NME2020&CMA2020
CONFERENCE PROGRAM

December 6-9, 2020

China Standard Time (GMT+8:00)

ONLINE-Microsoft Teams Meeting

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Part II Keynote Speeches

Keynote Speech 1: Vibration and Stability of Distributed Structural Systems

Speaker: Prof. Weidong Zhu
Department of Mechanical Engineering, University of Maryland, USA

Bio: Weidong Zhu is a Professor in the Department of Mechanical Engineering at the University of Maryland, Baltimore County, and the founder and director of its Dynamic Systems and Vibrations Laboratory and Laser Vibrometry Laboratory. He received his double major BS degree in Mechanical Engineering and Computational Science from Shanghai Jiao Tong University in 1986, and his MS and PhD degrees in Mechanical Engineering from Arizona State University and the University of California at Berkeley in 1988 and 1994, respectively. He is a recipient of the 2004 National Science Foundation CAREER Award. He has been an ASME Fellow since 2010, was an Associate Editor of the ASME Journal of Vibration and Acoustics from 2007-2014 and is a Subject Editor of the Journal of Sound and Vibration. His research spans the fields of dynamics, vibration, control, applied mechanics, metamaterials, structural health monitoring, and wind energy, and involves analytical development, numerical simulation, experimental validation, and industrial application. He has published 180 SCI-indexed journal papers in these areas.

Abstract of the speech: Some interesting results on the dynamics of continuous systems are reviewed. They involve: 1) vibration and stability of translating media with time-varying lengths and/or velocities; 2) nonlinear vibrations of systems with large degrees of freedom and general nonlinearities; 3) new spatial discretization and substructure methods for one- and two-dimensional continuous systems; and 4) new formulations of flexible multibody dynamics with application to elevator traveling cables. Two types of dynamic stability problems are addressed from the energy viewpoint in the first area: dynamic stability of translating media during extension and retraction, and parametric instabilities in continuous systems with periodically varying lengths and/or velocities. The incremental harmonic balance method is used and modified in the second area to handle periodic responses of high-dimensional models of nonlinear continuous systems and their stability and bifurcations, as well as quasi-periodic responses. The new spatial discretization and substructure methods in the third area ensure that all matching conditions of continuous systems are satisfied, and hence uniform convergence of solutions. New nonlinear models of slack cables with bending stiffness and arbitrarily moving ends are developed for moving elevator traveling cables in the fourth area. Some experimental results are presented to validate theoretical predictions.

Keynote Speech 2: An Integrated Material-structural Approach for Multi-durability Impacts to Concrete Structures

Speaker: Prof. Fuyuan Gong
College of Civil Engineering and Architecture, Zhejiang University, China

Bio: Dr. Fuyuan Gong graduated from Tsinghua University (China) for his bachelor's degree, and then got the master's and Doctor's Degree from Hokkaido University (Japan). After that, Dr. Gong worked as a post-doctor researcher in The University of Tokyo and then moved to Yokohama National University as the Assistant Professor. Currently Dr. Gong is working as the "ZJU 100 Talents" Professor in College of Civil Engineering and Architecture, Zhejiang University. His research interests include concrete durability; thermodynamics, poromechanics and micromechanics for porous material; computational modeling; lifetime assessment, etc. In the last 5 years, Dr. Gong has published 26 journal papers which are indexed by SCI and has been selected as the JSPS (Japan Society for the Promotion of Science) Research Fellow (2014 - 2016), and visiting scholar in Princeton University (2012). He has also been awarded the Japan Concrete Institute (JCI) Award in 2014, and "Achievement Award for Young Engineers" by fib (The International Federation for Structural Concrete) in 2017. Currently, Dr. Gong serves as the Associate Editor of Journal of Advanced Concrete Technology (SCI) and International Journal of Structural Engineering (Scopus).

Abstract of the speech: Concrete structures always suffer multi-durability impacts which can significantly reduce their service lives, such as fatigue loads, corrosion, alkali silica reaction (ASR), freeze-thaw cycles (FTC), condensed water and so on. In addition, those deteriorations are usually coupled simultaneously or sequentially in terms of physical, chemical and mechanical process, which cannot be predicted simply by the design formula. To capture those interactive effects, multi-scale modeling can be beneficial because the chemo-physical mechanisms can be modeled properly at the material level while the nonlinear mechanical performance can be simulated at structural level. This talk introduces such a numerical platform for the above-mentioned deteriorations in consideration of the mutually interacting processes. The proposed model attempts to cover the most essential aspects, from thermo-chemo coupling at micro-scale to the poro-mechanical coupling at meso-scale, and finally leads to the coupled fracture of structural concrete at macro-scale. This multi-physical and multi-scale coupling model can provide a platform, on which the coupled complex damages to structural concrete are consistently dealt with for damage assessment of structural concrete.

Keynote Speech 3: Finite Element Analysis of FRP-strengthened RC Structures

Speaker: Prof. Guangming Chen
School of Civil Engineering and Transportation, South China University of Technology, China

Bio: Dr. Guang-Ming Chen is a Professor in School of Civil Engineering and Transportation, South China University of Technology (SCUT). He obtained his bachelor and master degrees both from Huazhong University of Science and Technology (HUST), and his PhD from Hong Kong Polytechnic University. Before taking the current role, he worked as a Professor in Guangdong University of Technology (GDUT). He also worked in University of California at Berkeley as a one-year visiting scholar during 2015-2016. Prof. Chen has been the PIs for four NSFC projects, including one young scholar project and three general projects. He was elected as "outstanding young teacher" of Guangdong Province in 2014. He is now a council member of the International Institute of FRP in Construction (IIFC) and an external reviewer of National Natural Science Foundation of China (NFSC). He is now the Associated Editor of international journal Advances in Structural Engineering and Guest Associate Editor of the international journal Frontier in Materials, and serves as reviewers of a number of reputable international journals such as Journal of Structural Engineering, ASCE, Journal of Composites for Construction, ASCE, Engineering Structures, Construction and Building Materials, Composite Structures etc. His main research areas focus on use of fiber reinforced polymer (FRP) in construction (structural strengthening and new structures) and use of recycled concrete aggregate concrete (RAC) in construction. He has published over 60 peer reviewed journal and conference papers (with an H-index of 20 in Google Scholar).

Abstract of the speech: Failure of reinforced concrete (RC) members (such as beams, slabs) strengthened with externally bonded fiber-reinforced polymer (FRP) is usually governed by the debonding between FRP and concrete, which is associated with the cracking behaviour of the strengthened RC members. In experimental studies, it is usually difficult to capture such debonding failure due to its brittle and quick nature. The finite element (FE) method is a useful tool for investigating the failure mechanisms and processes of such debonding failure. This lecture provides a review of existing FE studies on FRP-strengthened RC structures, including but not limited to the research work done by the authors' research group in the past decade. Key issues in the FE analysis of the debonding failure are discussed, based on which, an advanced FE model capable of predicting the failure mode and failure process of FRP debonding is introduced. A dynamic approach developed by the authors' research group to overcome the difficulties in achieving numerical convergence, which is usually associated with FRP debonding and concrete cracking, is also presented. The proposed FE modeling approach has been successfully used to accurately simulate the intermediate crack (IC) debonding failure of RC beams strengthened in flexure with FRP plates, failure of FRP-plated beams with end-anchorages, failure of RC beams shear-strengthened with FRP and debonding failure of FRP-concrete bonded joints. Some numerical results are presented as examples to substantiate the accuracy of the proposed approach.

Keynote Speech 4: Multi-scale Numerical Investigation on the Whole PM Process of High-performance Pure W and W-Cu Alloy

Speaker: Prof. Xizhong An
School of Metallurgy, Northeastern University, China

Bio: Dr. Xizhong An got his Ph.D degree from University of Science and Technology Beijing (USTB) in 2002, and currently he is working as a full professor and director of Institute of Particle Technology in School of Metallurgy, Northeastern University (NEU). Prof. An's research interests include numerical and physical studies on particle packing, powder processing, granular matter, powder metallurgy, additive manufacturing, material design and optimization, etc. In recent years, he has undertaken more than 30 projects from overseas, Chinese government, local government, and enterprises. More than 120 papers were published, including one book chapter and >90 SCI journal papers in Physical Review Letters, Soft Matter, Powder Technology, Journal of Alloys and Compounds, Europhysics Letters, Computer Physics Communications, Chemical Engineering Science, Nanotechnology, European Physical Journal E, Applied Physics A, AIP Advances, RSC Advances, Sensors & Actuators: B. Chemical, Metals, Applied Surface Science, Advanced Powder Technology, Metallurgical and Materials Transactions A, Metallurgical and Materials Transactions B, Granular Matter, Particuology, Engineering Applications of Computational Fluid Mechanics, Particulate Science and Technology, Engineering Analysis with Boundary Elements, Journal of Mining and Metallurgy Section B: Metallurgy, Nanoscale Research Letters, Journal of Nanoscience and Nanotechnology, Materials Chemistry and Physics, Computer & Fluids, Catalysts, Diamond and Related Materials, Materials Science and Technology, Polish Journal of Environmental Studies, Chinese Physics Letters, International Journal of Minerals, Metallurgy, and Materials, Mathematical Problems in Engineering, et al. More than 30 Chinese patents were applied, where 13 of them were authorized. His honors and awards include: Candidate for "Liaoning Hundred, Thousand, and Ten Thousand Talents Engineering", Hundred Level (2009); Candidate for "New Century Outstanding Talents" of Ministry of Education of China (2010); "Outstanding Scientific and Technological Worker" of Liaoning province (2014); "Longchuan Talent" of Yangzhou City, China (2015); "Shuangchuang Doctor" of Jiangsu Province (2016); "Science and Technology Progress Award (second prize)" of Chinese Society of Particuology (2016); "Leading Talent" of Shenyang (2017); "Natural Science Award (second prize)" of Chinese Society of Particuology (2018); "Liaoning Revitalization Talents Program -Leading Talent of Hundred, Thousand, and Ten Thousand project" of Liaoning Province (2018). He is the executive director of National Materials New Technology Development Research Institute; Director of Chinese Society of Micro-Nano Technology; Youth Director of Chinese Society of Particuology; Director of Liaoning Society of Particuology. Member of editorial board for many domestic and international journals.

Abstract of the speech: With the problems in the current powder metallurgy (PM) production of high-performance pure tungsten (W) metal and its alloy like tungsten-copper (W-Cu), comprehensive multi-scale

dynamic simulations on the whole PM process (including die filling, compacting and sintering) of elemental W and composite W/Cu powders were performed by using the coupled discrete element method (DEM) and finite element method (FEM). The effects of operating conditions, processing parameters, powder properties as well as their initial packing structures on the powder densification behaviour in each PM stage were systematically investigated. And the macroscopic and microscopic properties of the W and W-Cu compacts/sintered parts obtained from different PM stages were quantitatively characterized and compared. Meanwhile, corresponding densification dynamics and mechanisms in each PM stage were discussed and analysed based on the force/stress evolution. Numerical simulation results indicate that by properly controlling the operating conditions and processing parameters, high-performance pure W metal and W-Cu alloy can be numerically reproduced by PM technique. Different processing methods can lead to the difference of powder densification dynamics and mechanisms in each PM stage. Compared with the traditional simulation method, the coupled DEM and FEM approach can realize the multi-scale simulation of the whole PM production process of pure W and W-Cu alloy. It can not only solve the deficiency in current physical experiments and numerical simulations, but also make the simulation results more accurate and much closer to the real process.

Keywords: Powder metallurgy, multi-scale simulation, pure W metal and W-Cu alloy, structure characterization, densification behaviour and mechanism

Acknowledgements: The authors are grateful for the financial support from National Key Development Program of the Ministry of Science and Technology of China (2017YFB0305603), Liaoning Revitalization Talents Program (XLYC1805007), and Shenyang Young and Middle-aged Science and Technology Innovation Talent Support Program (RC170512).

Part III Oral Presentations

Oral Presentation Guidelines

- Online Oral Presentations will be conducted via Microsoft Teams Meeting (Click here to join NME2020&CMA2020 via Teams)
- All presenters are requested to reach the Online Session Room prior to the schedule time and complete their presentation on time.
- All presentations are scheduled in China Standard Time (GMT+8).
- If a presenter is not able to show up via Teams, the session chair / conference secretary will download and play the pre-recorded video presentation during his/her scheduled presentation time, if listeners have questions about the presentation, please contact the conference secretary to forward the questions.
- Signed and stamped electronic presentation certificate would be issued via e-mail after presentation.

Best Oral Presentations Selection

Selection Criteria:

The session chair will select one best oral presentation from his/her session based on the following criteria:

✓ Research Quality

✓ Presentation Performance

✓ Presentation Language

✓ PowerPoint Design

Session 1: Metals and Alloys

Please Click http://www.academicconf.com/teamslink?confname=nme2020 to enter the conference meeting room.

Session Chair: Dr. Changming Fang, Brunel University London, United Kingdom

Time: 14:00-17:35, Monday, December 7, 2020

14:00-14:20	CMA1099	An Investigation into The Phenomenon of Macroscopic Plastic Deformation Localization in Metals *Dr. Pierre Darry Versaillot, School of Engineering, RMIT University, Australia*
14:20-14:40	CMA1122	Influence of Alloying Elements X on ω-phase Stability in Ti–Nb–X Alloys from First-Principles Calculations *Prof. Tokuteru Uesugi, Osaka Prefecture University, Japan*
14:40-14:55	CMA1092	Effect of Applied Strain Rate on the Mechanical Properties of the Stainless Steel SUS316LN Bearing Heterogeneous-nano Structure *Mr. Hua Jiang, Kanazawa University, Japan*
14:55-15:15	CMA1105	Effects of V-substitution on Thermoelectric Properties of Pseudogap Intermetallic TiNiSi Compound *Ms. Yi Huang, Tohoku University, Japan*
15:15-15:35	CMA1127	Determination of True Stress Strain Characteristics of Structural Steels Using Instantaneous Area Method *Dr. Ho Ho-Cheung, The Hong Kong Polytechnic University, Hong Kong, China*
15:35-15:50		**COFFEE BREAK**
15:50-16:15	CMA1128 *(Invited Talk)*	Recognizing the Bifilm Defects in Casting *Assoc. Prof. Lunyong Zhang, Harbin Institute of Technology, China*
16:15-16:40	CMA1131 *(Invited Talk)*	Impact of Plasma-based Processes in Surface Modification of Titanium Alloys and Polymeric Substrates for Applications in Orthopaedics *Assoc. Prof. Karol Kyziol, AGH University of Science and Technology, Poland*
16:40-17:00	CMA1126	The First-principle Study of TiPtHf for High Temperature Shape Memory Alloys Applications *Dr. M P Mashamaite, University of Limpopo, South Africa*
17:00-17:20	CMA1129	Si Solutions in Al-rich FeAl Intermetallic Compounds from First-principles Calculations *Dr. Changming Fang, Brunel University London, United Kingdom*
17:20-17:35	CMA1121	Microstructure Evolution and Sintering Kinetics of Ti (C, N)-based Cermet *Dr. Shuiqing Xiao, Lingnan Normal University, Zhanjiang Guangdong, China*

Abstracts of Session 1

CMA1099 To avoid repeatability issue, this abstract will be available after the full paper is published in the conference proceedings.

CMA1122 To avoid repeatability issue, this abstract will be available after the full paper is published in the conference proceedings.

CMA1092

Effect of Applied Strain Rate on the Mechanical Properties of the Stainless Steel SUS316LN Bearing Heterogeneous-nano Structure

Hua Jiang[1], Yoji Miyajima[2], Chihiro Watanabe[2,], Yoshiteru Aoyagi[3], Masakazu Kobayashi[4], Hiromi Miura[4].*
[1]Graduate School of Natural Science and Technology, Kanazawa University, Japan
[2]Insititute of Science and Engineering, Kanazawa University, Japan
[3]Department of Finemechanics, Tohoku University, Japan
[4]Department of Mechanical Engineering, Toyohashi University of Technology, Japan

Abstract. The heterogeneous-nano (hetero-nano) structure consisting of rhombic deformation twin domains, conventional lamellar grains and shear bands was formed in SUS316LN steels during the heavy cold rolling. The steels bearing such the hetero-nano structure exhibited a superior balance of strength and ductility. Tensile tests of the steels under different strain rates of $\dot{\varepsilon}$=10^{-4}~10^{-2} s^{-1} were examined at room temperature. In-situ X-ray diffraction (XRD) measurements were also conducted during the tensile tests. The strength and ductility were simultaneously increased with increasing applied strain rates. By the application of the modified Williamson-Hall Method and the modified Warren-Averbach Method to the XRD profiles, the developments of dislocation density were obtained. Moreover, using the Warren and Cohen methods to the XRD profiles, the probabilities of stacking faults and twins were estimated, respectively. The dislocation density and twin probability became higher with increasing applied strain rate. The formation of a high density of deformation twins was also confirmed by observations by transmission electron microscopy in the specimens after tensile tests. Thus, it can be concluded that the superior balance of strength and ductility in the hetero-nano structured steels would be ascribed to the activation of the twinning induced plasticity effect.

Keywords: heterogeneous-nano structure, SUS316LN stainless steel, in-situ XRD, dislocation density, deformation twin

CMA1105

Effects of V-substitution on Thermoelectric Properties of Pseudogap Intermetallic TiNiSi Compound

Yi Huang, Hiroki Nagai, Kei Hayashi, and Yuzuru Miyazaki[*]
Department of Applied Physics, Graduate School of Engineering, Tohoku University, Japan

Abstract. Thermoelectric (TE) materials are of interest for applications as power generators. We theoretically and experimentally investigated the TE properties of TiNiSi-based solid solutions with a pseudogap at the Fermi level in the electronic band structure. Calculated TE properties of TiNiSi predicted that electron-doping leads to a higher power factor than hole-doping. According to this prediction, we prepared the partially V-substituted TiNiSi-based samples ($Ti_{1-x}V_x$) NiSi (x = 0, 0.05, 0.10, 0.15, and 0.20) using arc-melting and

subsequent spark plasma sintering. An increase in the V content x improved the n-type TE properties: the absolute values of the Seebeck coefficient and electrical conductivity both increased, while the thermal conductivity slightly decreased. The highest dimensionless figure-of-merit, zT, was 0.032 at 600 K, obtained for the $x = 0.20$ sample.

Keywords: TiNiSi-type compound, thermoelectric property, Pseudogap, electronic structure

CMA1127 To avoid repeatability issue, this abstract will be available after the full paper is published in the conference proceedings.

CMA1128
Recognizing the Bifilm Defects in Casting

Lunyong Zhang
Harbin Institute of Technology, China

Abstract. Bifilm defect in casting was proposed by the famous scholar Prof. John Campbell about thirty years ago and has attracted numerous investigations coming from the community because it is deemed as the precursor of various macroscopic metallurgical defects and is widely discovered in different metallic systems. However, many aspects of bifilm defects such as morphology, composition and control process have never been explored in a state that they are kept inner of the casting (in-situ) so far, this prohibits the understanding of formation and evolution behaviors and mechanisms of them. The present talk will discuss these points based on our recent works of using varied advanced characterization techniques and studying methods to investigate the bifilms discovered in varied specific alloy castings. These results aroused updated understanding of bifilm defects in casting.

Keywords: casting bifilm defects, morphology, structure, 3D CT, process control

CMA1131
Impact of Plasma-based Processes in Surface Modification of Titanium Alloys and Polymeric Substrates for Applications in Orthopaedics

Karol Kyzioł
AGH University of Science and Technology, Faculty of Materials Science and Ceramics, Poland

Abstract. Aims: The work presents the obtained results of the selected physicochemical, corrosion and biological properties of Ti6Al7Nb, NiTi and PE substrate after surface modification. During the experiments the PE CVD (*Plasma Enhanced Chemical Vapour Deposition*) method, as well as deposition of biopolymers (based chitosan coatings (CS)) using the immersion method was applied.
Methods: In the experimental part the different type and multi-system, based on DLC structure, were investigated. Additionally, the selected substrates were chemically treated or functionalized by plasmochemical process before coatings deposition. Typical techniques for materials engineering such as scanning electron microscopy with EDS analysis, AFM, optics profilometry, IR spectroscopy, ICP-MS and nanoindentation method were applied. Moreover, biological activity was also studied.
Results: It can be concluded that the obtained biopolymeric coatings (CS with or without Me_NPs) provide an efficient barrier to impede the out-diffusion of titanium and nickel ions. In the case of PE substrate modified

by DLC: N/DLC multi-layers we observed the positive influence on the mechanical properties and biological activity.
Conclusions: In the case of PE and Ti-based substrates, this is the main goal of current scientific research focused on surface modifications to increase its safe medical application.

Acknowledgements: This work has been supported by Polish National Center for Science, NCN, grant decision DEC-2017/01/X/ST8/00886.

CMA1126 To avoid repeatability issue, this abstract will be available after the full paper is published in the conference proceedings.

CMA1129
Si Solutions in Al-rich FeAl Intermetallic Compounds from First-principles Calculations

Changming Fang, Zhongping Que and Zhongyun Fan*
BCAST, Brunel University London, United Kingdom

Abstract. Al-rich Fe-intermetallic compounds (Fe-IMC), including θ-$Al_{13}Fe_4$ and β-AlFeSi form during the casting processes of most Al alloys. Si is added to Al alloys to improve the mechanical performances of the products. These Fe-IMCs have nontrivial impacts on the mechanical performances of the solidified Al-based parts. Here, we investigate systematically Si solution in the Al-rich Fe-IMCs, Al_6Fe, θ-$Al_{13}Fe_4$ and β-AlFeSi using *ab initio* density-functional theory (DFT). We reveal i) Si prefers not doping in Al_6Fe; ii) Si prefer substitution on two Al sites (Al9 and Al8) in θ-$Al_{13}Fe_4$, forming θ-$Al_{70}(Si,Al)^{IX}{}_4(Al,Si)^{VIII}{}_4Fe_{24}$ (the Roman numerals represent the Al sites (Grin et al., 1994), iii) Si prefers solution in either Al1 or Al6 site in β-AlFeSi, forming β-$Al_{4.5}Si^{I}Fe$ or β-$Al_{4.5}Si^{VI}Fe$. The Si solution strongly stabilises β-AlFeSi that it become more stable than the θ-phase. The knowledge obtained here is useful to get insight into the formation and structural and chemical properties of the Fe–Al–Si intermetallic compounds and to optimise the microstructures and properties of the solidified Al based alloys.

CMA1121 To avoid repeatability issue, this abstract will be available after the full paper is published in the conference proceedings.

Session 2: Civil Engineering

Please Click http://www.academicconf.com/teamslink?confname=nme2020 to enter the conference meeting room.
Session Chair: Prof. Junfeng Zhang, Bharti School of Engineering, Laurentian University, Canada

Time: 09:00-12:20, Tuesday, December 8, 2020

09:00-09:15	NME1230	Thermal Performance on the Influence of Filling Ratio of an Acetone Thermosyphon Through Numerical Modelling *Dr. Chao Wang, Guizhou University, China*

09:15-09:30	NME1238	Experimental and Numerical Study of the Effects of Ullage Height on Plume Flow and Combustion Characteristics of Heptane Pool Fires *Dr. Chunxiang Liu, University of Science and Technology of China, China*
09:30-09:45	NME1239	Numerical Analysis of the Effect of Fuel Load on Downward Flame Spread *Dr. Xianli Zhu, University of Science and Technology of China, China*
09:45-10:00	NME1245	The Behavior Validation of Bamboo Reinforced Concrete Beam Using the Finite Element Method (FEM) and Artificial Neural Networks (ANNs) *Dr. Muhtar, University of Muhammadiyah Jember, Indonesia*
10:00-10:25	NME1248 *(Invited Talk)*	Accuracy Improvement for Immersed Boundary Method Using Lagrangian Velocity Interpolation *Prof. Junfeng Zhang, Bharti School of Engineering, Laurentian University, Canada*
10:25-10:45	**COFFEE BREAK**	
10:45-11:05	NME1251	Lagrangian Gradient Smoothing Method (L-GSM): A Novel Meshfree Method for Large Deformation Problems Simulation *Dr. Zirui Mao, Texas A&M University, USA*
11:05-11:25	NME1253	Model Updating for Nam O Bridge in Vietnam Using Krill Herd Optimization Algorithm *Mr. Hieu Tran Nguyen, Faculty of Engineering and Architecture, Ghent University, Belgium*
11:25-11:45	NME1277	Prediction of Microstructure and Hardness for Low Carbon Steel WAAM component by FEM Numerical Simulation *Dr. Ling Yong, Soete Lab UGent, Belgium*
11:45-12:00	NME1268	Simulation of Automotive/Aircraft Fuel Systems with Complex 3D Tank Geometries Using a 1D Flow Solution *Dr. Arpit Tiwari, Gamma Technologies, LLC., USA*
12:00-12:20	NME1273	Open FOAM for the Non-Newtonian Fluid Dynamics *Dr. Noor Muhammad, Texas A&M University, USA*

Abstracts of Session 2

NME1230 To avoid repeatability issue, this abstract will be available after the full paper is published in the conference proceedings.

NME1238
Experimental and Numerical Study of the Effects of Ullage Height on Plume Flow and Combustion Characteristics of Heptane Pool Fires

Chunxiang Liu, Jie Ji,

State Key Laboratory of Fire Science, University of Science and Technology of China, China

Abstract. Aims: This study aims to investigate the effects of ullage height (distance between the fuel surface and the container upper rim), on one of the most important boundary conditions, on plume flow and combustion characteristics of heptane pool fires.
Methods: A series of experiments were systematically conducted to obtain the evolutions of flame shape, plume centerline temperature, and flame oscillation frequency under different ullage height conditions. Three-dimensional large eddy simulation (LES) model was systematical validated by the above experimental results and was applied to reveal the plume flow, combustion characteristics, and underlying physical mechanisms.
Results: In terms of the dynamic of the flame base with respect to the pool upper rim, three classes are identified, namely, *Class I:* Flame base anchoring around the pool upper rim; *Class II*: Flame base entering into the pool but not merging; *Class III*: Flame base entering into the pool and merging. Accordingly, three plume flow patterns are first revealed. It is also found that the percentage of premixed combustion is increased with ullage height.
Conclusions: Ullage height has significant effects on the plume flow and combustion characteristics of heptane pool fires. Absolute negative pressure within the pool increases with ullage height and drives the surrounding air into the pool. Three classes of flame characteristics and plume flow patterns could be classified under different ullage height conditions. The flame contains more premixed combustion with higher ullage height.

Acknowledgements: This work was supported by the National Natural Science Foundation of China (NSFC) under Grant No. 51722605. The authors would like to express their thanks to Dr. Mehdi Jangi for his constructive suggestions for this work.

NME1239 To avoid repeatability issue, this abstract will be available after the full paper is published in the conference proceedings.

NME1245

The Behavior Validation of Bamboo Reinforced Concrete Beam Using the Finite Element Method (FEM) and Artificial Neural Networks (ANNs)

Muhtar
Faculty of Engineering, University of Muhammadiyah Jember, Jember, Indonesia

Abstract. Aims: This study aims to validate the behavior of BRC beams and SRC beams from experimental results using the finite element method (FEM) and Artificial Neural Networks (ANN) method. Validation is carried out on the load vs. deflection relationship, the crack pattern, and the stress that occurs.
Methods: The specimens used 21 single reinforced concrete beams consisting of 20 BRC beams and one SRC beam. The size of the beams is 75 mm x 150 mm x 110 mm. The beams were tested using the four-point load method.
Results: The test results show that the BRC beam and the SRC beam have different behavior, especially in the crack distribution patterns and and the stress coordinates that occur. The deflection of BRC beams is greater when compared to SRC beams.
Conclusions: The BRC beams have an elastic limit point and lower stiffness than SRC beams. The advantages of BRC beams are that they have elastic properties and high energy absorption.

Acknowledgements: This research was supported by the Directorate of Research and Community Service, the Directorate General of Research and Technology Strengthening and Development of the Ministry of Education and Culture of the Republic of Indonesia or DRPM of the Republic of Indonesia.

NME1248

Accuracy Improvement for Immersed Boundary Method Using Lagrangian Velocity Interpolation

Junfeng Zhang
Bharti School of Engineering, Laurentian University, Canada

Abstract. The immersed boundary method (IBM) has been extensively utilized in computational fluid dynamics (CFD) for various systems, such as flow-structure interaction, cell/particle dynamics, microorganism swimming, insect (butterflies, dragonflies, etc.) flight, and blood flows through heart valves. There are two key steps in IBM, namely the force distribution and velocity interpolation steps; and the kernel function ϕ plays important roles in both steps. The purpose for the velocity interpolation is to enhance the no-slip condition between fluid and boundary surface. However, with the kernel function designed to satisfy the basic requirements for the force distribution, the boundary velocity calculation process in traditional IBM simulations is actually a weighted averaging operation instead of an interpolation. This induces large errors in the calculated boundary velocity for general nonlinear velocity distributions. In this paper, we propose to release the kernel function's role from the boundary velocity calculation, and replace it with the classical Lagrangian interpolation schemes to obtain the boundary velocity from the local flow field. This idea has been tested in several two-dimensional periodic systems, and both flat and curved surfaces and steady and unsteady flows have been considered. Our simulation results show that in general a 20%~30% accuracy improvement in velocity and flow-structure interaction can be achieved with no extra cost in computational complexity and efficiency, thanks to the simple mathematical formulation and computational algorithm.

NME1251

Lagrangian Gradient Smoothing Method (L-GSM): A Novel Meshfree Method for Large Deformation Problems Simulation

Zirui Mao
Texas A&M University, USA

Abstract. The traditional Finite Element Method has been widely known suffers from some challenges in handling large deformation problems due to the severe mesh distortion. From this viewpoint, the meshfree methods, like Smoothed Particle Hydrodynamics (SPH) and Material Point Method (MPM) have huge advantages over the conventional grid-based methods. However, the meshfree methods are always relatively weak in the stability condition and computational efficiency. We developed a novel meshfree method, L-GSM, by employing a robust gradient smoothing strategy. L-GSM is proven owning much better stability condition and computational efficiency than the most widely used SPH meshfree method, meanwhile, possessing excellent adaptability to large-deformation problems. It has been applied successfully to address some large-deformation free surface flows in geotechnical engineering and hydrodynamics.

NME1253

Model Updating for Nam O Bridge in Vietnam Using Krill Herd Optimization Algorithm

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Abstract. Aims: Creating the numerical model with high accuracy for Nam O bridge in Vietnam
Methods: In order to get a high-fidelity model for Nam O bridge, Finite Element method combined with Krill Herd optimization algorithms solves this problem.
Results: The Nam O bridge's numerical model with high accuracy is created.
Conclusions: In this paper, the finite element model of the Nam O bridge in Vietnam will be built after model updating process. In the process, Krill Herd algorithms is used for updating uncertain parameters. As a result, the high accuracy model gives the closest correspondence between numerical model and experimental measurement.

Acknowledgements: The authors acknowledge the financial support of VLIR-OUS TEAM Project, VN2018TEA479A103, 'Damage assessment tools for Structural Health Monitoring of Vietnamese infrastructures', funded by the Flemish Government.

NME1277

Prediction of Microstructure and Hardness for Low Carbon Steel WAAM component by FEM Numerical Simulation

Ling Yong
Soete Lab UGent, Belgium

Abstract. Aims: To develop a numerical tool that is suitable to define an optimized strategy for WAAM (wire arc additive manufacturing) processing is one goal of this research project. The parameters of WAAM processing have important effects on the qualities of the components. For instance heat input, inter layer cooling, and wire composition directly influence on the microstructure or phase formation, ultimate mechanical properties as well as functionality of WAAM steel components. Methods: A three dimensional FEM thermo-metallo-mechanical thin wall model was built for numerical simulations. The modified Godak model for thermal behavior and the thermodynamics-based metallurgical model for analyzing microstructure and phase volume fractions are applied to WAAM process through impalement user subroutines of ABAQUS CAE. It is capable of predicting the distribution of phase volume fractions and hardness of a low alloy steel component by WAAM processing. Results: A series of numerical simulations of thermal and phase volume fraction distribution on the WAAM low carbon steel wall have been done. By comparing to experimental data and the results of mechanical properties calculated in commercial software JmatPro the strategy for WAAM processing will be defined. Conclusions: Numerical simulation is an efficient algorithm to replace real intensive experiments to obtain optimal parameters and to determine a strategy for WAAM. The challenge is to reduce the time for preforming the calculations and to speed up the computations.

Keywords: WAAM, FEM simulation, modelling, metallurgy, additive manufacturing

NME1268

Simulation of Automotive/Aircraft Fuel Systems with Complex 3D Tank Geometries using a 1D Flow Solution

Arpit Tiwari
Gamma Technologies, LLC., USA

Abstract. Fuel system simulation is of critical importance to avoid starvation in the propulsion system. The fuel system, however, involves multiple 3D tanks moving in complicated trajectories that are difficult to simulate and typically require computationally expensive 3D CFD for accurate prediction. The multiphase dynamics involved inside the tank further complicates and slows down the simulation. The computational challenges in solving the 3D dynamics of the entire fuel system make reduced-order modeling (0D/1D) attractive for system simulation. However, such approaches are often too simplified, which makes them suitable only for limited applications. There is thus a need for a fast and efficient solution to explore the fuel system design space. We present such an approach in this presentation. The method solves multiphase compressible Navier-Stokes equations in the entire system, including inside the tanks. Efficiency comes from 0D/1D reduction of the flow dynamics, planar modeling of the gas-liquid interface, and fast and robust implicit time marching. The reduction is performed such that important dynamical details are preserved. In particular, the approach accurately captures the location and orientation of the liquid surface inside 3D tanks with an accounting of surface angle variations due to gravity and aircraft acceleration. Among other benefits, this allows accurate determination of the composition of the phases leaving a port. The exit of two phases through a port is fully supported by the underlying multiphase flow-system solver, which is itself embedded in the multi-physics solver of GT-SUITE. The ultimate outcome is a fast and efficient simulation of the entire propulsion system. We first validate the accuracy and efficiency of the overall approach and then demonstrate its capability for realistic automotive and aircraft simulations.

NME1273
Open FOAM for the Non-Newtonian Fluid Dynamics

Noor Muhammad[1,2]
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[2]*Department of Mathematics, Quaid-i-Azam University, Pakistan*

Abstract. This article explains the non-Newtonian fluid simulations via Open-FOAM. The nonNewtonianIcoFoam solver is used for the simulation of the non-Newtonian fluid flow. High resolution mesh is used for the simulation of flow around the cylinder. The article focuses on the implementation and functionality of the code of the non-Newtonian Power law equations. Some basic information about OpenFOAM is also presented in the manuscript. The method used in the analysis for the simulation of the problem in the article is Finite Volume Method (FVM). The simulations of the problem are demonstrated via graphs and animated videos. The flow analysis made by OpenFOAM states the behavior of velocity field when the fluid hit the obstacle. The animated videos further include the behavior of velocity in the leaving zone of cylinder obstacle. The clear view of fluid flow can be seen far from the cylindrical object.

Keywords: nonNewtonianIcoFoam, non-Newtonian fluid, finite volume method

Session 3: Materials Science and Engineering

Please Click http://www.academicconf.com/teamslink?confname=nme2020 to enter the conference meeting room.

Session Chair: Dr. Min Haonian, South China University of Technology, China

Time: 14:00-17:15 Tuesday, December 8, 2020

14:00-14:10	NME1207	The Inverse Design and Optimization for Composite Materials with Random Uncertainty *Dr. Shufang Song, Northwestern Polytechnical University, China*
14:10-14:25	NME1232	Influence of Different Materials of Electric Vehicle Body on Low Frequency Electromagnetic Exposure for Driver *Dr. Xuwei Dong, Lanzhou Jiaotong University, China*
14:25-14:45	NME1274	Development of Controlled Heating for Fatigue Test in Overhead Conductors at High Temperature *Dr. Elizete Rocha Costa, University of Brasília, Brazil*
14:45-15:10	NME1263 *(Invited Talk)*	Numerical Methods Preserving Multiple Hamiltonians for Stochastic Poisson Systems *Assoc. Prof. Lijin Wang, University of Chinese Academy of Sciences, China*
15:10-15:25	NME1227	Coupled Thermomechanical Analysis of Stress Distributions in a Ceramic Matrix Composites Turbine Vane Considering the Anisotropic Properties *Dr. Guangwu Fang, Anhui University of Technology, China*
15:25-15:40		**COFFEE BREAK**
15:40-15:55	NME1278	Thermal Response of Low-E and Float Glass Facades Under Various Heating Rates *Dr. Wei Lu, University of Science and Technology of China, China*
15:55-16:15	NME1262	Wave Propagation Analysis Based on Periodic Homogenization of Materials with Microstructure Towards Viscoelastic Strain Gradient Effective Media *Dr. Yosra Rahali, Université de Rouen, France*
16:15-16:30	NME1272	Overview of Applications Networks: From Neurons to Circuits *Prof. Kelly Cristiane Iarosz, Federal University of Technology, Brazil*
16:30-16:45	NME1255	Elastic-plastic Finite Element Analysis of Metallic Bellows *Dr. Aakash, Homi Bhabha National Institute, India*
16:45-17:00	NME1250	Extracting the Macroscopic Failure Surface of Materials Involve Microscopic Defects Using Computational Homogenisation Method

		Dr. Ahmad Akbari, Azad University of Kermanshah (IAUKSH) Kermanshah, Iran
17:00-17:15	NME1283	Paradox of Fatigue of Perfect Soft Metals in terms of Energy Dissipation on Micro Plasticity and Damage *Dr. Isaak Blechman, Israel Institute of Technology, Israel*

Abstracts of Session 3

NME1207 To avoid repeatability issue, this abstract will be available after the full paper is published in the conference proceedings.

NME1232 To avoid repeatability issue, this abstract will be available after the full paper is published in the conference proceedings.

NME1274
Development of Controlled Heating for Fatigue Test in Overhead Conductors at High Temperature

Elizete Rocha Costa, José Alexander Araújo, Luiz Augusto C. M.Veloso, Cosme Roberto Moreira da Silva, Jorge Luiz A. Ferreira*
Fatigue Fracture and Materials Research Group (GFFM), University of Brasília (UnB), Brazil

Abstract. The objective of this work was to evaluate the influence of elevated temperature on the fatigue resistance of an all-aluminum conductor (AAC). A dispositive was developed to reach temperatures like those undergone by high voltage electrical conductors during their useful life. This dispositive is based on the classical temperature control of proportional integral derivative (PID). In this work, the dispositive used for heating the conductor/suspension clamp assembly and the methodology used to execute fatigue tests at of one "All Aluminum Conductor" (Orchid) were presented in detail. There is a remarkable and sensible difference between S-N curves for tests carried out at room temperature and those accomplished at, which may indicate degradation of all aluminum conductors when tested under fatigue conditions at higher temperatures.

NME1263
Numerical Methods Preserving Multiple Hamiltonians for Stochastic Poisson Systems

Lijin Wang
School of Mathematical Sciences, University of Chinese Academy of Sciences, China

Abstract. In this talk, we present a class of numerical methods that can preserve simultaneously all invariant Hamiltonians of stochastic Poisson systems, based on discrete gradients and a projection technique. Structure-preserving properties of such methods are investigated and the root mean-square convergence orders of the schemes are analyzed. Numerical tests are performed to verify the theoretical results and illustrate the numerical behavior of the proposed methods.

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NME1278 To avoid repeatability issue, this abstract will be available after the full paper is published in the conference proceedings.

NME1262

Wave Propagation Analysis Based on Periodic Homogenization of Materials with Microstructure Towards Viscoelastic Strain Gradient Effective Media

Yosra Rahali [1,] Hilal Reda [2], and Jean-François Ganghoffer[3]*
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[2]Faculty of Engineering, Section III, Lebanese Universit, Lebanon
[3]LEM3. Université de Lorraine, France

Abstract. A homogenization methodology for the construction of viscoelastic effective substitution media for heterogeneous materials of generalized continua type is proposed, combining a variational principle in linear viscoelasticity with the extended Hill-Mandel lemma accounting for the generalized kinematics. The proposed method has the chief advantage of size-independent higher order effective moduli, and it incorporates the fluctuation of the microscopic displacement which corrects for the polynomial homogeneous part. We also analyse the propagation of linear waves in homogenized periodic 2D structures.
The effective mechanical properties of composite media will be evaluated using a variation principle for the characterization of the solution of the in conjunction with Hill macro homogeneity condition extended to viscoelastic effective strain gradient media.

Keywords: periodic homogenization, viscoelasticity, variational principles, strain gradient media, coupling tensor, size effect

NME1272

Overview of Applications Networks: From Neurons to Circuits

Kelly Cristiane Iarosz
Federal University of Technology, Brazil

Abstract. The 20th-century idea that the adult brain is essentially is changing into a new model of a plastic organic. Research about the plastic brain and how to find new ways of treatment for people with mental illness are among the sciences 10 hottest fields. Therefore, the understanding of how to evolve a network whose final state reassembles functionally or physically a brain is our first step to investigate. The outcomes of this research will also contribute to researchers working in the area of complex sciences mainly by introducing the following three new topics of research that were not previously considered in the study of heterogeneous complex networks: models, synchronisation and control.

NME1255

Elastic-plastic Finite Element Analysis of Metallic Bellows

Aakash [1,2], Dureja A.K.[1, 2], Khan I.A.[1, 2] and Sapra M.K.[2]
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[2]Bhabha Atomic Research Centre, Mumbai, India

Abstract. Aims: Bellows are thin, flexible shell structures generally made using thin metallic sheets by hydroforming process. In nuclear industry, the target application for these metallic bellows is in the Hot Shutdown Passive Valves (HSPVs) of Advanced Heavy Water Reactor (AHWR), in these HSPVs the bellows are planned to be used for sealing as well as actuating purposes. The basic designing of bellows is generally done by Expansion Joints Manufactures Association's (EJMA) design procedures. The equations and the charts used in the EJMA were developed by Anderson based on the shell theory and equilibrium considerations. EJMA doesn't consider the effect of plasticity in the equations for the calculation of stresses in bellows. The purpose of this study is to understand the effect of plasticity on the stresses and fatigue life estimation of bellows.
Methods: The U-shaped metallic bellows were designed using EJMA design procedures for pressure and displacement loading. The stresses for the elastic-plastic and elastic model were estimated using finite element analysis (FEA) and compared with EJMA stresses to better optimize the effect of parametric variation on the fatigue life of bellows.
Results: The stresses extracted from the FEA were compared with EJMA stresses and the fatigue life was estimated considering the effect of plasticity. These stresses were better matched and close to the realistic design considerations.
Conclusions: The elastic-plastic analysis of the bellows is better to predict the stress distribution and fatigue life of the bellows.

NME1250

Extracting the Macroscopic Failure Surface of Materials Involve Microscopic Defects Using Computational Homogenisation Method

Ahmad Akbari
Computational Mechanics, Department of mechanical Engineering, Azad University of Kermanshah (IAUKSH) Kermanshah, Iran

Abstract. Computational homogenisation is a well established method for bridging between scales in material science. This method effectively passes data between scales and is able to handle smooth nonlinearities of microstructures. At the presence of sharp nonlinearities, for instance crack initiations, the conventional homogenisation technique cannot predict the overall microstructural response due to the size effect of the representative volume element (RVE) employed for homogenisation. However, this method still can be implemented in the elastic regime of material before losing stability. As matter of fact, the moment of losing stability can be recorded as tensile strength of material. In this work, by imposing several configurations of boundary condition on the RVE of a polycrystalline microstructure the macroscale failure surface is extracted. The effect of microscopic parameters, e.g. grain size, grain length ratio and voids on the macroscopic failure surface are studied.

Keywords: computational homogenisation, polycrystalline microstructure, failure surface, defects and voids

NME1283

Paradox of Fatigue of Perfect Soft Metals in terms of Energy Dissipation on Micro Plasticity and Damage

Abstract. Since the production of engineering parts is under rigid control, which does not permit any cracks, the fatigue problem of high frequency stressing is modeled for perfect soft metals in macro, in terms of energy

spent on damage. According to the last research, irreversible strains of instant relaxation, (relief), created at any cycle, can be calculated even for very small durations of a single pulse. They are the origin of irreversible energy spent on micro plasticity of single grains, with consequent damage by microcracking.
In soft metals fatigue appears through the state of elasticity, below the yielding limit. It is found that only a little part of the irreversible energy, (defined as _-quant of fatigue), is responsible on the fatigue process. Operator of integrity, complementary to damage, is introduced to describe the preservation of the solids under damage, while their elastic modulus remains constant. The definition of reactive stress is given and it is used to express the alteration of stresses by declining integrity.
It is shown that damage shifts the yielding point down. Equation of this shift is obtained and used to predict the passive elastic energy spent on damage under state of constant maximum stress amplitude. _-quant of fatigue reflects the dislocation's pressure vs the resistance of lattice. It is a material parameter in macro, found specific for any metal. The value of _-quant were estimated for steel, aluminium, titanium and copper, demonstrating its wide range and its central place in the life time of soft metals.
Two distinct constitutive equations of the life numbers of pulses are obtained for constant stress and for constant strain amplitude resp., as a function of the mu-quant, stressing and of the pulse factors, without free parameters. The equations show that fatigue life under constant strain amplitude is prolonged vs constant amplitude stress state, against lower residual strength. An equation linking the mu-quant with temperature is proposed, The way to express the nonlinearity of the _-quant vs stressing is shown. The differential of the equation of fatigue process is given. Method of evaluation the remaining life-time of equipment under fatigue is presented. Paradox of fatigue at low stressing is solved as a tunneling effect, cased by micro plasticity. It explains the transformation of soft metal into brittle solid under low consumption of energy.

Keywords: soft metals, fatigue, instant relaxation, irreversible strains, micro plasticity, accumulated damage, integrity loss, shifted end-point, passive energy, mu-quant, Live Equation, fatigue evaluation, tunneling effect

Session 4: Mechanical Engineering

Please Click http://www.academicconf.com/teamslink?confname=nme2020 to enter the conference meeting room.
Session Chair: Dr. Ho Ho-Cheung, The Hong Kong Polytechnic University, Hong Kong, China

Time: 09:00-12:45 Wednesday, December 9, 2020

09:00-09:15	NME1234	Design and Modelling of a MEMS for Detection of Volatile Organic Compound *Dr. Francisco Lopez-Huerta, Universidad Veracruzana, Mexico*
09:15-09:30	NME1258	Modeling and Analysing of Spring-loaded Double Parallelogram Mechanism Using Moment Balance *Dr. Min Haonian, South China University of Technology, China*
09:30-09:55	NME1265 *(Invited Talk)*	Numerical Study on Flame Merging Behavior and Air Entrainment Restriction of Multiple Fires *Prof. Jie Ji, University of Science and Technology of China, China*

09:55-10:20	NME1266 *(Invited Talk)*	Effects of Ambient Pressure on Smoke Movement and Temperature Distribution in Inclined Tunnel Fires *Assoc. Prof. Long Ding, University of Science and Technology of China, China*
10:20-10:35	NME1209	Active Subspaces and Ensemble Algorithm for Efficient Parameter Identification in Modeling of Electrocardiology *Ms. Ruonan Cao, Shantou University, China*
10:35-10:50	NME1216	Bio-structure on the Rachis Outer Surface of a Bird Feather *Dr. Yuping Zhao, Tsinghua University, China*
10:50-11:00		**COFFEE BREAK**
11:00-11:25	NME1267	Numerical Bifurcation Analysis of Grinding Model Built on Oscillators with Nonlinear Coupling *Dr. Pavel Kuptsov, Mechanical Engineering Research Institute of the Russian Academy of Sciences (IMASH RAN), Russia*
11:25-11:45	NME1269	Multiscale Permutation Entropy and Supervised Classifiers for State Detection in an ICE *Dr. Héctor Fabio Quintero, Universidad Tecnológica de Pereira, Colombia*
11:45-12:00	NME1231	Research on Pedestrian Detection Using Optimized Mask R-CNN Algorithm in Low-light Road Environment *Dr. Kuncheng Lai, Guizhou University, China*
12:00-12:15	NME1280	Experimental Study on Interaction Phases Change of Two Line Fires with Unequal Heat Release Rates *Dr. Yonglong Huang, University of Science and Technology of China, China*
12:15-12:30	NME1206	Dark Gap Localized Modes in Nonlinear Periodic Systems *Prof. Jianhua Zeng, Xi'an Institute of Optics and Precision Mechanics of Chinese Academy of Sciences, China*
12:30-12:45	NME1282	Analytics and Numerics of a Class of Lotka-Volterra Systems with Gaussian Noise *Dr. Yuchao Wang, University of Chinese Academy of Sciences, China*

Abstracts of Session 4

NME1234 To avoid repeatability issue, this abstract will be available after the full paper is published in the conference proceedings.

NME1258 To avoid repeatability issue, this abstract will be available after the full paper is published in the conference proceedings.

NME1265
Numerical Study on Flame Merging Behavior and Air Entrainment Restriction of Multiple Fires

Jie Ji

State Key Laboratory of Fire Science, University of Science and Technology of China (USTC), China

Abstract. Fire is a typical thermal runaway process of uncontrolled energy release. The possible ignition of adjacent leaked fuel might induce multiple fires burning simultaneously. Improving the security of energy storage and management is thus a great concern to us. A series of numerical simulations have been conducted to study the flame merging behavior and air entrainment restriction effect from square propane fire arrays. The simulation results were first systematically compared to experimental data, showing that the flame characteristics including the flame height, flame centerline temperature, and velocity distributions can be successfully reproduced numerically. Then, the flame merging phenomenon was studied by varying fire spacing, the number of fires, and the heat release rate of an individual fire in the array. Results show that the critical flame merging spacing of the fire array equals to 0.4 times the flame height of a single fire, which is independent of the fire array size. More importantly, a parameter denoting the extent of air entrainment restriction.

NME1266

Effects of Ambient Pressure on Smoke Movement and Tempera-ture Distribution in Inclined Tunnel Fires

Ding Long
State Key Laboratory of Fire Science, University of Science and Technology of China, China

Abstract. When a fire breaks out in an inclined tunnel, the thermal buoyancy induced by smoke temperature difference will induce airflow through the tunnel due to the stack effect. The induced longitudinal airflow is a key factor in inclined tunnel fires. In this talk, under the combined effect of induced longitudinal airflow and ambient pressure, the smoke movement and temperature distribution pattern are presented firstly. Then the variation of induced longitudinal airflow velocity with tunnel slope and ambient pressure is explained. Finally, taking the tunnel slope, the ambient pressure and the velocity of resulted induced longitudinal airflow into account, a correlation predicting the maximum smoke excess temperature beneath the ceiling is proposed and the correlation agrees well with previous experimental results at normal pressure. The results can provide an engineering reference for tunnel structural fire protection, smoke control and safe evacuation in inclined tunnels at different ambient pressures.

NME1209

Active Subspaces and Ensemble Algorithm for Efficient Parameter Identification in Modeling of Electrocardiology

*Ruonan Cao, Huanhuan Yang**
Department of Mathematics, Shantou University, China

Abstract. Computational modeling of electrocardiology has a great potential for use in improved diagnosis and prognosis of cardiac arrhythmia. However, patient-specific modelling is limited in clinic use due to the high computational demand in personalizing the model parameters, especially the cardiac conductivities. In this talk, we will present an efficient cardiac conductivity estimation approach, i.e. using an ensemble algorithm combined with the active subspaces method.

Keywords: electrocardiology, monodomain equation, active subspaces, ensemble algorithm

NME1216 To avoid repeatability issue, this abstract will be available after the full paper is published in the conference proceedings.

NME1267

Numerical Bifurcation Analysis of Grinding Model Built on Oscillators with Nonlinear Coupling

Pavel Kuptsov
Mechanical Engineering Research Institute of the Russian Academy of Sciences (IMASH RAN) Moscow, Russia

Abstract. A known model of grinding takes into account an interaction between a tool and a workpiece as sliding friction while an effective work of the tool expended for cutting roughnesses is considered as being negligibly small. Both the grinding tool and the workpiece are described by vertical (normal) and horizontal (tangential) coordinates and velocities, so the phase space is eight dimensional. Since taken into account forces nonlinearly depend on coordinates and velocities the resulting model consists of four oscillators coupled via nonlinear terms. In this work we consider a reduced version of this model where either a tool or workpiece are strongly damped so that two of four oscillators decay and can be neglected. The purpose of this work is to reveal regimes that this model can demonstrate. We demonstrate two-frequency quasiperiodicity, chaos, and transition to chaos via destruction of torus. Author acknowledges support from Russian Science Foundation, grant No 20-19-00299.

NME1269 To avoid repeatability issue, this abstract will be available after the full paper is published in the conference proceedings.

NME1231 To avoid repeatability issue, this abstract will be available after the full paper is published in the conference proceedings.

NME1280

Experimental Study on Interaction Phases Change of Two Line Fires with Unequal Heat Release Rates Heat

*Yonglong Huang[1], Jie Ji[1, 2], Long Ding[1, *], Chen Wang[1]*
[1]State Key Laboratory of Fire Science, University of Science and Technology of China, China
[2]Institute of Advanced Technology, University of Science and Technology of China, China

Abstract. This paper presents an experimental study on the flame shape and merging behaviors of two line fires in open space. Two identical line burners with different heat release rates (HRRs) were employed as fire sources, and propane was used as fuel. The experimental results showed that the shape of a line fire could be simulated by a combination of a triangle in the lower portion and a parabola in the upper portion. The maximum flame width and the corresponding height had a good linear relationship with the flame height. Compared with the flame from a square or round burner, a line fire has a "thinner" flame shape on the short side and the position corresponding to the maximum flame width is higher. Based on the assumed flame shape, for two fires, the interaction phase at different flame height ratios can be divided into two phases with $Z_{f0,\,l} = 1.47Z_{f0,\,s}$ as the dividing line. When $Z_{f0,\,s} < Z_{f0,\,l} < 1.47Z_{f0,\,s}$, the merging probability increases with increasing HRR of the large fire. However, when $Z_{f0,\,l} > 1.47Z_{f0,\,s}$, the merging probability decreases with the increasing HRR of the large fire. At each phase, as the burner distance increases, the flame merging state can be divided into

three stages, i.e., fully merging, intermittent merging, and non-merging. Correlations of merging probability for each stage were proposed and validated by the literature data, which presented high reliability. Besides, a distribution map was obtained to determine the flame height and merging probability directly when HRRs and burner distance were known.

NME1206
Dark Gap Localized Modes in Nonlinear Periodic Systems

Jianhua Zeng
State Key Laboratory of Transient Optics and Photonics, Xi'an Institute of Optics and Precision Mechanics of Chinese Academy of Sciences, China

Abstract. Periodic potentials such as photonic crystals and lattices in optics and optical lattices in Bose-Einstein condensates (BECs) have recently attracted increasingly research attention. There are many emergent nonlinear phenomena in such physical systems, e.g., bright and dark gap solitons, gap waves and vortices waves. Particularly, one-dimensional (1D) bright gap solitons has been experimentally observed in atomic BECs loaded onto an optical lattice. The observation was also made for 1D dark solitons in the BECs, while their gap-type counterparts (dark gap solitons) are still waiting for experimental identification. Theoretically, the existence and properties of dark gap solitons in the two-dimensional (2D) coordinates have not been revealed yet. Herein, I will focus on the nonlinear periodic systems characterizing the dynamics of BECs in optical lattices and describing the propagation of light waves in photonic crystals and lattices in the optics context, and showcase relevant significant advance of gay-type dark localized modes in such systems, including 1D and 2D dark gap solitons and their arrangements—gap soliton clusters, as well as 2D gap vortices [1]. A unique feature peculiar to such gay-type dark localized modes is that they are all stand on the nonlinear Bloch-wave background of the underlying physical model. The stabilities of all the dark localized modes are verified through solid numerical methods—linear stability analysis and direct simulations. Our findings point out the experimental directions for further research that can be readily realized in BECs and in optics under the existing state-of-the-art experimental conditions.

Keywords: nonlinear periodic systems, localized gap modes, bright and dark solitons, photonic crystals and optical lattices

Acknowledgements: The National Natural Science Foundation of China and the Youth Innovation Promotion Association of the Chinese Academy of Sciences.

Reference:

[1] Liangwei Zeng and **Jianhua Zeng***, Gap-type dark localized modes in a Bose-Einstein condensate with optical lattice, ***Advanced Photonics*** 1, 046004, (2019).

NME1282
Analytics and Numerics of a Class of Lotka-Volterra Systems with Gaussian Noise

Yuchao Wang
University of Chinese Academy of Sciences, China

Abstract. Lotka-Volterra equations are widely applied in many scientific fields, including physics, chemistry,

biology, economics, etc.. We study a class of Lotka-Volterra equations with Gaussian noise in the Stratonovich sense, propose a sufficient condition for the existence (non-explosion) and uniqueness of their solutions, and further prove that the solutions are almost surely positive and bounded. In addition, we construct a new numerical method for the system, which can exactly preserve the energy and Casimir functions. Numerical experiments are performed to a three-dimensional Lotka-Volterra system with Gaussian noise to verify our results, which also show the root mean-square order 1 of our method.

Part IV Call for Papers for Peer Review Journals

Part V Acknowledgements

On behalf of the Organizing Committee of NME2020 &CMA2020, we would like to take this opportunity to express our sincere thanks to the support and contributions of participants from all over the world. We would also like to express our sincere acknowledgements to the Technical Program Committee members who have given their professional guidance and valuable advice to the conference. Below are the lists of the Technical Program Committee members. For those who contribute to the success of the conference organization without listing the name here, we would love to say thanks as well.

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