, Covilha, Portugal)
A. Dumas, M. Trancossi (Dipartimento di Scienze e Metodi dell\'Ingegneria Universita di Modena e Reggio Emilia, Italy)

Analysis of Failure Mechanisms in Fatigue Test of Reinforced Concrete Beam Utilizing Acoustic Emission
N. Muhamad Bunnori, S. Abdul Kudus, N. Md Nor, T.K. Goh

An Optimum Magnetic Control Torque Generation of a Momentum Bias Satellite
Nurulasikin Mohd Suhadis (School of Aerospace Engineering, Engineering Campus, Universiti Sains Malaysia, Malaysia)
Renuganth Varatharajoo (Department of Aerospace Engineering, Faculty of Engineering, Universiti Putra Malaysia, Malaysia)

The Turbojet-Ramjet Propulsion System for Supersonic Flight: A Statistical Evaluation of Performance Parameters
M. Mustafa Kamal (Department of Engineering, University of Cambridge, UK)
H. Khawaja (Narvik University College, Norway)

11:00-11:30 Coffee Break

Friday 13 December 2013

11:30 – 13:00 Session 2.2
Impacts & Explosions

Chair: Z. Ren, University of Maribor, Slovenia

Pre-processing Technology Using Shock Loading for Marine Products Freeze-drying
Toshiaki WATANABE: Dept. of Ocean Mech. Eng., Nat. Fisheries Univ., Japan, Hironori MAEHARA: Shock Wave and Condensed Matter Research Center, Kumamoto Univ., Japan, Shigeru ITOH: Okinawa National College of Tech., Japan

Effects to Underwater shock wave by Improvement of Current characteristics of Spark discharge
Takumi Matsui, Soichiro Hanashiro, Katsuya Higa, Shigeru Itoh, Okinawa National College of Technology

A Computational Prediction of Fragment Behavior due to Underground Explosion
Yoshikazu HIGA(1), Hirofumi IYAMA(2) and Shigeru ITOH(3);
(1)Dept. of Mechanical Systems Engineering, Okinawa National College of Technology.
(2)Dept. of Mechanical and Intelligent Systems Engineering, Kumamoto National College of Technology.
(3)President, Okinawa National College of Technology

Improvement juice extraction of pumpkin oil by underwater shock wave
Ken Shimojima, Eisuke Kuraya, Osamu Higa, Katsuya Higa, Yoshikazu Higa, Ayumi Takemoto, Shigeru Itoh, Matej Vesenjak, Zoran Ren

Continuous operation of milling flour system by underwater shock wave and fixed quantity evaluation
Ken Shimojima, Osamu Higa, Katsuya Higa, Yoshikazu Higa, Ayumi Takemoto, Shigeru Itoh

13:00-15:00 Lunch

Friday 13 December 2013

14:00-15:30 Session 2.3
Materials & Nano-Technology

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

Rashba spin-orbit coupling effects in low dimensional nanostructures
R.V.N. Melnik and S. Prabhakar, M2NeT Lab, Wilfrid Laurier University, Waterloo, ON, Canada

An experimental and computational prediction for material characteristics of Jahgal Soil
Hirofumi IYAMA(1), Yoshikazu HIGA(2), Ken SHIMOJIMA(2), Shigeru TANAKA(3), Hironori MAEHARA(3) and Shigeru ITOH(2)
(1)Kumamoto National College of Technology.
(2)Okinawa National College of Technology.
(3)Kumamoto University.Ceramic powder compaction via elastoplasticity theory

Characterization of defect sizing in aluminum alloys by eddy current technique
Bennoud salim, Laboratory of Aircrafts, University of Saad Dahlab, Blida, Algeria

Some elastic parameters of zinc blende ZnS
E. Guler (1), M. Guler (1), E. Aldirmaz (2)
(1) Hitit University, Department of Physics, Turkey
(2) Amasya University,Department of Physics,Turkey

A comparative study for cubic elastic constants of fcc Ag, Au and Cu
M. Guler,E. Guler, H.Gunguneu and U. Alp, Hitit University, Department of Physics, Turkey

15:30-16:00 Coffee Break

Friday 13 December 2013

16:00-17:30 Session 2.4 Posters

Cavitation Inception in Fuel Injector Nozzle: A CFD based Parametric Analysis

M. Mustafa Kamal (Department of Engineering, University of Cambridge, UK)

Drying of Ceramic Hollow Bricks in an Industrial Tunnel Drier: A Finite volume Analysis

*Francisca Valdeiza de Souza Tavares (1), Severino Rodrigues de Farias Neto (2), Enivaldo Santos Barbosa (1), Antonio Gilson Barbosa de Lima (1)**

(1) Department of Mechanical Engineering, Federal University of Campina Grande, Brazil

(2) Department of Chemical Engineering, Federal University of Campina Grande, Brazil

Effect of Reversible Hydrogen Trapping on Crack Propagation in the API 5CT P110 Steel: A Numerical Simulation

J. P. Carrasco (1), E. T. da Silva(1), D. D. S. Diniz(1), A. A. Silva(1), J. M. A. Barbosa(2),

(1) Federal University of Campina Grande, Campina Grande, PB- Brazil

(2) Federal University of Pernambuco, Recife, PE - Brazil.

Evaluation of the contact switch materials in high voltage power supply for generate of underwater shockwave by electrical discharge

Katsuya Higa, Takumi Matsui, Soichiro Hanashiro, Osamu Higa, Shigeru Itoh, Okinawa National College of Technology, Japan

Evaluation of the effect of mechanical vibration on the levels of residual stresses in steel welded joints using an Interface Matlab based on Norm API 579

Rodrigues, Rmulo do Nascimento; Silva, Antonio Almeida; Maciel, Theophilo Moura; UFCG, Campina Grande-PB, Brasil

Multiphysics Investigation of Composite Shell Structures Subjected to Water Shock Wave Impact in Petroleum Industry

H. Khawaja and M. Moatamedi, Narvik University College, Norway

Nanoindetation and AFM Imaging of RuSr2RECu2O8 (RE = Eu, Gd and Ho) Superconductors

U.Alp (a), U.Kulemen (b), M. Guler (a), H.Gunguneu (a) and F. Yilmaz(b);
(a)- Hitit University,Department of Physics, Turkey
(b)- Gaziosmanpasa University, Department of Physics,Turkey

Numerical evaluation of multipass welding temperature field in API 5L X80 steel welded joints

Jailson Alves da Nbrega; Diego David Silva Diniz; Bruno Alisson Arajo; Theophilo Moura Maciel; Antonio Almeida Silva; Neilor Cesar dos Santos; UFCG, Brasil

Operation Control of Fluids Pumping in Curved Pipes during Annular Flow: A Numerical Evaluation

*Tony Herbert Freire de Andrade (1), Severino Rodrigues de Farias Neto (2), Antonio Gilson Barbosa de Lima (1)**
(1) Department of Mechanical Engineering, Center of Science and Technology, Federal University of Campina Grande, Brazil.
(2) Department of Chemical Engineering, Center of Science and Technology, Federal University of Campina Grande, Brazil.

Solution of the time-dependent Schrodinger equation for coupled harmonic oscillator and geometric phase

Hacene Bekkar Ferhat abbas University setif1 and Salim Medjber

Three-phase flow (water, oil and gas) in vertical circular cylindrical duct with leaks: A theoretical study by CFD

*Wanessa Raphaella Gomes dos Santos (1), Enivaldo Santos Barbosa (1), Severino Rodrigues de Farias Neto (2), Antonio Gilson Barbosa de Lima (1)**
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17:30 Close of Conference

SESSION 1.1

KEYNOTE ADDRESS

THURSDAY, 12 DECEMBER 2013
10:00 – 11:00

CHAIR

M Moatamedi
Narvik University College
Norway

Thursday, 12 December 2013
10:00 – 11:00

Keynote Address

Multiphysics, Composites and Aerospace

Costas Soutis
Professor of Aerospace Engineering
Director of the Aerospace Research Institute
The University of Manchester
United Kingdom

Estimating precisely where a small crack will develop in a material under stress and exactly when in time catastrophic fracture of the structure will happen is not an easy task in the design and building of large engineering structures. It is when structural integrity of the material is lost that disaster strikes! Structural integrity is the term used when analyse how best components and parts can be joined by embracing materials science and mechanics, by understanding manufacturing methods, by coming to grips with non-destructive evaluation and service monitoring, and by multi-scale modelling of damage and fracture. When human life depends upon structural integrity as an essential design requirement, in building with composite materials, it takes over ten thousand test coupons per laminate configuration to evaluate an airframe, plus loading to ultimate failure of tails, wing boxes, and fuselage sections to achieve a commercial aircraft airworthiness certification, which increases cost considerably.
For high efficiency and safety assurance throughout an economically viable lifetime, a modelling strategy is required to devise a robust methodology that is successfully predictive of reliability and life expectancy of safe structure. Successful prediction requires detailed information obtained from test programmes of all possible failure mechanisms across the widest spectrum of size-scale that operates in service. These multi-scale problems of structural failure can be solved by testing (limited) and analysis across a size spectrum. Understanding though the structural behaviour, especially of anisotropic structures at the various size scale, requires a good grasp of continuum mechanics (semi-empirical analyses), micro-mechanics (damage mechanism models), and tools that determine constitutive equations based on the rules of material behaviour; a multi-physics approach.
Current research effort in composites is devoted to analysis and computational simulation of the performance of the structure, as well as the simulation of the manufacturing and assembly process, since these are intimately connected. In this talk, applications of modern composite systems will be presented and achievements, but also challenges, in the modelling and characterisation of such materials will be discussed with some thoughts on future needs, developments and prospects for novel materials and processes, structural health monitoring, maintenance and repair.

SESSION 1.2

HEAT TRANSFER & THERMODYNAMICS

THURSDAY 12 DECEMBER 2013
11:30 – 13:00

CHAIR

B Alzahabi
Kettering University
USA

CONTINUOUS HOT DIP GALVANIZING MODELLING AND SIMULATION OF SIGNIFICANT PHYSICAL PHENOMENA USING ZINC BASED ALLOYS BASED ON ANSYS FLUENT

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J. Strutzenberger, voestalpine Stahl GmbH

C. K. Riener, voestalpine Stahl GmbH

Hot dip galvanizing is one of the fastest growing technologies for surface treatment of steel strip. In the last years, this process was highly improved in order to fabricate high quality zinc-coated surfaces and new zinc based alloys with superior corrosion resistance. The essential process steps are: pretreatment of the steel strip in the annealing furnace, dipping into a Zn-alloy, gas jet stripping of the surplus molten zinc and cooling and solidification in the cooling tower. Many physical phenomena occurring during the overall process are not fully understood in detail. Therefore, further development of this technology requires a deeper insight into relevant process steps and material related phenomena. The first part of the presentation focuses on simulation of turbulent fluid flow and temperature distribution in a 3D, inductively heated molten zinc bath. The behavior of fluid flow and temperature highly influence the reactions on the steel strip such as dissolving of iron from the strip into the zinc bath, growth of intermetallic phases and Al-intake. Formation of Fe2Al5 phases in the molten zinc bath, regulated by the local temperature, may reduce coating quality when sticking onto the immersed steel strip. In the second half the focus is set on gas jet stripping of the surplus molten zinc from the coated steel strip. It will be shown that by using the Volume of Fluid Method it is possible to simulate the behavior of the flow inside the molten zinc while being removed by a highly turbulent gas jet. Furthermore, it will be demonstrated that the flow of zinc near the surface of the zinc bath influences the amount of lifted zinc and therefore the necessary power of the gas jet in order to fabricate the required coating thickness and high standard of quality demand.

Keywords: Hot Dip Galvanizing, Simulation, Ansys Fluent, coating steel strips, zinc alloys

THEORETICAL ANALYSIS FOR A MULTILAYER THERMOELASTIC CONTACT PROBLEM

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Multilayer contact problems are involved in a variety of engineering applications, such as clutches. One of the problems that arise in such systems is thermoelastic instability. This is because frictional heat is generated when bodies are sliding against each other. To study the stability of a system, it is required to determine the critical sliding speed at which the system becomes unstable. A theoretical analysis can be done using a solution to general thermoelastic contact problem for a layer. The basic idea behind this analysis is to take two layers out of the whole system and find the equations that relate the contact pressure, displacement, the temperature filed, and the applied boundary conditions to solve the problem.

A characteristic equation that determines the stability was derived utilizing relations for the displacement, and temperature profiles, in each layer, as well as the layer-to-layer contact pressure field. the characteristic equations that were obtained were verified by application to some special cases. When an elastic half-plane slides against a rigid non-conductive layer, the stability of the system becomes depending only on the material properties and the wavenumber of the half-plane. The analyses also suggested studying a two-dimensional system based on a plane strain model in order to ensure conservative results. This is because the plane strain model gives a lower stability region than that corresponding to plane stress. This method enable us to determine whether the system is stable at a given operating speed.

Keywords: Multilayer, Thermoelastic Instability, Critical Speed, half-plane

MODELLING PHASE CHANGE IN A 3D THERMAL TRANSIENT ANALYSIS

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P. R. Hampson, E. E. U. Haque, University of Salford, UK

A 3D thermal transient analysis of a gap profiling technique which utilises phase change material (plasticine) is conducted in ANSYS. Phase change is modelled by assigning enthalpy of fusion over a wide temperature range based on Differential Scanning Calorimetry (DSC) results. Temperature dependent convection is approximated using Nusselt number correlations. A parametric study is conducted on the thermal contact conductance value between the profiling device (polymer) and adjacent (metal) surfaces. Initial temperatures are established using a liner extrapolation based on experimental data. Results yield good correlation with experimental data.

Keywords: Transient thermal analysis, Phase change, ANSYS

A 1D THERMO- FLUID DYNAMIC MODEL OF WOOD PARTICLE GASIFICATION- AND COMBUSTION PROCESSES

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Gernot Boiger and Christoph Meier; ICP Institute of Computational Physics, School of Engineering, Zurich University of Applied Sciences, Wildbachstrasse 21, P.O. Box, 8401 Winterthur, Switzerland

In order to qualitatively understand and evaluate the thermo- fluid dynamic situation within a wood gasification reactor, a fully featured 1D particle model has been created. The presented tool accounts for the highly in-stationary kinetic- and thermochemical effects, leading to partial gasification and combustion of a wood particle collective. It considers the fluid dynamic situation within the changing porous bulk structure of the packed bed, its impact on species- and heat transition mechanisms, the energy- and mass balances of wood, coal, pyrolysis-gas, wood-gas and off-gas phases, the thermodynamics of locally developing gasification- and combustion reaction equilibria, as well as the presence of the chemical species hydrogen, water, carbon (di-) oxide, methane, oxygen, solid carbon and gaseous, longer chain hydrocarbons from pyrolysis.
So far the model achieves a full, comprehensive simulation of the life span of a gasified wood particle. Results can be shown to yield good, qualitative resemblance with flame front velocity measurements, conducted on a lab-scale gasifier.

Keywords: gasification, combustion, pyrolysis, thermochemistry, particle collective

TOWARDS TO THE NUMERICAL INVESTIGATION OF NATURAL CONVECTION AND RADIATION IN A TILTED CAVITY USING AN MRT-LATTICE BOLTZMANN METHOD COMBINED WITH FINITE VOLUME AND DISCRETE ORDINATES METHODS

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The study of combined natural convection and volumetric radiation continues to attract a considerable amount of interest in the recent past. It is a lasting research subject for many investigators not only for academic reasons but also for a wide variety of engineering applications, such as the design of furnaces, heat exchangers, cooling of electronic devices and nuclear reactors, spacecraft, thermal insulation, heat buildings, the metallurgy and solar capture, etc.

Indeed the coupling between natural convection and radiation in a semi-transparent medium (the component scatters absorbs and emits thermal radiation) assumes that the radiative transfer has, on one hand, a direct influence on the thermal field in the disparities in the absorption and emission, and on the other hand, it has an indirect influence on the dynamic field that is slandered by the variation of buoyancy forces.

From the literature browsed, we have found that the simulation of combined natural convection-volumetric radiation was studied in the most of cases by using FVM with the Simpler algorithm or LBM-BGK to solve momentum and energy equations. Based on the foregoing considerations, we aim to use the multiple relaxation time-lattice Boltzmann method (MRT-LBM) by combining FVM and DOM methods to demonstrate the ability of such a combination to carry out such problems, and to examine its accuracy over a wide parametric study. it should be noted that at present, the LBM is considered as a potential tool of calculation for solving a large class of problems; It has been successfully used to simulate fluid flows, heat transfer and model physics in many problems. Because of its mesoscopic origin, LBM seems to be a flexible method of calculation with many advantages, compared with conventional numerical methods, which are based on discretization of macroscopic governing equations.

Keywords: Numerical simulation; Heat transfer; Natural convection; Volumetric radiation; Lattice Boltzmann method; Discrete ordinates method.

SESSION 1.3

ADVANCE MODELLING TECHNIQUES

THURSDAY 12 DECEMBER 2013
14:00 - 15:30

CHAIR

T. Watanabe,
National Fisheries University,
Japan

ON THE DESIGN OF SPH SCHEMES FOR HYPERVELOCITY IMPACTS INTO LAMINATES

Corresponding Author

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Bas van der Linden (Laboratory for Industrial Mathematics Eindhoven and Eindhoven University of Technology);
Christina Giannopapa (ESA and Eindhoven University of Technology).

Satellites in orbit experience hypervelocity impacts by small-sized meteorites; these are collisions at velocities greater than the materials speed of sound. Such impacts produce shock waves that propagate through colliding bodies. Laminated structures are often used as shielding materials for satellites and their effectiveness is assessed from computational studies.

Smoothed Particle Hydrodynamics (SPH) numerical method is typically used for the simulation of hypervelocity impacts and has given insight into shock loading of homogeneous materials. Nevertheless, shock wave propagation through solids with discontinuous density distribution such as laminated inhomogeneous materials has not been considered in depth, yet. It is customary that they are treated with homogenization of the structure, a process that neglects wave transmission-reflection effects on the interface of different materials.

Furthermore, not all of the available SPH discretizations are adequate to be used in algorithms for materials with discontinuous distribution; special treatment is needed. Additionally, accuracy issues occur because SPH schemes used for the simulation of hypervelocity impacts are rarely developed within a variational framework.

In this paper, we firstly describe the derivation of SPH schemes from the Euler-Lagrange equation; thus guarantying conservative schemes. Secondly, we show which SPH discretizations give accurate results for multi-material shock-loading simulations. And finally, we furnish an SPH scheme able to treat materials withpurely discontinuous density distribution.

Keywords: SPJ; hypervelocity impacts; laminates

FULLY COUPLED COMPUTATIONAL SIMULATIONS OF CLOSED-CELL CELLULAR MATERIALS WITH GASEOUS PORE FILER UNDER MULTIAXIAL DYNAMIC LOADING

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Matej Vesenjak and Zoran Ren, Faculty of Mechanical Engineering, University of Maribor, Slovenia

The presentation focuses on computational characterisation of materials with closed-cell cellular structure and gaseous pore filler when subjected to multiaxial dynamic loading, considering the influence of: (i) the relative density, (ii) the base material, (iii) the strain rate and (iv) the pore gas pressure. Research study was conducted by extensive parametric fully-coupled computational simulations using the explicit finite element code LS-DYNA run on the HPC-Europa large scale computing systems (HLRS Stuttgart and SCC Karlsruhe). Parametric computational simulations have shown that the macroscopic yield stress of cellular material rises with increase of the relative density, while its dependence on the hydrostatic stress decreases. The yield limit also rises with increase of the strain rate, while the hydrostatic stress influence remains more or less the same at different strain-rates. The macroscopic yield limit of the cellular material is also strongly influenced by the choice of base material since the base materials with higher yield limit contribute also to higher macroscopic yield limit of the cellular material. The investigation has also shown that the gaseous pore filler also influences the behaviour of closed-cell cellular material and thus cannot be neglected. By increasing the pore gas filler pressure the dependence on hydrostatic stress increases while at the same time the yield surface shifts along the hydrostatic axis in the negative direction. This means that yielding at compressive loading is delayed due to influence of the initial pore pressure (positive hydrostatic stress) and occurs at higher compressive loading, while the opposite is true for tensile loading.

Keywords: Cellular materials, Gaseous pore filler, Finite element analysis,

RANDOM VIBRATION AND FATIGUE ANALYSIS USING MODAL ANALYSIS

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The present work concerns solving Noise, Vibration and Harshness (NVH) and fatigue based on Power Spectrum Density (PSD) analysis of a landing gears leg for an Un-Manned Aerial Vehicle (UAV). This analysis includes random vibration and high-cycle fatigue analysis in a random vibration environment. In this analysis, the cumulative damage ratio is computed using material S-N (Stress-Number of cycles) fatigue curve. Dirlik method is used for the analysis of life time as it is proven to provide accurate results for large number of applications, both in automotive and aerospace industry. It is also compared to other methods that have been developed in LS-DYNA as well. The input acceleration PSD data are provided through measurements.

The obtained analysis results shows that although the landing gear design is safe according to dynamic and static load, its service life is about 3037 hours due to random vibration effect.

Keywords: PSD, modal analysis, fatigue

ON THE ACCURATE NUMERICAL SOLUTIONS OF THE RADIAL SCHROEDINGER EQUATION

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We demonstrate an explicit numerical method for accurate solving the eigenvalue and related problems for ODE of the second order with singular points, namely the radial Schroedinger equation, describing Coulomb states of a hydrogen-like atom in various cases, e.g. states of shallow donor impurities in a bulk direct gap semiconductor or in a semiconductor quantum dot. Energies and wave functions of some lowest discrete states are calculated both in the conventional case when exact analytical solution to the problem is known that makes possible to estimate accuracy of the method, and in case when only numerical methods are applicable.

Keywords: numerical method, ordinary differential equations, eigenvalue problem, Coulomb potential, hardcore potential, scattering problem

NUMERICAL INVESTIGATION OF CAVITATION EFFECTS IN NUCLEAR POWER PLANT PIPES

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In the nuclear and petroleum industry, supply pipes are often exposed to high pressure loading which can cause to the structure high strains, plasticity and even in the worst scenario failure. Fast Hydraulic Transient phenomena such as Water Hammers (WHs) are of this type. It generate a pressure wave that propagates in the pipe causing high stress. Such phenomena are of the order of few msecs and numerical simulation can offer a better understanding and an accurate evaluation of the dynamic complex phenomenon including fluid-structure interaction, multi-phase flow, cavitation.

For the last decades, the modeling of phase change taking into account the cavitation effects has been at the centre of many industrial applications (chemical engineering, mechanical engineering) and has a direct impact on the industry as it might cause damages to the installation (pumps, propellers, control valves). In this presentation, numerical simulation using FSI algorithm and the two One-Fluid: Cavitation models ‘Cut-Off’ and ‘Schmidt’ of WHs including cavitation effects is presented.

Keywords: Cavitation, Water Hammer, Shock Wave, ALE method, FSI

SESSION 1.4

DEVELOPMENT IN MULTIPHYSICS (Sponsored by CD-Adapco)

THURSDAY 12 DECEMBER 2013
16:00 – 17:30

CHAIR

M. Souli
University of Lille
France

STAR-CCM+ A MULTI-DISCIPLINE FINITE VOLUME CODE: INTRODUCTION

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Ashkan Davoodi, CD-Adapco

CD-Adapco is the world's largest independent CFD-focused provider of engineering simulation software, support and services. This presentation highlights STAR-CCM+ capabilities for modelling multi physics problems and gives examples covering a range of applications touching on multi physics i.e. multi-phase flows, CHT, FSI etc

STAR-CCM+ A MULTI-DISCIPLINE FINITE VOLUME CODE: LIVE DEMONSTRATION

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Ashkan Davoodi, CD-Adapco

A live product demonstration showing STAR-CCM+ being used for a Multi physics problem. This is a Simulation of a metered-dose inhaler, exploring spray angle, as one of many parameters that influence the effectiveness of this drug delivery system. Lagrangian spray modelling and fluid film formation are used to capture the physics behind this life saving device.

Keywords: Lagrangian, Liquid Film, STAR-CCM+, Multiphase Flow, Life Sciences, CFD, Multiphysics

SESSION 2.1

AEROSPACE & MULTIPHYSICS (Sponsored by AAU)

FRIDAY 13 DECEMBER 2013
09:30 – 11:00

CHAIR

C. Soutis
The University of Manchester
UK

AUTOMOTIVE WIND NOISE USING COMPUTATIONAL FLUID DYNAMICS

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The perceived quality of a vehicle is largely influenced by the interior noise that a driver experiences in the vehicle. To increase the comfort level of a vehicle, reducing interior noise of a vehicle is one of the high priority tasks for the automakers to improve NVH performance. The aerodynamic noise is a significant contributor to the total interior noise level in an automobile especially at high speed. The aerodynamic noise is generated by unsteady airflows outside of a vehicle and the airflow around the vehicle is determined by the shape of the vehicle. Due to the complex flow passages around a vehicle or other automotive parts, the application of computational fluid dynamics techniques in the design has become widely used in the automotive industry.

The aerodynamic noise generated by an automobile at high cruising speeds is studied in this paper using computational fluid dynamics (CFD). The object is to predict the aerodynamic noise generated at high speed. The high noise source regions of the vehicle are predicted so that the noise, vibration, and harshness (NVH) performance of the vehicle can be improved by further modification of the vehicle geometry.

Keywords: Wind Noise, Automotive, Computational Fluid Dynamics

NUMERICAL MODELING OF COANDA EFFECT IN A NOVEL PROPULSIVE SYSTEM

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Coanda effect (adhesion of jet flow over curved surface) is fundamental characteristics of jet flow. In the present paper, we have carried out numerical simulations to investigate Coanda flow over a curved surface and its application in a newly proposed Propulsive system 'A.C.H.E.O.N' (Aerial Coanda High Efficiency Orienting jet Nozzle) which supports thrust vectoring. The A.C.H.E.O.N system is presently being proposed for propelling a new V/STOL airplane in European Union. This system is based on cumulative effects of three physical effects such as (1) High speed jet mixing speeds (2) Coanda effect control by electrostatic fields. The performance of this nozzle can be enhanced by increasing the jet deflection angle of synthetic jet over the Coanda surface. This newly proposed nozzle has wide range of applications. It can be used in industrial sector such as plasma spray gun and for direct injection in combustion chamber to enhance the efficiency of the combustion chamber. Also, we studied the effect of Dielectric barrier discharge (DBD) plasma actuators on A.C.H.E.O.N system. Dielectric barrier discharge (DBD) plasma actuators are active control devices for controlling boundary layer and to delay the flow separation over any convex surfaces. Computations were performed under subsonic condition. Two dimensional CFD calculations were carried out using Reynolds averaged Navier stokes equations (RANS). A numerical method based on finite volume formulation (FVM) was used. SST k-e; model was considered to model turbulent flow inside nozzle. Nano second DBD (NSBD) model was used to model the plasma. Moreover, a body force treatment was devised to model the effect of plasma and its coupling with the fluid. This preliminary result shows that, the presence of plasma near Coanda surface accelerates the flow and delays the separation and enhances the efficiency of the nozzle.

Keywords: Coanda effect, ACHEON system, thrust vectoring, flow separation, plasma, combustion, turbulence model

ANALYSIS OF FAILURE MECHANISMS IN FATIGUE TEST OF REINFORCED CONCRETE BEAM UTILIZING ACOUSTIC EMISSION

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The acoustic emission technique is used for monitoring the fatigue failure mechanisms in reinforced concrete beam under three point bending. The analysis was conducted by using the bathtub curve method plotted from acoustic emission data. In this study, the fatigue behavior was divided into three stages. The first stage is involved with the decreasing failure rate, known as early life failure or burn-in phase, the second stage is characterized by constant failure rate and the third stage is called the burn-out phase which is an increase of failure rate. The three parameters used in analyzing is the fatigue behavior for each stage of failure which are severity, signal strength and the cumulative signal strength. From severity analysis, the range of each stage of failure had been determined while from signal strength analysis, the initiation of distribution of crack had been detected through the fluctuation of signal strength. Cumulative signal strength parameter provides a clearer view of the initiation and distribution of crack.

Keywords: Acoustic emission, bathtub curve, fatigue test, severity analysis

AN OPTIMUM MAGNETIC CONTROL TORQUE GENERATION OF A MOMENTUM BIAS SATELLITE

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This paper describes a comparison study of magnetic attitude control torque generation performance of a momentum bias satellite operated in Low Earth Orbit (LEO) with various orbit inclinations. The satellite is equipped with two magnetic torquers that are placed along the +x and +y axes whereby the magnetic control torque is generated when these magnetic torquers couple with the geomagnetic fields and its vector direction is perpendicular to both the magnetic fields. The control algorithm was structured using a proportional (P) controller for satellite attitudes/nutation control and a proportional-integral (PI) controller for managing the excess angular momentum on the momentum wheel. The structured control algorithm is simulated for 23, 53 and 83 orbit inclinations and the generated attitude torque performances are compared to see how the variation of the satellite orbit affects the satellite's attitude torque generation as the magnitude and direction of the geomagnetic fields vary with respect to the altitude while the magnitude and direction of the magnetic fields generated by the magnetic torquers vary with respect to the orbital motion. Simulation results show that the higher orbit inclination generates optimum magnetic attitude control torque for this satellite configuration. Note that this work is the extension of the previous work published in The International Journal of Multiphysics.

Keywords: Coupled magnetic fields, magnetic torquer, magnetic attitude control system

THE TURBOJET-RAMJET PROPULSION SYSTEM FOR SUPERSONIC FLIGHT: A STATISTICAL EVALUATION OF PERFORMANCE PARAMETERS

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This study reports the performance evaluation of turbojet and ramjet propulsion systems working in parallel. From a brief literature review, carried on the issues of applying propulsion systems to subsonic and supersonic aircraft, a number of research works have shown that neither turbojet engines nor ramjet engines are entirely satisfactory when used by themselves as propulsion systems to supersonic aircraft. But when these two systems are combined, an effective propulsion system (Turbojet-Ramjet propulsion system or Dual working propulsion system) is developed which enabled the flight to achieve high supersonic performance along with substantial cost effectiveness. Instead of using engine specific performance parameters for evaluation and comparison in the present work, rather a simpler approach is adopted for performance comparison i.e. the thrust is evaluated by varying mass flow rate across the system. The software used for this analysis is ‘PARA’ that is based on governing equations of thrust and other performance parameters. First the ideal case is studied for the sake of elementary analysis, and later on realistic effects are studied by introducing efficiencies to the calculations. Finally the deviation from ideal to real case is estimated and corresponding overall effect on the engine performance parameters are plotted for various regimes of flight.

Keywords: Turbojet; Ramjet; Propulsion system; Thrust; Supersonic aircraft

SESSION 2.2

IMPACTS & EXPLOSIONS

FRIDAY 13 DECEMBER 2013
11:30 – 13:00

CHAIR

Z. Ren
University of Maribor
Slovenia

PRE-PROCESSING TECHNOLOGY USING SHOCK LOADING FOR MARINE PRODUCTS FREEZE-DRYING

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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 phenomena will be modeled, and it will be compared with a result of an experiment.

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

EFFECTS TO UNDERWATER SHOCK WAVE BY IMPROVEMENT OF CURRENT CHARACTERISTICS OF SPARK DISCHARGE

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We are developing the food processing device using the underwater shock wave. The shock wave is generated by a spark discharge at the underwater spark gap. The underwater shock wave has the such effects on the food processing as softening, fracturing and sterilization. These technologies are attractive due to the food is not heating and is kept a nutrition of them. In this research, we are developing the rice powder manufacturing system using underwater shock wave. The rice grains are very hard, so that the process must be repeated using the momentary high pressure in order to fracture the rice grains. The fast repeat processing needs that the high pressure is generated by low energy. Therefore, we are analyzing mechanisms of the shock wave generation by electric discharge to improve the before described procedure. The purpose of this research is to achieve the more high pressure by underwater gap discharge with the low energy. We increased the pulse compression by decreasing the circuit impedance of the device and increasing the charging voltage. We measured the differential of the pressure by the charging energy and the rise time of discharge current, using optical observation and a pressure sensor. In the result, we decreased the rise time of discharge current to 17% with keeping the current peak. We increased the high pressure of underwater shock wave to 135% of previous system.

Keywords: Shock wave, Pulse power, High pressure, Food processing

A COMPUTATIONAL PREDICTION OF FRAGMENT BEHAVIOR DUE TO UNDERGROUND EXPLOSION

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In order to clarify the characteristic behavior such as shockwave propagation, fragment behavior and the shape of crater caused by underground explosion, the SPH computational models of soil, explosive and surrounding metal have been constructed based on HyperWorks-RADIOSS software. By conducting a series of numerical simulations, it has been observed the characteristic behavior depending to the different of explosive volume and the depth of buried. And then, we have also shown that it can be predicted a fragment behavior induced by underground explosion. These results based on the computational mechanics are useful data for setting an area of refuge.

Keywords: Underground Explosion, Fragment Behavior, SPH, Soil Mechanics

IMPROVEMENT JUICE EXTRACTION OF PUMPKIN OIL BY UNDERWATER SHOCK WAVE

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The food processing device by the underwater shock wave has been developed in Okinawa College of Technology. In the food processing with this device, the effects such as the improvement of the amount of the extraction, softening, non-heating sterilization, and milling flour are achieved. In the present study, the effect of the improvement of the amount of the extraction in the above-mentioned effect is targeted and, the food processing object is pumpkin oil. This oil is produced a lot in Slovene, and eaten widely in Europe. The improvement of the amount of the extraction greatly contributes to the oil production. In this presentation, the relation between the number of shock wave processing and the amount of the extraction of oil is shown. It is cleared that the shock wave processing contributes to the improvement of the amount of the oil extraction.

Keywords: underwater shock wave, pumpkin oil, improvement extraction

CONTINUOUS OPERATION OF MILLING FLOUR SYSTEM BY UNDERWATER SHOCK WAVE AND FIXED QUANTITY EVALUATION

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The milling flour system of the rice powder by the underwater shock wave has been developed in Okinawa College of Technology. The evaluation of the amount of the mill of the device is clarified by the batch experiment. However, it is preferable that the milling flour is continuously processed. In this study, to achieve the continuous operation, the system is improved. In this report, the system to which the factor to obstruct a continuous driving is improved is referred. The result of the amount of the milling flour in the continuous operation of the system is shown.

Keywords: underwater shock wave, rice, powder, disintegrator

SESSION 2.3

MATERIALS & NANO-TECHNOLOGY

FRIDAY 13 DECEMBER 2013
14:00 – 15:30

CHAIR

E A Al-Bahkali
King Saud University
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RASHBA SPIN-ORBIT COUPLING EFFECTS IN LOW DIMENSIONAL NANOSTRUCTURES

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The splitting of spin bands in low dimensional semiconductor nanostructures is a result of a combined (Rashba) effect of spin-orbit coupling and asymmetry of the potential. It plays an important role in the properties of such nanostructures. In this contribution, we analyze in detail the influence of Rashba spin-orbit coupling in several types of low dimensional nanostructures, focusing on nanowires modulated by longitudinal periodic potentials. If the modulation potential is obtained from a superlattice, the resulting structure is known as the nanowire superlattice. We demonstrate that the Rashba spin-orbit interaction induces the level crossing point in such nanowire superlattices. Finally, we study the phonon and electromagnetic field mediated spin transition rates in these structures for different values of Rashba spin-orbit coefficients.

Keywords: spin-orbit coupling effects, nanostructures, superlattices, coupled effects in quantum mechanical systems

AN EXPERIMENTAL AND COMPUTATIONAL PREDICTION FOR MATERIAL CHARACTERISTICS OF JAHGAL SOIL

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(3)Kumamoto University.

In order to clarify the shock material characteristics of Jahgal that is typical soil type of Okinawa, a experimental investigation of dynamic property such as shockwave propagation, pressure and particle velocity have been performed using impedance matching method. Thereby, we have also obtained the Jahgal's Hugoniot data.

And then, in order to reveal a validity of the material characteristic, we have developed a computational model for the experimental procedure using ALE simulation. Through the comparison between numerical and experimental results, we examined the capability of proposed method through the numerical simulations.

Keywords: Shock Wave, Soil, Hugoniot data, ALE simulation

CHARACTERIZATION OF DEFECT SIZING IN ALUMINUM ALLOYS BY EDDY CURRENT TECHNIQUE

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Various non destructive testing techniques are used to locate defect and to estimate its profiles and characteristics (for example, visual inspection can be used to locate defects and ultrasonic testing is used to estimate defect profiles). In this context, recent studies affirm that the eddy current technique is expected to be effective for solving this problem. The competence and the aptitude of different numerical methods in solving inverse problems become one of the important recent activities in the research field about the electromagnetic non destructive evaluation. The principal objective of this study is to evaluate the effectiveness of eddy current testing to the detection and sizing of defects embedded in structure from aluminum alloys A2024 and A7075. Experiments and numerical modeling are carried out to study the effect of defect on the response of eddy current inspections. Plate specimens and defects as cracks are artificially introduced into the specimens, eddy current signals are performed using a uniform eddy current probe with various frequencies, and all of the defects are detected. Problems have solved by means of finite elements method modeling. The solution of the forward problem able to determinate the impedance changes of the probe that gives a possibility to validate the obtained values with the experimental one.

The solution of the inverse problem performs the reconstruction of the shape and characteristics of the notches. So, the defects were then reconstructed from measured eddy current signals. The problem deals with a pancake coil, placed above a plate in aluminum with a crack. The probe coil moves parallel to the chosen axis, placed along the crack length direction.

This case will first be discussed and compared to an analytical and experimental model. The knowledge from this model is then used in the set up and analysis of the more complex case.

Keywords: Non destructive testing, eddy current, finite element method, aluminium parts, numerical simulations, inversing problem

SOME ELASTIC PARAMETERS OF ZINC BLENDE ZNS

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We report a comparison for some elastic parameters such as typical cubic elastic constants, bulk modulus etc. of zinc-blende poltype of ZnS compound in the framework geometry optimization calculations. During study, we evaluated previous theoretical results and our current results with each other as well as with former experimental findings. Generally, our results exhibit a good consistency with experiments and better than those of several recent density functional theory results for the studied parameters of related material.

Keywords: Zinc blende, ZnS, bulk modulus, elastic constants.

A COMPARATIVE STUDY FOR CUBIC ELASTIC CONSTANTS OF FCC AG, AU AND CU

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We report a comparison for typical cubic elastic constants of fcc Ag, Au and Cu elements in the framework of embedded atom method (EAM) calculations. During study, we evaluated previous and present results of four different EAM potentials with each other as well as with former experimental findings. Calculated elastic constant values of Ag, Au and Cu metals were found to be strictly dependent to the applied interatomic potential. However, in general, all considered potentials are able to reproduce consistent results within few percent of overestimating or underestimating the experimental data.

Keywords: Lammps, EAM, elastic constants, fcc.

SESSION 2.4

POSTERS

FRIDAY 13 DECEMBER 2013
16:00 – 17:30

CAVITATION INCEPTION IN FUEL INJECTOR NOZZLE: A CFD BASED PARAMETRIC ANALYSIS

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This study reports a multi-objective optimization of a modular fuel injector, and is based on the numerical investigation of the viscous effects caused by both the dynamics and geometrical factors on the fuel flow inside the injector. The dynamic factors involved in this study included injection pressure and back pressure, both of which were set as the boundary conditions at inlet and outlet respectively. Whereas the geometrical factors included inlet corner radius of nozzle orifice, orifice length, orifice diameter, and the inclination angle of nozzle orifice. Numerical investigation was carried through Software program FLUENT based on the Finite Volume method. The main fluid dynamics phenomena studied in this project including Turbulence, Multiphase flow and cavitation (vapour bubbles), were implemented through the Standard k-ε model, Mixture model and Full Cavitation model respectively. It is reported from the findings of this numerical investigation that flow states/ regimes inside injector nozzle are directly influenced by the dynamic factors, i.e. an increase in the injection pressure at a constant back pressure cause the transition of fuel flow from the single-phase turbulent state to cavitation (multiphase) state. The sub-stages in the cavitation are also elaborated on the basis of the injection pressure. It has been also concluded from this study that the nozzle geometry greatly influence the flow pattern and any variation in these factors can affect the nozzle flow either in negative or positive manner depending upon the overall nozzle geometry and dynamics of inside flow.

Keywords: Cavitation; Fuel Injector; Nozzle; Multiphase flow; CFD

DRYING OF CERAMIC HOLLOW BRICKS IN AN INDUSTRIAL TUNNEL DRIER: A FINITE VOLUME ANALYSIS

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Ceramic processing has been studied based on the material formulation and industrial arts used in the production of commercial products. These products are very different in size, shape, detail, complexity, material composition, structure, and cost. In the manufacturing process of buildings bricks water is added to the clay before forming to increase plasticity. After plastic forming and casting, brick must be dried, in order, to removal of the moisture prior for further processing and/or firing. If this moisture content is not removed adequately, severe stresses occurs inside the brick causing cracking and fissures reducing quality of product post-drying process. In this sense, this paper aim to study drying of industrial hollow bricks in a tunnel dryer of cross flow type. The theoretical model is based on mass and energy conservation equations applied to air and product including water condensation. To validate the methodology, numerical and experimental results for the moisture content and the temperature of brick during the drying on an industrial scale are compared and a good correlation was obtained. Results of moisture content and temperature of the product, and temperature, relative humidity and absolute humidity of drying air as a function of drying time and bed length of the dryer are presented and analysed.

Keywords: Simulation, Mass, Heat, Brick, Drying

EFFECT OF REVERSIBLE HYDROGEN TRAPPING ON CRACK PROPAGATION IN THE API 5CT P110 STEEL - A NUMERICAL SIMULATION

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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. The trapping level can modify the steel susceptibility to hydrogen embrittlement because the main effect of traps is to reduce the hydrogen transport rate through the material. Some studies show the beneficial effect of hydrogen trapping, others indicate the potential of traps to start cracks when are saturated with hydrogen. This paper presents a numerical simulation of the reversible hydrogen trapping effect on crack propagation in the API 5CT P110 steel using the damage model proposed by Bolotin & Shipkov [1]. In order to simulate the effects of hydrogen trapping in a way closer to reality, the trapping term at the diffusion equation of damage model was replaced by the equivalent term of McNab & Foster's model [2]. 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 simulation showed that the time of onset and crack growth decreases with the presence of traps in the microstructure, and increases when the trapping effect is not considered.

Keywords: Numerical Simulation; Hydrogen Trapping; Crack Propagation; API 5CT P110 Steel.

EVALUATION OF THE CONTACT SWITCH MATERIALS IN HIGH VOLTAGE POWER SUPPLY FOR GENERATE OF UNDERWATER SHOCKWAVE BY ELECTRICAL DISCHARGE

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We have developed the high voltage power-supply unit by Cockcroft-Walton circuit for ingenerate high pressure due to underwater shockwave by electrical discharge. This high voltage power supply has the problem of the metal contact switch operation that contact switch stop by melting and bonding due to electrical spark. We have studied the evaluation of materials of contact switch for the reducing electrical energy loss and the problem of contact switch operation. In this research, Carbon material is use the contact switch. Measurement of discharge voltage and high pressure due to underwater shockwave was carried out using the contact switch made of different materials. The materials of contact switches are brass plate only use, brass plate-carbon plate-brass plate and carbon block only use. As evaluation of the contact switch made of brass plate only use, the unstable discharge and variation of pressure occurs because of the roughness of the brass plate surface due to electric sparking and melting of contact. As the contact switch made of brass plate-carbon plate-brass plate has the electrical energy loss due to the roughness of the brass plate surface due to sparking and melting of brass-plate contact of double side of carbon plate. As the contact switch made of the carbon block, the stable discharge and high pressure occurs because of Carbon electrode can be kept to a flat surface in the discharge, and has the high wear-resistance. We have verified that the contact switch made of carbon block reduce the electrical energy loss and the melting of metal plates of the contact switch, is effective solve problem of contact switch operation. We have concluded that Carbon block is suitable for material of contact switch in the high voltage power-supply unit for ingenerate high pressure due to underwater shockwave by electrical discharging and sparking.

Keywords: Shockwave, Electrical discharge, power supply, Energy loss

EVALUATION OF THE EFFECT OF MECHANICAL VIBRATION ON THE LEVELS OF RESIDUAL STRESSES IN STEEL WELDED JOINTS USING AN INTERFACE MATLAB BASED ON NORM API 579

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Nowadays with the high growth of petrochemical welding technology a great development due to high manufacturing offshore structures, storage tanks of petroleum, boilers and pressure vessels for refining plants have been done. Due to various metallurgical changes and restrictions to contraction and expansion undergone by materials when subjected to welding thermal cycle, internal stresses are generated in welded joint which are nominated residual stresses. It is generally undesirable because it can lead to several problems, such as cracks, cold stress fracture, corrosion under voltage, among others. Although several studies involving residual stresses have been developed in recent years, few information's known about the variation of the residual stresses level in welded joints when subjected to the treatment of stress relief by mechanical vibration. Likewise, there are few information related to the comparison between the degree of efficiency by using the post-weld heat treatment and those treatment. Therefore, the goal of this work was to apply the relieve residual stresses treatment by mechanical vibration in ASTM A516 Gr 60 steel welded joints used in oil industry, and compare the results with those obtained by post heat treatment and evaluate the efficiency level of this technique. A graphical interface with Matlab algorithm was developed to express the permissible residual stresses for norm API 579, aiming to compare the results of the residual stresses obtained by the thermal treatments with vibration mechanical treatments. Was verified that the treatment for vibration it was better took care that the thermal treatment obtaining of maximum reduction of 48,78% for the transversal tensions and 46,53% for the longitudinal ones when compared with the tensions permissible limits for norm API 579.

Keywords: Welded Joints, Residual Stresses, API 579, Treatment by Vibrations.

MULTIPHYSICS INVESTIGATION OF COMPOSITE SHELL STRUCTURES SUBJECTED TO WATER SHOCK WAVE IMPACT IN PETROLEUM INDUSTRY

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Composites are being used for the oil and gas transportation in flow lines, gathering and distribution pipeline systems. Oil and gas transmission lines are required to be tested periodically and the maximum pressure they can be operated at can be down rated. These pipelines are generally operated at high pressures and therefore there is a need to investigate the composite materials subjected to high pressure dynamic loading. Although some work on transient pressure loading and failure of curved composite structures has been undertaken the work was restricted in several ways. Work has taken place on cylindrical composite shells subjected to external pressure loading with application to marine/submarine structures, the effect of explosion inside the shell has been studied and the failure of composite hemispheres under axial compression induced by impact with a flat plate has also been investigated. Similarly, current work presents effect of shock wave on composite shell structures using Shock Tube, MTS and FEM testing. It is found that carbon fibre laminates behave linearly in transient loading conditions. Results achieved from the shock tube experimentation, Material Test System (with both tensile and flexural testing) and the simulations proved that under dynamic loading, carbon fibre composite behaves linearly. This proves that the mechanical properties and failure mechanisms for quasi-isotropic carbon fibre composite are the same during high speed, short time dynamic shock wave loads as it is for long time static low velocity loading conditions.

Keywords: Composite, Shell, Shock Wave, MTS, FEM

NANOINDETATION AND AFM IMAGING OF RUSR2RECU2O8 (RE = EU, GD AND HO) SUPERCONDUCTORS

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Some mechanical properties of RuSr2RECu2O8 (RE = Eu, Gd and Ho) prepared by using the ammonium nitrate melt technique (ANMT) were investigated with nanoindentation technique. The indentation load-displacement curves of the samples were obtained for different peak load levels changing from 10 to 400 mN. Reduced elastic modulus and hardness values were calculated from loading-unloading curves in which these curves show peak load dependence, i.e. Indentation Size Effect (ISE). As well, ISE was analyzed by using the Modified Proportional Specimen Resistance (MPSR) model. According to the MPSR model results, we found the hardness values of RE=Eu, Gd and Ho as 0.94, 0.83 and 2.33 GPa respectively. Present results indicate that Ho substitution leads a substantial improvement in the hardness and reduced the modulus of the samples. Possible reasons of this hardness improvement were discussed with the support of XRD, SEM, AFM and EDX mapping analysis.

Keywords: Superconductors; Powder metallurgy; Indentation; Mechanical properties, Indentation Size Effect (ISE).

NUMERICAL EVALUATION OF MULTIPASS WELDING TEMPERATURE FIELD IN API 5L X80 STEEL WELDED JOINTS

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Many are the metallurgical changes suffered by the materials when subjected to welding thermal cycle of promoting a considerable influence on the welded structures-thermo-mechanical-properties. In project phase, one alternative for evaluating the welding cycle variable, would be the employment of computational methods through simulation. So, this paper presents an evaluation of the temperature field in a multipass welding of API 5L X80 steel used for oil and gas transportation, using the ABAQUS software, based on Finite Elements Method (FEM). During the simulation complex phenomena including: Variation in physical and mechanical properties of materials as a function of temperature, welding speed and the different mechanisms of heat exchange with the environment (convection and radiation) were used. These considerations allows a more robust mathematical modeling for the welding process. An analytical heat source proposed by Goldak, to model the heat input in order to characterize the multipass welding through the GTAW (Gas Tungsten Arc Welding) process on root and the SMAW (Shielded Metal Arc Welding) process for the filling passes were used. So, it was possible to evaluate the effect of each welding pass on the welded joint temperature field, through the temperature peaks and cooling rates values during the welding process.

Keywords: Multipass welding, temperature field, weld thermal cycles, finite element method, computer simulation.

OPERATION CONTROL OF FLUIDS PUMPING IN CURVED PIPES DURING ANNULAR FLOW: A NUMERICAL EVALUATION

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To generate projects which provide significant volume recovery from heavy oils reservoirs and improve existing projects, is important to develop new production and transport technologies, especially in the scenario of offshore fields. The core-flow technique is one of new technologies used to transport of heavy oil. The core-flow technique does not alter the oil viscosity, but transforms the flow pattern and reduces friction during transport of very viscous products, such as heavy oils. This flow pattern is characterized by a water pellicle that is formed close or adjacent to the inner wall of the pipe, functioning as a lubricant. The oil flows in the center of the pipe causing a reduction in longitudinal pressure drop. In this sense, this work presents a numerical study heavy oil annular flow (core-flow) assisted by computational tool ANSYS CFX Release 12.0. It was used a three-dimensional, transient and isothermal mathematical model that considers the mixture and Turbulence models to address the water-heavy oil two-phase flow, assuming laminar for oil phase e turbulent flow for water phase. Results of the distribution pressure, velocity, temperature and volume fraction as function of the phases and the pressure drop time are presented and evaluated. It was observed that the core of the flowing oil eccentrically in the pipe and stops the water flux considerably increases the pressure drop in the pipe after the restart of the pump.

Keywords: Heavy oil, transportation, water flow rate, numerical simulation.

SOLUTION OF THE TIME-DEPENDENT SCHRODINGER EQUATION FOR COUPLED HARMONIC OSCILLATOR AND GEOMETRIC PHASE

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In quantum mechanics, usually, non conservative systems are represented by time-dependent Hamiltonian. Time-dependent harmonic oscillators have attracted considerable interest in the literature thanks to their usefulness for describing the dynamics of many physical systems such as: the quantum optic, plasma physics, the fission of heavy nuclei , electric conductivity , optical resonant cavity , quantum Hall effect , tunneling problems through potential barriers , Josephson current , or quantum chaos with dissipation , In the meantime, coupled harmonic oscillators have become powerful modeling tools and, consequently, are frequently used for modeling a wide range of physical phenomena. With further progress in research, one may be interested in knowing what would happen if the two dimensional harmonic oscillator is elaborated through the coupling of two additive potentials. As far as we know, the first to deal with issue where Kim et al. [1] 30 years ago. Abdella demonstrated how to treat time dependent coupled oscillators in the context of quantum mechanics [2]. The propagator for time-dependent coupled and driver harmonic oscillator with time varying frequencies and masses was investigated by Benamira and Ghechi [3] using path integral methods, and recently, Menouar et al. [4] studied the time-dependent coupled oscillator model for the motion of a charged particle in the presence of a time-varying magnetic field by using invariant method via unitary transformation. Berry's discovery that the adiabatic geometric phase of wave function arises in adiabatic quantum process [5] opens up new opportunities for investigating the global or topological properties of quantum evolution. It is now well known that the geometric phase appears in systems with the time-dependent Hamiltonian, or in systems whose Hamiltonian possesses evolution parameters. Differing from the dynamical phase that depends on dynamical quantities of systems, the geometric phase is independent of these dynamical quantities such as energy, frequency, velocity as well as coupling coefficients. Instead, it is only related to the geometric nature of the pathway along which quantum system evolve.

Keywords: geometric phase, time-dependent Schrodinger equation, coupled harmonic oscillator

THREE-PHASE FLOW (WATER, OIL AND GAS) IN VERTICAL CIRCULAR CYLINDRICAL DUCT WITH LEAKS: A THEORETICAL STUDY BY CFD

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Pipeline is a conventional, efficient and economic way for oil transportation. However operation of pipelines is subject to failure because the action of physicochemical nature agents that eventually deteriorates part of the duct for instance corrosion and disruptions. Leakage monitoring systems in oil pipeline must be capable to detect and locate a leak quickly, reducing risks of environmental and socioeconomics impacts, contributing significantly to operational safety and cost saving in petroleum industry. When a leak occurs, the pressure wave will propagate through the pipeline depending on the position and shape of the leak. For an efficient detection, we must determine and understand the hydrodynamics of flow inside the duct in each instant of time after the occurrence of leak. In this sense, this research aims to study the three phase flow of water, oil and gas in a vertical pipe with and without leakage by CFD (ANSYS CFX). Results of the pressure, velocity and volume fraction distribution of the involved phases are present and analyzed.

Keywords: Simulation, Leakage, CFX, Fluid flow

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