CONFERENCE PROGRAM

2022 9th International Conference on Mechanics, Materials and Manufacturing

ICMMM 2022

With Workshop

2022 4th International Conference on Trends in Mechanics and Aerospace

August 26-28, 2022 | Washington, USA
Conference Venue: Capitol Technology University, USA
Address: 11301 Springfield RoadLaurel, MD 20708

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WELCOME MESSAGE

On behalf of the conference committees, we are pleased to welcome you to attend the 2022 9th International Conference on Mechanics, Materials and Manufacturing (ICMMM 2022), with its workshop of 2022 4th International Conference on Trends in Mechanics and Aerospace (TMAE 2022), which will be held during August 26-28, 2022, co-sponsored by Capitol Technology University, USA. We were looking forward to seeing everyone face to face, but we are excited for the opportunity to innovate by creating an engaging virtual conference that will be rewarding for both presenters and attendees.

This event will provide a unique opportunity for international scholars, researchers and practitioners who are working in the field of Mechanics, Materials and Manufacturing & Trends in Mechanics and Aerospace to get the theoretical grounding, practical knowledge, and personal contacts that will help you build a long term, profitable and sustainable communication.

Under this special pandemic situation, ICMMM 2022 & TMAE 2022 are held with online, which includes technical paper presentations and keynote talks. We totally have 2 oral parallel sessions (Advanced Engineering Materials and Their Properties & Applied Mechanics, Manufacturing and Mechanical Engineering), as well as keynote speeches delivered by 4 distinguished guests. They are ***Prof. Dr. Osamu TABATA*** (Fellow of the IEEE), from Kyoto University of Advanced Science, Japan, ***Prof. Weidong Zhu*** (ASME Fellow), from University of Maryland, USA, ***Prof. Zengtao Chen*** (ASME and CSME Fellow), from University of Alberta, Canada, ***Prof. Songgang Qiu***, from West Virginia University, USA. We would like to express our gratitude to all the speakers in this conference.

Special appreciation delivered by the conference committees for their great support. Apart from that, we'd like to extend our thanks to all the authors for your contribution as well as the technical program committee members and external reviewers. Their high competence, enthusiasm, valuable time and expertise knowledge, enabled us to prepare the high-quality final program and helped to make the conference become a successful event.

We truly hope this conference will provide each one of you with a good platform for networking opportunities and interactions with other delegates from both the academics and industry. At last, we appreciate your participation and support.

With Warmest Regards,

Organizing Committee

ICMMM 2022, TMAE 2022

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CONFERENCE COMMITTEES

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ZOOM PRE-TEST

[Virtual Background]

[Conference banner]

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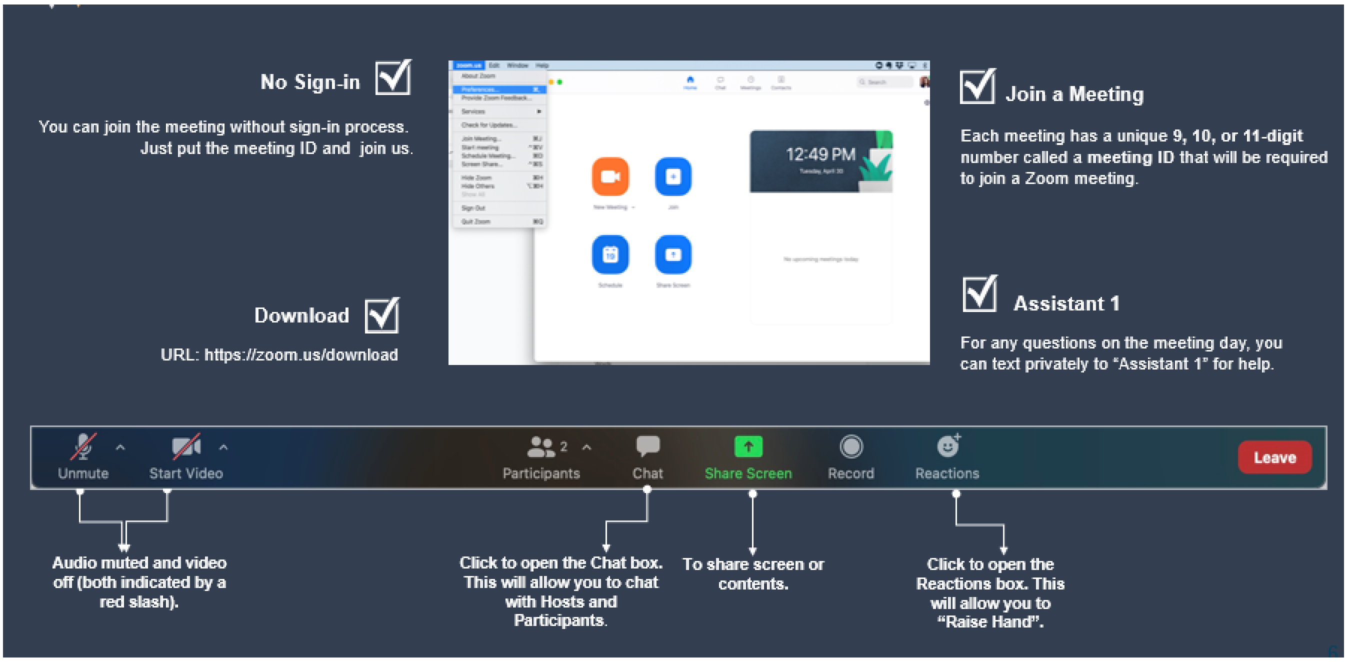
Note:

1. Each presenter will be given 3-5 mins for this pre-test, you can leave once the testing for your presentation is done.
2. The testing will consist of screen sharing, audio & video on/off, and how to "Raise Hand" in Zoom. Please get your PPT slides, or PDF slides, and computer equipment prepared beforehand.

Zoom Guidance



AGENDA OVERVIEW

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August 26 | Friday (GMT+2)		
12:00pm-01:00pm	Zoom Pre-test	See Page 6
August 27 | Saturday (GMT+2)		
02:00pm-02:10pm	Chairman / Conf. General Chair Opening Remarks from Conf. General Chair	**Prof. Ian McAndrew** *Capitol Technology University, USA*
02:10pm-02:55pm	**Keynote Speech I** Body on a Chip: A Way to Mimic a Body on a Chip	**Prof. Dr. Osamu TABATA** Fellow of IEEE, *Kyoto University of Advanced Science, Japan*
02:55pm-03:40pm	**Keynote Speech II** Vibration-based Structural Damage Detection	**Prof. Weidong Zhu** ASME Fellow, *University of Maryland, USA*
03:40-04:00pm	Group Photo & Break	
04:00pm-04:45pm	**Keynote Speech III** Non-Fourier Heat Conduction and Nonlocal Theory, Recent Progress and Application in Thermal Stress Analysis	**Prof. Zengtao Chen** ASME and CSME Fellow, *University of Alberta, Canada*
04:45pm-05:30pm	**Keynote Speech IV** Material Compatibility Study for Latent Heat Energy Storage System	**Prof. Songgang Qiu** *West Virginia University, USA*
August 28 | Sunday (GMT+2)		
02:00pm-03:45pm	**Session 1:** Advanced Engineering Materials and Their Properties	M032, M010, M026, M011, M059, M019, M009
03:45pm-04:00pm	Break Time	
04:00pm-05:45pm	**Session 2:** Applied Mechanics, Manufacturing and Mechanical Engineering	M060, M014, M023, M034, M008-A, M012, M0001

Note: *Please note that time zone provided in the program is GMT+2.

*A 15-minute report online, 2-3 min for question & answer is included. PowerPoint file, PDF file or Pre-recorded video is accepted.

*Session Group Photo: A picture captured at the end of each session.

INTRODUCTION OF KEYNOTE SPEAKERS

Prof. Dr. Osamu TABATA

IEEE Fellow

Kyoto University of Advanced Science, Japan

Speech Title: Body on a Chip: A Way to Mimic a Body on a Chip

Abstract: In vitro cell-based assay with human cells is getting attention since the accuracy of preclinical predictions of drug responses should be improved to reduce costly failures in clinical trials. In order to generate reliable predictions, a micro-engineered biomimetic systems, so called "Body on a Chip: BoC" was proposed. The BoC make it possible to investigate the effects of drugs/metabolites on various organs by assembling a closed-loop medium circulation system on one microfluidic device. In this talk, we demonstrate our two examples. One is a BoC in which human heart and liver cell lines are integrated to evaluate the effects of an anti-cancer drug (doxorubicin) on cell survival. The next is a BoC in which human gut and liver cell lines are integrated to investigate Non-alcoholic fatty liver disease (NAFLD). In both examples, a three-dimensional (3D) polymeric device fabrication technique based on the reliable 3D lithography with the process optimization method is applied to realize a better performance of the integrated fluidic components such as a valve and a pump.

Biography: Osamu Tabata received his M.S. and Ph.D. degrees from Nagoya Institute of Technology, Japan, in 1981 and 1993, respectively. Since April 2005, Osamu Tabata has been a Professor at Graduate School of Engineering, Kyoto University, Japan. October 2019, he moved to Kyoto University of Advanced Science as a founding Dean of New Engineering School launched in 2020. He is currently engaged in research on micro/nano processes, MEMS, DNA nanotechnology. He is an editorial board member of the Microsystems & Nanoengineering and Journal Sensors and Actuators. From 2020, he has been serving as a chair of the Robert Bosch Award Committee for EDS. He is a Fellow of Institute of Electrical and Electronics Engineers and Institute of Electrical Engineer Japan.

Prof. Weidong Zhu
ASME Fellow
University of Maryland, USA

Speech Title: Vibration-based Structural Damage Detection

Abstract: Recent advances in model- and non-model-based damage detection methods using vibration data such as natural frequencies and mode shapes are presented. Two major challenges associated with model-based methods are addressed: accurate modeling of structures and development of a robust inverse algorithm to detect damage, which are defined as the forward and inverse problems associated with model-based damage detection methods, respectively. To resolve the forward problem, new physics-based finite element modeling techniques for fillets in thin-walled beams and bolted joints are developed, so that complex structures with thin-walled beams and/or bolted joints can be accurately modeled with a reasonable model size. To resolve the inverse problem, a robust iterative algorithm that uses Levenberg-Marquardt method is developed to accurately detect locations and extent of damage using a minimum number of measured natural frequencies. Non-model-based methods that use vibration shapes measured from scanning laser vibrometry, without use of any a priori information of undamaged structures that is usually not available in practice, are introduced. Curvature vibration shapes are compared with those from polynomial fits with proper orders to yield curvature damage indices to identify damage. A new multi-scale differential geometry scheme is developed to calculate curvature vibration shapes. Spatially detailed vibration shapes can be measured by a continuously scanning laser Doppler vibrometer system developed in-house in a rapid and accurate manner. Application of the methodology to detect delaminations in composite plates are demonstrated. Use of operational modal analysis and digital image correlation to detect damage in membranes is also demonstrated.

Biography: 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 and Optical Measurement 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, and has served as an Associate Editor of the ASME Journal of Vibration and Acoustics and the ASME Journal of Dynamic Systems, Measurement, and Control, and as a Subject Editor of the Journal of Sound and Vibration and Nonlinear Dynamics. 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 277 SCI-indexed journal papers in these areas and holds seven U.S. patents. He is a recipient of the 2020 University System of Maryland Board of Regents Faculty Award for Excellence in Research.

Prof. Zengtao Chen

ASME and CSME Fellow

University of Alberta, Canada

Speech Title: Non-Fourier Heat Conduction and Nonlocal Theory, Recent Progress and Application in Thermal Stress Analysis

Abstract: High-energy pulse laser beams are widely used in additive manufacturing of metals, ceramics and other high-melting temperature materials, where the workpiece experiences sudden heating process with extremely high temperature gradient localized in the heating spot. Recent experimental and theoretical results have showed that thermal stress analysis based on the classical Fourier heat conduction and continuum mechanics will lead to a much more optimistic prediction of the thermomechanical behavior of the material than the actual situation. This overestimate in the thermomechanical response to transient, localized, high-energy heating process will eventually jeopardize the manufacturing and subsequent application of the additively manufactured products. Non-Fourier heat conduction theories were proposed to address the transient heating process involving high temperature or temperature gradient, extremely low temperature, or heterogeneous material structures. This presentation summarizes some of our recent works on thermal stress analysis of transient heat process using non-Fourier heat conduction theories. Rationality of application of non-Fourier heat conductions and nonlocal continuum theory will be discussed first. Then some typical thermomechanical problems extracted from additive manufacturing will be solved to illustrate the advantages of these theories over the classical theories. In particular, nonlocal theory of continuum exhibits perfect applicability in dealing with localized heating process when combined with non-Fourier heat conduction.

Biography: Professor Zengtao Chen is a tenured professor in the Department of Mechanical Engineering of University of Alberta. He got his first PhD in solid mechanics from Harbin Institute of Technology in 1995 and second PhD in mechanical engineering from University of Waterloo in 2004. He has been a faculty member at Harbin Institute of Technology, Tsinghua University and University of New Brunswick prior to the current position. He is an elected Fellow of American Society of Mechanical Engineers (ASME) and Canadian Society for Mechanical Engineering (CSME). Dr. Chen's research area include Mechanics of Materials, Materials Modelling, and Damage and Fracture Mechanics. His recent interests are in multiscale modelling of deformation and damage evolution in metal forming processes, advanced thermal stress analysis of smart materials and structures, and composite structures. Dr. Chen has published more than 260 journal papers, three books, numerous conference papers and invited and keynote speeches. Dr. Chen has trained more than 60 graduate students and post-doctoral fellows, and many of them became academics in renowned institutions, including McGill, Waterloo, Nagoya, Lanzhou, Nanjing, etc.

Prof. Songgang Qiu

West Virginia University, USA

Speech Title: Material Compatibility Study for Latent Heat Energy Storage System

Abstract:

Biography: Dr. Qiu has extensive experiences in the analysis and design of power generator, gas and liquid fuel burners, and heat exchangers. He is currently working on the development of a SOLID FUEL BURNER. This burner is to be used to gasify supplied charcoal, combusts and transfers heat to a Stirling engine for power generation. He is also developing an advanced Stirling generator for combined heating and power generation under a DOE ARPA-E grant. Dr. Qiu has served as PI for numerous research projects funded by DOE, DoD (Army, Navy, Air Force) and NASA. He was the prime designer of an Advanced Radioisotope Stirling Generator (ARSG) for NASA/DOE. He is the lead inventor of 9 issued US patents.

PARALLEL SESSIONS

Session 1: Advanced Engineering Materials and Their Properties

Time: 02:00pm-03:45pm | Aug. 28

Zoom ID: 875 3045 7906 | Meeting Link: https://zoom.us/j/87530457906

Session Chair: Prof. Zengtao Chen, University of Alberta, Canada

Time & Paper ID	Title & Presenters
02:00pm-02:15pm M032	Physical Modeling for Thermal Proposal Validation (TES) in Lima Offices with Air Conditioning **Washington Rojas Casaverde & Angel De La Torre Galdo** *Universidad Peruana de Ciencias Aplicadas(UPC), Peru* *Abstract*-Climate change adaptation measures are demanding the use of technologies that promote energy saving. The search for thermal comfort has encouraged the use of technologies such as the TES tank (Tank Energy System). This article presents the validation of the results obtained in the CFD simulation of a TES tank, through an evaluation of the model at 1/25 scale, to corroborate the thermal resistance of the tank whit thermal conductivity of 1.63 W/m. °K and expanded polystyrene with thermal conductivity of 0.036 W/m°K for both the walls and the lid. The circular TES tank designed guarantees, in addition to adequate thermal resistance, impermeability and durability so that it can function correctly during temperature measurements. In the model, the thermal resistance of the tank was corroborated, by obtaining an increase in the temperature of the temperature of the water in 8 hours of 7°C. That is, from 5.9 °C to 12.9 °C, which does not exceed 15 °C, the recommended value for its viability.
02:15pm-02:30pm M010	PLA/MWCNT Nanocomposite: Improved Electrical, Thermal and Antibacterial Properties for Fused Deposition Modelling Additive Manufacturing Applications **Persia Ada Narag de Yro** *Mapua University, Philippines* *Abstract*- Incorporation of nanoparticles in Polylactic Acid (PLA) for additive manufacturing is explored to alter the material property to suit its intended application. In this study, PLA is reinforced with multi-walled carbon nanotubes (MWCNT) using two-roll mill for fused deposition modeling (FDM) additive manufacturing. The chemical composition, thermal behavior, electrical, and antibacterial properties of the PLA/MWCNT nanocomposite were investigated. The Fourier transform infrared spectroscopy (FTIR) analysis showed the physical interaction of MWCNT to the PLA matrix. The x-ray diffraction analysis (XRD) data showed that increasing the MWCNT percentage increases the amorphous region and intensity, indicating the nucleating effect of MWCNT on PLA. Differential scanning calorimetry (DSC) analysis showed a decrease in the glass transition and melting temperatures compared to pure PLA by up to 9.36°C and 23.25°C, respectively, while introducing cold crystallization with the addition of MWCNT. The two point -probe resistance measurement showed a decreasing trend in the resistance of the composite which indicates an increase in conductivity as the the amount of MWCNT is increased. The analysis of disk diffusion test concluded that no bacterial growth of Escherichia coli and Staphylococcus aureus happened underneath the sample. Furthermore, the nanocomposite was successfully extruded into a filament and test samples were 3D printed using FDM. The PLA/MWCNT produced are suitable for the production of a multifunctional filament with improved electrical, thermal and antimicrobial properties for different fused deposition modelling (FDM) additive manufacturing increasing the probable applications and competitiveness of this promising market niche.

02:30pm-02:45pm M026	Effects of Wood flour Reinforcement on the Warpage and Compressive Strength of 3D Printed HDPEs **Mark Anthony Ramos Agbayani** *Industrial Technology Development Institute, Philippines* *Abstract*- The study involves the use of high density polyethylene (HDPE) as a filament for 3D printing. Considering the warpage and adhesion problem of HDPE on the build plate during 3D printing, this was addressed through the incorporation of wood flour compatibilized with styrene-ethylene-butylene-styrene grafted maleic anhydride (SEBS-gMAH). The composite wood-HDPE (cHDPE) was studied to observe warpage changes. Using different SEBS, heat bed parameters and identification of the suitable print heat beds for HDPE was conducted. Results from the mechanical testing show that the compressive strength and elastic force of virgin HDPE (vHDPE) increases with infill percentage, while the same properties for cHDPE increases up to 50% infill density/percentage then decreases as it approaches 100% infill percentage. Digital microscopy imaging shows that poor layer adhesion initiated the poor compressive performance of cHDPE. Warp studies reveal that wood flour significantly decreases warping of HDPE by 42.88% at 50% infill density. While different SEBS brands show similar effectiveness as heat beds in reducing warping of HDPE during printing.
02:45pm-03:00pm M011	ABS/AgZrP Nanocomposite Additive Manufacturing Filament for Antibacterial Applications **Persia Ada Narag de Yro** *Mapua University, Philippines* *Abstract*- The emergence of COVID-19 raised awareness in hygiene practices and reminded us of the harm that microbes bring to our health. Incorporating antibacterial agents in polymeric materials would allow us to combat lingering bacteria on surfaces that we often use. The utilization of composite filaments with antibacterial activity would allow us to employ better precautions in reducing contact with harmful bacteria. Antibacterial acrylonitrile - butadiene - styrene (ABS) nanocomposites were prepared by incorporating silver zirconium phosphate (AgZrP) nanoparticles via twin screw extruder. The ABS/AgZrP nanocomposite filament with 5 wt % and 20 wt% of AgZrP were synthesized and characterized with Differential scanning calorimetry (DSC), Thermogravimetric Analysis (TGA), X-ray diffraction analysis (XRD), and Fourier transform infrared spectroscopy (FTIR). DSC and XRD data denote an increase in the presence of crystalline regions as the AgZrP content is increased. TGA data indicate that the addition of AgZrP has no effect on the thermal stability of the material. FTIR data indicate a decrease in transmission at higher AgZrP loading. The decreasing trend in tensile properties of the 3D-printed neat and AgZrP-filled ABS may have been due to particle agglomeration acting as stress concentrators. Antibacterial activity assessment via disk diffusion test showed a zone of inhibition within the sample indicating that there is no bacterial growth both for Escherichia coli and Staphylococcus aureus.
03:00pm-03:15pm M059	Effect of Addition Amount of Surface Treated Wood Flour on Moisture Absorption Property of Green Composite **Hideaki Katogi** *Jissen Women's University, Japan* *Abstract*- This study was examined the moisture absorption property of green composite using surface treated wood flour for sustainable development goals (SDGs) of product. Constituent materials of green composite were Japanese cedar flour and poly(lactic acid). The lumber of Japanese cedar was cut by hand saw for wood flour. The surface treatment of wood flour was conducted by stone mill. The number of cycle was 400 cycles. The maximum addition amount of wood flour was 20wt%. Molding method of green composite was vacuum compressive method. The moisture absorption test of green composite was conducted by using KNO3 solution. The maximum test time was four weeks (672 hours).

	The environmental temperature was room temperature. The humidity was 93%. As a result, following conclusions were obtained. In case of test time 672 hours, coefficient of moisture absorptions of green composites using non and surface treated wood flour 1.0wt.% were similar to that of poly(lactic acid). But, the coefficient of moisture absorption of green composite using surface treated Japanese cedar flour 20wt.% was larger than that of green composite using non-treated Japanese cedar flour 20wt.%. The water penetration probably occurred at interface between Japanese cedar flour and matrix. Therefore, the moisture absorption property of green composite using surface treated Japanese cedar flour 20wt% was affected by water penetration at interface between Japanese cedar flour and matrix.
03:15pm-03:30pm M019	Prediction of Mechanical Properties and Failure Behavior of Nano-Alumina Reinforced Poly(lactic) Acid Composite for Fused Deposition Modeling 3D Printing via Finite Element Analysis **Marvin S. Tolentino** *Mapua University, Philippines* *Abstract*- Mechanical properties and failure behavior of 3D printed poly(lactic) acid (PLA) reinforced with varying loadings of nano-alumina (Al2O3) (0, 2.5, 5.0, and 10.0 wt.%) were investigated through simulation using a finite element analysis (FEA)-based software. Tensile test specimens were 3D printed via fused deposition modeling (FDM) technique and underwent actual testing. The mechanical properties determined were then used as parameters for the FEA simulation to achieve prediction accuracy. Specifically, this study utilized MSC Patran and Nastran software to simulate the tensile test on the modeled test specimen with tetrahedron mesh. The finite element model was verified by comparing the simulated values with the results of actual experimental testing. Upon calculation, the average percentage differences for the tensile strength, elastic modulus, and displacement were 5.86%, 12.07%, and 10.57%, respectively. Although percentage differences were obtained, using FEA as an initial analysis for the prediction of mechanical properties and failure behavior could serve as a solution for better design and materials optimization.
03:30pm-03:45pm M009	Characterization of Eco-Friendly Lightweight Aggregate Concretes Incorporating Industrial Wastes **Gianmarco Di Rienzo** *Department of Engineering, University of Naples Parthenope, Italy* *Abstract*- Towards the sustainable development goals in the built environment, the use of waste and recycled sources has been attaining great interest among researchers and policy-makers, especially in concrete as the most used construction material. Excess use of natural aggregates, as one of the main components of concrete, causes the depletion of natural resources and the associated environmental problems, thus, the use of artificial and recycled aggregates is of great importance. In this regard, the production of lightweight artificial aggregates from industrial and hazardous wastes may be a promising solution that not only mitigates the depletion of natural resources but also stabilize those kinds of wastes. This study aimed to investigate the production of concrete with recycled aggregates from industrial wastes, mainly municipal solid waste incineration fly ash (MSWI-FA). To this end, different kinds of mix designs to manufacture the aggregates were developed based on MSWI-FA, ground granulated blast furnace slag (GGBFS), marble sludge (MS), and cement. The concrete samples containing different artificial aggregates, as well as recycled polyethylene terephthalate (PET) in the sand form, were produced and the properties, including compressive strength and thermal insulation, were evaluated. The obtained results of the lightweight concrete demonstrated enhanced thermal property (up to 30%), but at least 30% lower resistance with respect to the normal concrete produced from the natural aggregate.

Session 2: Applied Mechanics, Manufacturing and Mechanical Engineering

Time: 04:00pm-05:45pm | Aug. 28

Zoom ID: 875 3045 7906 | Meeting Link: https://zoom.us/j/87530457906

Session Chair: Prof. Weidong Zhu, University of Maryland, USA

Time & Paper ID	Title & Presenters
04:00pm-04:15pm M060	Test-free Simulation Method for Blowout Preventer Pipe Shearing Powered by Data **Yaou Wang** *Schlumberger, USA* *Abstract*-A Blowout Preventer (BOP) serves as a safety valve in the drilling process in the oil and gas industry. It will be closed if an influx of formation fluids occurs and threatens the rig. A Ram BOP is one type of widely used BOP. It is composed of two ram blades, which will move toward each other to shear the drilling pipe and to close the valve. To ensure the shearing process is completed on the rig, lab tests are often run to evaluate the BOP's capability and the required shearing pressure. Over the last decade, Finite element analysis (FEA) based simulation method has been set up to predict the shearing process. The simulation method still requires pipe damage parameters and requires lab test. This paper presents a test-free simulation method enabled by analyzing the ram BOP pipe shearing data, which significantly reduces the lead time and test costs.
04:15pm-04:30pm M014	Predictive Modeling of Out-of-Plane Deviation for the Quality Improvement of Additive Manufacturing **Hao Wang** *Binghamton University, United States* *Abstract*- Additive manufacturing (AM) is a new technology for fabricating products straight from a 3D digital model, which can lower costs, minimize waste, and increase building speed while maintaining acceptable quality. However, it still suffers from low dimensional accuracy and a lack of geometrical quality standards. Moreover, there is a need for a robust AM configuration to perform in-situ inspections during the fabrication. This work established a 3D printing-scanning setup to collect 3D point cloud data of printed parts and then compare them with nominal 3D point cloud data to quantify the deviation in all X, Y, and Z directions. Specifically, this work aims at predicting the anticipated deviation along the Z direction by applying a deep learning-based prediction model. An experiment with regard to a human "Knee" prototype fabricated by Fused Deposition Modeling (FDM) is conducted to show the effectiveness of the proposed methods.
04:30pm-04:45pm M023	Effect of Line Width and Wall Count on the Compressive Strength of Single and Functionally Graded Additively Manufactured ABS Gyroid Structure **Shaun Angelo C. Arañez** *Industrial Technology Development Institute, Philippines* *Abstract*- Additive Manufacturing (AM) has been in the manufacturing industry for more than a decade. It has aided in producing several intricate objects for several purposes. One of the most used techniques in AM is fused deposition modeling (FDM) wherein a plastic filament is heated to its melting point and deposited layer by layer in a build plate to form a 3D model. Acrylonitrile butadiene styrene (ABS) is one of the commonly used filaments because of its relatively good impact resistance and toughness, and workability in 3D printing various structures. The gyroid structure is a self-supporting structure that has a good strength-to-weight ratio. The compressive strength of single and multiple-layered structures of ABS gyroid lattice structure with different line widths, infill densities, and wall counts was observed. A 0.35 line width with an infill density of 25% and wall count of 3 has a compressive strength of 11.94 MPa, material consumption of 1.87 grams, and printing time

	of 14 min which makes it the most efficient design for single-layered structures. Among three-layered structures, the combination of infill densities of 25% and 35% is the most efficient with 0.45 line width and 3 walls. It has a compressive strength of 15.87 MPa, printing time of 13 min, and material consumption of 2.3 grams. Nowadays, there are limited research articles on AM of a single structure with gradual varying densities as well as the effect of lesser-known printing parameters on the mechanical properties of AM parts. This study aims to aid future research by providing data on single and functionally graded structures with different line widths and wall counts. With the information from this study, future researchers and designers can further optimize printing parameters to make an efficient design that is light and has sufficient mechanical strength to serve a specific function.
04:45pm-05:00pm M034	Computerized Simulation of Meshing of S-gears and Modification Geometry **Chao Jia** *Fuzhou University, China* *Abstract*- S-gear is a new type of gear with advantages of small sliding coefficient, high meshing efficiency and large load-bearing capacity due to the concave-convex contact in a vicinity of the meshing start and end. In view of the excellent characteristics and potential value of S-gears, the designation and meshing characteristics of the S-gears are deeply studied in this paper. First, the tooth surface of the S-gears is generated based on the relationship of S-shaped rack-cutter and machining motion. Second, the modified tooth surface of S-gears is constructed by superimposing the surface of modified volume with the standard tooth surface. On this basis, the coordinates of 3D grid node of modified S-gears are calculated by using MATLAB programming. Third, loaded tooth contact analysis (LTCA) is used to study the meshing characteristics of the S-gears with longitudinal modifications and misalignment angle errors. Ultimate, one example is presented and the results show that the load distribution of S-gears is improved effectively and error sensitivity is reduced greatly after tooth surface modification. S-gear is a new type of gear which is different from involute gears and has great potential application prospect in large load-bearing field, which will be further studied in the future.
05:00pm-05:15pm M008-A	Material Fracture Life Prediction Under High Creep Conditions Using a Rule-based Model Based On Cubist Algorithm **Roberto Fernandez Martinez** *University of The Basque Country (UPV/EHU), Spain* *Abstract*- Many industrial installations use elements that work under extreme temperature and pressure conditions, and therefore, are part of the group of critical elements of the system. A system where several critical elements can be found are power plants, where many elements usually made from steel alloys are subject to extreme creep conditions. These work requirements mean that these elements must be manufactured based on highly efficient materials with high production costs and long periods to be tested. One of the most typical materials used in this type of problems are alloy steels, since they allow to prolong the life of the material and improve its mechanical properties. The problem arises when determining the composition and the appropriate heat treatments to optimize the mechanical properties of the material. This information is normally based on standards, but these standards leave a very wide value range within each of the variables that define the material. And of course, the final mechanical properties differ depending on the value of these variables. These properties are usually analyzed by performing creep tests, but these tests require a high consumption of time and are not usually studied on working conditions where the fracture appears after a long period of time. In order to analyze this issue and to understand the relationship between the fracture time and the properties of the material, the use of regression models is proposed. The use of these models on power plant maintenance tasks can help in decision-making for preventive maintenance and improve the operating efficiency of these plants. In this work, regression techniques based on decision rules are applied, specifically the Cubist algorithm, extension of Quinlan's M5

	model tree. These models are trained based on 344 creep tests performed on steel alloys based on the P92 standard, a number of instances considered as significant to cover the whole space of possibilities of the problem. This dataset is analyzed and preprocessed to adapt the starting information to the solution of the problem, to obtain a broader understanding of the problem, and to identify possible relationship between variables. Finally, applying a training/testing methodology the model generalization is analyzed according to the error generated for the model on real cases. The proposed methodology using the Cubist algorithm shows how this type of techniques based on decision rules and linear regressions can achieve accurate results, obtaining very low errors such as a MAE close to 3.5% and a RMSE close to 7%.
05:15pm-05:30pm M012	Idea of Operational Load Monitoring Using Digital Image Correlation and Image Classification Networks **Waldemar Mucha** *Silesian University of Technology, Poland* *Abstract*- The following paper presents an idea for novel approach that can be applied to Operational Load Monitoring and Structural Health Monitoring processes. The approach is based on artificial intelligence (AI) and digital image correlation (DIC) techniques. DIC is an optical method that allows to measure full-field structural displacements and strains. In the presented approach only a relatively small fragment of the material's surface is monitored by DIC. The obtained partial image of strains or displacements is then processed by a carefully trained AI model, an image classification network, that predicts the state of the whole structure (e.g. materials stresses, potential loss of material continuity). The assumption is that all possible load cases and states of the monitored structure can be identified and simulated, so the data obtained from simulations can then be used to train the image classification network. Numerical example is presented as proof of the presented concept. A modern lightweight aerostructure in the form of a hat-stiffened composite panel is the monitored structure in the presented example where Operational Load Monitoring is performed based on a relatively small fragment of normal strains map. The reference maps to train the network were simulated numerically. The prediction model estimates the Tsai-Wu criterion value for the whole composite material. The obtained accuracy of predictions proved the effectiveness and efficiency of the proposed approach.
05:30pm-05:45pm M0001	A Precision Analysis of Machining Incoloy 901 Aerospace Materials with Cemented Carpide Tools by the Taguchi Method **Abdullah ALTIN** *Yuzuncu Yil University , Turkey* *Abstract*- In this research work, was made a study on the effects of turning conditions on incoloy 901 nickel-based superalloy and performed a precision analyzes using the Taguchi L27 orthogonal array. Using the results of variance analysis (ANOVA) and signal-to-noise (S / N) ratio and taking into account the "smaller is better" approach were statistically investigated to establish a correlation amongst the speed of cutting, feed rate and cutting tool with respect to surface quality and cutting forces. KCU10, K313 and KCU25 cemented carpide cutting tool were used in experimental study. The experimental results have revealed the most important factor influencing the cutting force and surface quality was the type of the cutting tool and it's had a serious effect on both, KCU10 and followed by KCU25 was found better than the other cutting tool. Optimum parameters for the cutting forces was found 0,150 mm/rev., 90 m/min. with KCU10 cutting tool The found findings can help for revealed the optimization of machining parameters and surface characteristics of Incoloy 901 during high speed turning.

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