Time Zone: GMT/UTC-4 (Washington, D. C. Time)

ICMMM 2023

2023 10th International Conference on Mechanics, Materials and Manufacturing

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August 18-20, 2023 | Washington, D. C., USA
Conference Venue: Holiday Inn Washington Capitol – National Mall
Address: 550 C Street S.W., Washington, DC 20024 United States

TABLE OF CONTENTS

Note

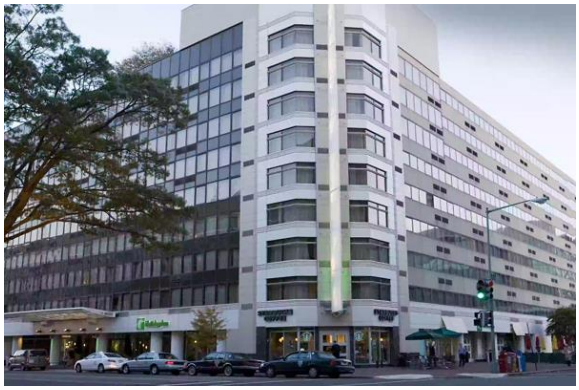
GENERAL INFORMATION

Onsite Conference Venue

Holiday Inn Washington Capitol – National Mall

Address: 550 C Street S.W., Washington, DC 20024 United States

Contact: Corrine De la Torre "corrine.delatorre@hicdc.com"



Onsite Registration

Go to the registration desk→ Inform the staff of your paper ID→ Sign-in→ Claim your conference kit.

Devices Provided by the Organizer

Laptops (with MS-Office & Adobe Reader) / Projectors & Screen / Laser Sticks

Materials Provided by the Presenter

Oral Session: Slides (pptx or pdf version). Format 16:9 is preferred.

Official language: English.

Duration of Each Presentation

Keynote Speech: 45min, including Q&A.

Oral Session: 15min, including Q&A.

Notice

※ Please wear your delegate badge (name tag) for all the conference activities. Lending your participant card to others is not allowed.

※ Please take good care of your valuables at any time during the conference. The conference organizer does not assume any responsibility for the loss of personal belongings of the participants during conference day.

※GMT/UTC-4 (EDT). Time in Washington, D. C. Please be aware of time difference between this and your region/country.

Online Presentation Tips

	ZOOM Meeting ID	Link
ZOOM Download	858 9310 0994	https://us02web.zoom.us/j/85893100994

Note:

We recommend that you install the Zoom platform on your computer before the conference starts. New users can participate in the Zoom meeting without registration.

Participants who are going to do an online presentation are required to join the rehearsal in Zoom on Friday, August 18. Duration: 3min apiece. Feel free to leave after you finish the test.

WELCOME MESSAGE

We are pleased to welcome you to attend the 2023 10th International Conference on Mechanics, Materials and Manufacturing (ICMMM 2023), which will be held in Washington, D. C., USA during August 18-20, 2023.
This event will provide a unique opportunity for international scholars, researchers and practitioners working in a wide variety of scientific areas with a common interest in mechanics, materials and manufacturing.
This year's conference will be composed of 1 onsite session and 1 online session, which cover the range of interesting topics include Materials Science and Mechanical Manufacturing & Engineering Material Evaluation, Solid Mechanics and Intelligent Manufacturing. In addition, 4 keynote speeches will be delivered by Prof. Guo-Quan Lu (Virginia Polytechnic Institute and State University, USA), Prof. Nourredine Boubekri (University of North Texas, College of Engineering Denton, Texas, USA), Prof. Weidong Zhu (University of Maryland, USA), and Prof. Michael E. Johnson (Capital Technology University, USA).
On behalf of the organizing committee, we would like to deeply express our heartfelt appreciation to all our delegates, keynote speakers, session chairs, as well as all the committee members involved in the technical evaluation of conference papers and in the conference organization for your time, effort, and great contributions. Apart from that, we'd like to extend our thanks to all the authors and external reviewers for your contribution. It is your high competence, enthusiasm, valuable time and expertise that have enabled us to prepare the final program with high quality and make the conference a great success.
Finally, I wish to thank all attendees for participating in the conference and hope you have a fruitful and memorable experience at ICMMM 2023!
Last but not least, take care and stay healthy!

With Warmest Regards,

Conference Organizing Committee

ICMMM 2023

Contact

ICMMM 2023

Ms. Weng P. L. Hwang

icmmm@zhconf.ac.cn

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Armando Roman-Flores, Tecnologico de Monterrey, Mexico

AGENDA OVERVIEW

August 18 | Friday (GMT/UTC-4 (EDT))		
15:00-17:00	**Onsite Registration in Washington**	**Hotel Lobby**
09:00-11:00	**Online Pre-test Session in Zoom**	**Zoom Room A: 858 9310 0994**
Zoom Test Timetable		
09:00-09:40	MA025 MA030 MA018 MA020 MA054 MA041 MA044 MA039 MA046 MA026 MA1002	
09:40-10:30	Alternative time for participants who are unavailable at allocated time. Other online participants, includes but not limited to plenary speaker, keynote speaker, session chair, committee member, listener.	

- ✧ Participants who are going to do an online presentation are required to join the rehearsal in Zoom on Friday, August 18, 2023. Duration: 3min apiece. Feel free to leave after you finish the test.
- ✧ We will test control panel including screen sharing, audio, video and "Raise Hand" feature, etc. Please get your presentation slides and computer equipment prepared beforehand.

August 19 | Saturday (GMT/UTC-4 (EDT))	
Keynote Session (Onsite & Online) Congressional II & ZOOM Meeting ID: 858 9310 0994 **Chairman:** Prof. Nourredine Boubekri, University of North Texas, USA	
09:00-09:10	Opening Remarks (Online): Prof. Ian McAndrew, Capitol Technology University, USA
09:10-09:55	**Keynote Speech I:** Power Module Packaging for Combating Climate Change **Prof. Guo-Quan Lu** (Fellow of IEEE), *Virginia Polytechnic Institute and State University, USA*
09:55-10:40	**Keynote Speech II:** Connected Manufacturing: Smart Manufacturing and Supply Chain **Prof. Nourredine Boubekri,** *University of North Texas, College of Engineering Denton, Texas, USA*
10:40-11:00	Group Photo & Coffee Break <Foyer>
11:00-11:45	**Keynote Speech III (Online):** Continuously Scanning Laser Doppler Vibrometry for Vibration Measurement: Principles, Recent Developments, and Applications **Prof. Weidong Zhu**, *University of Maryland, USA*
11:45-12:30	**Keynote Speech IV (Online):** Connecting the Connected Factory **Prof. Michael E. Johnson**, *Capital Technology University, USA*
12:30-14:00	Lunch Time | < Congressional II >
Onsite Session in Washington, D. C. Congressional II	
14:00-15:15	**Onsite Session-Part A:** Materials Science and Mechanical Manufacturing Chairperson: Assoc. Prof. Luísa Andréia Gachet, State University of Campinas - UNICAMP, Brazil MA032 MA010-A MA009 MA013-A MA011-A
15:15-16:00	Coffee Break | <Foyer>
16:00-17:15	**Onsite Session-Part B:** Materials Science and Mechanical Manufacturing Chairperson: Assoc. Prof. Luísa Andréia Gachet, State University of Campinas - UNICAMP, Brazil MA017 MA007-A MA042 MA036 MA014-A
18:00-19:30	Dinner Time | < Congressional II >

August 20 | Sunday (GMT/UTC-4 (EDT))	
Online Session in ZOOM ZOOM ID: 858 9310 0994	
09:00-11:45	**Online Session:** Engineering Material Evaluation, Solid Mechanics and Intelligent Manufacturing Chairperson: Dr. Jiwei Zhou, Heliponix, LLC, USA MA025 MA030 MA018 MA020 MA054 MA041 MA044 MA039 MA046 MA026 MA1002

Note

*Zoom Meeting online conference room will be open 30 mins before scheduled time. Please enter your room 10-15 minutes early.

*A paper not presented or presented by a non-author without prior written approval by the Conference TPC will be removed from the final conference proceedings.

INTRODUCTION OF SPEAKERS

09:10-09:55 Aug. 18 (Friday) | Washington, D. C. Time (GMT/UTC-4)
Meeting Room: Congressional II
ZOOM Meeting ID: 858 9310 0994

Prof. Guo-Quan Lu

Fellow of IEEE

Virginia Polytechnic Institute and State University, USA

Guo-Quan Lu is a professor jointly appointed between the Department of ECE and MSE at Virginia Tech. He is affiliated with the Center for Power Electronics Systems (CPES) at Virginia Tech. Dr. Lu has a Ph.D. in Applied Physics/Materials Science from Harvard University. For 25+ years, he has been developing nanomaterials and manufacturing technologies for power electronics packaging and integration. Dr. Lu has published more than 200 peer-reviewed journal articles. He is the winner of an NSF CAREER award, Virginia Tech Sporn award for teaching, and a R&D100 award. Dr. Lu is an IEEE fellow.

Speech Title: Power Module Packaging for Combating Climate Change

Abstract: Electrical engineers are pursuing a two-pronged approach to combat climate change and meet the growing demand on electricity: adding renewable energy sources to the electric grid and electrifying transportation. Success of this approach requires innovations in power electronics converters for the source-to-grid connection, traction drives, battery chargers, etc. At the heart of every one of the power converters is a semiconductor switching device or power module that controls the flow of electrical energy. The performance, reliability, and cost of the converters are dictated by the packaging of power modules for electrical interconnection, heat dissipation, and protection of the switches. Over the last 25 years, the Center for Power Electronics Systems at Virginia Tech has been developing innovative nanomaterials and assembly technologies for power module packaging. The research effort has been focused on three strategies: (1) double-sided cooling to reduce device junction-to-case thermal resistance and package stray inductances; (2) sintered-silver bonding to increase the junction temperature above 200 oC; and (3) electric-field grading by a nonlinear resistive coating to increase the partial discharge inception voltage of the module. Two examples will be presented to illustrate the implementation of these packaging strategies. One combines double-sided cooling and sintered-silver bonding for packaging a silicon carbide (SiC) module for a 100 kW/L traction inverter, and the other combines the three strategies for packaging a medium-voltage SiC power module for grid-tied applications.

09:55-10:40 Aug. 18 (Friday) | Washington, D. C. Time (GMT/UTC-4)
Meeting Room: Congressional II
ZOOM Meeting ID: 858 9310 0994

Prof. Nourredine Boubekri

University of North Texas, College of Engineering Denton, Texas, USA

Nourredine Boubekri is currently a Professor in the Department of Mechanical Engineering at The University of North Texas. He received his Ph.D. in Industrial and Management Systems Engineering. He received both his Master and Bachelor of Science degrees in Manufacturing Engineering. His career started at the University of Miami. There he founded the University of Miami Industrial Assessment Center in the year 2000, which is currently still funded by DOE. His experience includes his roles as Department chair /Director of Research and Innovation and currently Founder and Director of UNT DOE Industrial Assessment Center. He directed more than fifty Master and Ph.D. Students and published more than 100 technical articles and journal papers in the areas of Green Manufacturing, New Product/Process Development, Project Management and Quality Assurance. His research funding exceeds seven million dollars in grants and contracts. He has been an invited/Keynote speaker at a number of international conferences and symposiums.

Speech Title: Connected Manufacturing: Smart Manufacturing and Supply Chain

Abstract: Globalization has led to increasingly interconnected manufacturing systems. A fact made clear by the pandemic which demonstrated the complexity, uncertainty, and vulnerability of supply chains. Their sensitivity to even small errors or lack of accurate plans can have major consequences in terms of product availability, schedules, pricing, revenue, and wellbeing for mankind. On the other hand, smart manufacturing requires smart supply chain systems for it to be competitive. This presentation discusses these two important areas and their integration.

11:00-11:45 Aug. 18 (Friday) | Washington, D. C. Time (GMT/UTC-4)
Meeting Room: Congressional II
ZOOM Meeting ID: 858 9310 0994

Prof. Weidong Zhu

University of Maryland, USA

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, structural health monitoring, renewable energy, metamaterials, and involves analytical development, numerical simulation, experimental validation, and industrial application. He has published 308 SCI-indexed journal papers in these areas and has eight issued U.S. patents. He has received 14 best paper awards from the ASME and Society of Experimental Mechanics. He is a recipient of the 2020 University System of Maryland Board of Regents Faculty Award for Excellence in Research.

Speech Title: Continuously Scanning Laser Doppler Vibrometry for Vibration Measurement: Principles, Recent Developments, and Applications

Abstract: A laser Doppler vibrometer can measure the surface velocity of a point on a structure. A continuously scanning laser Doppler vibrometer (CSLDV) was developed to significantly improve efficiency and spatial resolution of vibration measurement of the structure. As a non-contact system, it can avoid the mass-loading problem in vibration measurement using accelerometers. The CSLDV was made by adding two orthogonal scan mirrors in front of a single-point laser Doppler vibrometer. Two scan mirrors can be referred to as X and Y mirrors based on their rotation axes, respectively. During CSLDV measurement, two scan mirrors can be controlled to continuously rotate about their rotation axes, and the laser spot of the CSLDV can continuously move along a pre-designed scan trajectory on the structure, which is a major difference compared to a conventional scanning laser Doppler vibrometer (SLDV) system that has a point-by-point scanning capability. This tutorial first overviews principles in vibration measurement using a CSDLV, such as signal processing methods for structures under various excitations such as sinusoidal, impact, and random excitations, and scan trajectory design methods for structures with various shapes. Recent developments on (1) a novel general-purpose three-dimensional (3D) CSLDV system for measuring 3D full-field vibration of a structure with arbitrarily curved surfaces, and (2) a novel zero-contact image-based tracking CSLDV system for measuring vibration of a rotating structure are presented. The general-purpose 3D CSLDV system can measure vibrations of difficult to access areas of structures with the assistance of reflective mirrors and obtain their 3D panoramic modal parameters through a novel vibration stitching method. The image-based tracking CSLDV system can track and scan a rotating structure such as a rotating wind turbine blade through a novel edge detection method and estimate its modal parameters through an improved lifting method and an improved demodulation method. Applications of continuous scanning laser vibrometry to structural damage detection will be discussed.

11:45-12:30 Aug. 18 (Friday) | Washington, D. C. Time (GMT/UTC-4)
Meeting Room: Congressional II
ZOOM Meeting ID: 858 9310 0994

Prof. Michael E. Johnson

Capital Technology University, USA

Michael E. Johnson has been working with Capital Technology University since 2020 as an adjunct professor in aerospace science. He also has spent the last 10 years working with Boeing's commercial and space activities with NASA, SpaceX, and Blue Origin. Dr. Johnson most recently was the lead liaison with the International Space Station (ISS) and ground support operations in Houston Texas. He has extensive experience and has published in the area(s) such as of Radio Frequency Identification (RFID) along with associated data systems used in global tracking. Dr. Johnson has had the privilege of publishing in numerous international technical journals and has assisted students at Capital in the same. Dr. Johnson is a member of the Royal Aeronautical Society along with several other institutions. He was recently appointed to the Board of Trustees for Capital in 2023.

Speech Title: Connecting the Connected Factory

Abstract: This presentation aims to show the underlying weakness in Factory 4.0 and the expectations of additional technology in manufacturing. We limit the promise and anticipation of the expanded and updated technology by updating the components and tools without changing how they communicate (connecting via Wi-Fi, Blue Tooth and Ethernet, and the like). We continue to use many connection methods instead of finding means of bringing connectivity into a single point. This presentation goes over the history of the advancement of factories and manufacturing. It will show the primary manufacturing means along with modern associated tooling in today's technical factory. Using new tools and systems will not guarantee improvement as long as we rely on the transport methods of yesteryear.

ONSITE SESSION-Part A

Aug. 19 (Saturday) 14:00-15:15	**Meeting Room: Congressional II**

Onsite Session: Materials Science and Mechanical Manufacturing
Chairperson: Assoc. Prof. Luísa Andréia Gachet, State University of Campinas - UNICAMP, Brazil

14:00-14:15 MA032	Mechanical Properties of Luffa Fiber Reinforced Recycled Polymer Composite ***Hoo Tien Nicholas Kuan***, *Universiti Malaysia Sarawak, Kota Samarahan, Sarawak, Malaysia* *Abstract*—Environmental issues over the eventual fate of post-consumer polymers can be dealt with in two separate ways which is recycling or using biodegradable polymers. However, it is evident that recycling polymers from post-consumer polymers can decrease the mechanical properties over time. Hence, to strengthen the recycled polymers, integrating fibers, such as luffa, into the High-Density Polyethylene (HDPE) matrix, was carried out to produce a fiber reinforced recycled polymer (FRrP) composite. The tensile testing of the FRrP composite shows that the 10% fiber volume fraction (FVF) composite exhibits a higher tensile strength of 3.9% than the neat recycled HDPE (RHDPE). In terms of Young's Modulus, the 5% FVF of FRrP is shown to have a higher value than the neat RHDPE by 54%. The low density of luffa fibers also contributes to the composites lightweight character. The impact testing shows that the FRrP enhances the impact properties when compared to the neat RHDPE. The peak load, perforation energy, and the total energy absorbed by the FRrP indicate an increasing trend when luffa, of up to 15% FVF, is added as the reinforcement. Thus, the addition of luffa as reinforcement in RHDPE shows significant potential as a high-performance, sustainable, and environmentally friendly material, such as automotive parts and protective gear.
14:15-14:30 MA010-A	The Influence of Waste Synthetic Dusts from CNC Milling Processes on the Mechanical Strength of High-Strength Cement-Glass Eco-composites ***Marcin Małek,*** *Military University of Technology, Warsaw, Poland* *Abstract*—The subject of the paper concerns the impact of waste synthetic dust dosed as an admixture or as an additive in compositions of high-strength cement-glass eco-composites. The eco-composite was a construction material modified with PMMA, PVDF, PTFE and PEEK dust, generated in the technology of multi-axis CNC 5D machining of semi-finished products in the medical, electronics, and aeronautics industries. The results of mechanical strength tests in the field of static load impact, rheological and thermal parameters are presented. The method of designing compositions of high-strength eco-composites formulas was described, promoting pro-ecological solutions of sustainable construction, the idea of a circular economy, the assumption of the "zero waste" principle, and focusing on reducing the carbon footprint in the product life cycle. A description of the solutions at the stage of qualitative and quantitative selection for eco-cement-glass mixtures is included, i.e. the introduction of partial substitutes of the CEM I type of hydraulic binder, the use of low-emission eco-cements, the complete abandonment of the use of conventional natural and broken rock aggregates in favor of glass crumb piles and material modification of the eco-composite microstructure with admixtures and waste additives or from recycling processes. Structures of crumb piles from groups of fractions of sodium glass granulate with additional graining with flour and sodium glass powder from post-consumer waste glass recycling were characterized. The characteristics of the components forming the microstructure of eco-cement-glass composites, i.e. waste industrial binders generated in the processes of energetic combustion of fossil fuels, glass crumb piles from waste sodium glass granulates, a new generation of highly fluidizing biopolymer admixture based on plant waste as well as dispersed reinforcement in the form of textile cord microfibers from recycled tires of motor vehicles. Examples of the practical applications of high-strength cement-glass eco-composites for the construction and architectural industries are described.

14:30-14:45 MA009	Research on the Influence of Humidity on the Manufacture of GFRP Vessels in the Equatorial ***Patrick Townsend,*** *Escuela Superior Politécnica del Litoral, ESPOL* *Abstract*—The objective of this research work is to analyze the behavior between fiberglass laminate under tensile tests, assembled under different humidity conditions. For which specimens were designed under the regime of the international standard ASTM D3039; which took an assembly process within a controlled environment; the design variables used were relative humidity and curing time. Subsequently, the traction-displacement behavior was checked under a uniaxial force, obtaining the maximum take-off force. In addition, Simpson numerical integration was applied to calculate elastic energy. Obtaining that the relative humidity and the days of curing influence the chemical and mechanical properties of the material. Se shows that the percentage of humidity recommended for assembling laminates in GRP is 66% since it has greater elastic energy and take-off force. Finally, it is concluded that to have a high resistance in the material at least 7 days of curing of the epoxy resin must be applied.
14:45-15:00 MA013-A	The Influence of the Addition of Waste Spiral Steel Chips on the Mechanical Strength and Thermal Parameters of Eco-cement-glass Composites **Emil Kardaszuk,** Military University of Technology, Warsaw, Poland *Abstract*—The paper's subject concerns the modification of the internal material structure of the cement-glass eco-composite with the addition of waste helical steel chips and the effect of this addition on the mechanical strength and thermal parameters determined on hardened standard samples. Characteristics of the components of the eco-cement-glass composites recipes, i.e. low-emission eco-cement, transparent colored sodium glass granules, a glass crumb pile with a high sand point, a new generation of fluidizing biopolymer admixture and waste steel helical chips, were presented. Spiral steel chips, which are a by-product of the multi-axis milling process, were obtained from plants specializing in the processing of metals and synthetic materials in CNC technology. The cement-glass eco-composite based on the matrix in the cement-fly ash system was a high-strength construction material with a crumb pile designed from groups of post-recycled ground sodium glass fractions. The construction of glass crumb piles with waste sodium dust and dispersed reinforcement in the form of steel helical chips was characterized. The method of designing the composition of eco-composite recipes based on pro-ecological solutions is described, i.e. the use of waste helical steel chips with variable geometry, the use of low-emission eco-cements, abandoning the use of conventional broken rock and pebble mineral aggregates in favor of waste sodium glass granulates from post-consumer glass recycling, among others bottles, jars, kitchen utensils. The samples of the cement-glass mixture were subjected to material modification with the addition of waste helical chips in the amounts of 5%, 10%, and 15% of the designed binder mass in the cement-fly ash system. Hardened cubic and beam samples were tested after 28, 56, and 90 days of material curing. The results of mechanical strength tests and thermal parameters of eco-composite samples, i.e. characteristic compressive strength, tensile strength at three-point bending and splitting, thermal conductivity coefficient, specific heat, and thermal diffusivity of the material are included.
15:00-15:15 MA011-A	Formation of Micro-Micro Titanium Composite Powder Using Layer-by-Layer Electrostatic Adsorption Process ***Mubasher Ali,*** *The Chinese University of HongKong, Hong Kong, China* *Abstract*—This study analyzes the electrostatic adsorption process parameters for micro-micro Ti-6Al-4V composite powder formation. The electrostatic adsorption process creates complex nano and micro-scale composite powder using surface charge. Existing literature has analyzed nano-micro particles to form composite powder using electrostatic adsorption; however, no study has reported the formation of micro-micro Ti-6Al-4V composite powder. Moreover, to understand the formation of Ti-6Al-4V composite powder more thoroughly, key electrostatic adsorption variables and their process window shall be quantitively investigated. This study demonstrated the formation possibilities of micro-micro Ti-6Al-4V composite powder using the electrostatic adsorption process. Four electrostatic adsorption process parameters, which are pH value, stirring duration, host particle size, and guest particle loading, were investigated for their influence on particle

	adsorption. Image analysis was conducted on scanning electron microscopy micrographs to quantify adsorption efficiency. Results from our study showed that high adsorption efficiency is achieved when the guest (at 10% loading) and host particles were adjusted with pH-2 and pH-12, respectively, and stirred for 1 minute. Moreover, bigger host particles led to better adsorption owing to the more abundant adsorption sites. This study provides a scientific understanding of micro-micro Ti-6Al-4V composite powder formation with a proposed process window for good adsorption efficiency.

ONSITE SESSION-Part B

Aug. 19 (Saturday) 16:00-17:15	**Meeting Room: Congressional II**

Onsite Session: Materials Science and Mechanical Manufacturing
Chairperson: Assoc. Prof. Luísa Andréia Gachet, State University of Campinas - UNICAMP, Brazil

16:00-16:15
MA017

Analysis of the Electrical and Mechanical Properties of Cement Composite Produced with Brake Lining Waste

Joao Batista Lamari Palma e Silva, *State University of Campinas - UNICAMP, Brazil*

Abstract —Cement composites such as mortars and concretes with electrically conductive properties, have different uses, such as electromagnetic shielding, electrical grounding, cathodic protection, vehicle traffic monitoring, and the detection of strains and cracks in buildings. However, for these composites to have their electrical conductivity increased, it is necessary to incorporate electrically conductive materials, such as metals and carbon. Nonetheless, such materials tend to be expensive, which makes the manufacture of the composite more expensive. In this sense, using waste materials can help reduce costs and minimize impacts on the environment. Therefore, cement mortars were produced in this research with waste of brake linings from heavy vehicles, which may contain metallic and carbon-based materials. The mortars produced had part of the sand replaced by up to 70% crushed waste, which was submitted for analysis of compressive strength and electrical impedance. Preliminary results showed a decrease in the impedance (showing a trend of increasing electrical conductivity) of mortars with brake lining waste compared to mortars without waste, as well as a decrease in compressive strength. Finally, the use of brake lining waste in the production of cement composites can help reduce the consumption of natural resources as well as minimize the disposal of waste in landfills, which in both cases contributes to the sustainability of the environment.

16:15-16:30
MA007-A

Influence of Irregular Load on Structure and Properties of Laser Welded Joint of Magnesium Alloy AZ31

Marcin Wachowski, *Military University of Technology, Warsaw, Poland*

Abstract—The real structural elements made of AZ31 magnesium alloy are exposed to various loads during exploitation. The real irregular load is proposed to be simulated in two steps: 1) monotonic tensile load the specimen with applied additional shock force impulse (combined load); 2) implementation random load of the specimen. Combined loading initiates dynamic non-equilibrium processes (DNEP) in the material in order to adjust the material to a new state of conditional equilibrium. Under certain load conditions, the external energy is almost completely absorbed by the material and is spent on forming to dissipate structure. The newly created structure has different mechanical properties than the original one, adequate to the new type of the load. At the energetic point of view, it is optimal to shape such a structure in the material in the local volume. The aim of the work was to investigate the influence of irregular loading on the structure and properties of the laser welded joint of AZ31 magnesium alloy in laboratory conditions. Specimens are subjected to two-stage loading in accordance with the previously described scheme. In order to perform the fractographic tests, some specimens were destroyed under monotonic tension conditions. It has been found that irregular loading, especially the application of additional shock impulse load on the elastic section of the stress diagram, causes increase plastic deformation at room temperature of both the base material and the laser welded joint compared to monotonic loading. The revealed phenomenon has a long-term character and influences the modification of the mechanical characteristics of the alloy, as evidenced by the results of the second stage of these tests under random loading conditions. Fractographic studies revealed differences in local structural changes in the base material and within the heat-affected zone and the welded seam itself.

16:30-16:45 MA042	Effect of Heat Treatment on Formability of AZ61 Magnesium Alloys ***Adel Khalid Alfozan,*** *Imam Mohammad Ibn Saud Islamic University, Saudi Arabia* *Abstract*—The current paper focuses on enhancing the manufacturability of AZ61 magnesium alloys by heat treatment. Specimens are subjected to solution heat treatment. First, all samples underwent a 15-hour treatment at 415ºC before aging at 50ºC, 100oC, and 150ºC. The specimens were furnace cooled and quenched after achieving the precise aging temperature. The results have been extracted from tensile and cupping tests. The outcomes of each test have been compared with the data taken without heat treatment, so the ductility increase can be observed. Tests revealed better results for furnace-cooled specimens. The increase in formability of about 9% along with a decrease in strength of only 11% is observed for 150ºC aging temperature.
16:45-17:00 MA036	Modeling and Optimization of Turning Hastelloy C-276 under Sustainable Machining Environments ***Balkar Singh,*** *I.K Gujral Punjab Technical University, Kapurthala, Punjab, India* *Abstract*—Due to their numerous applications in the aerospace, chemical, and nuclear power industries, environmentally responsible superalloy machining is a major problem in the current production environment. Additionally, Ni-based superalloys are regarded as difficult to manufacture because of their great strength under hot and chemically reactive settings. Therefore, it is necessary to machine these materials using adequate cooling and lubricating solutions. Current study has been based on the optimisation and modelling of turning Hastelloy C-276 under dry, flood, and least lubrication system. A Taguchi L-9 arrangement was used as plan of experiment and modeling was enabled through ANOVA, regression analysis and Taguchi optimization. The results depicted optimal parameters for surface roughness and temperature at v2-f1-d1-CE3 and v1-f2-d1-CE3. Likewise, for CRC and shear angle the best combination was observed at v3-f3-d2-CE2. From ANOVA analysis, the benefaction of C.E, depth of cut and feed rate on S.R been listed as 46.70%, 40.44% and 10.66%. Likewise, for temperature cutting speed has benefaction of (53.09%), cooling environment (23.94%), depth of cut (6.10%) and feed rate 5.49% . In similar fashion, CRC and Shear angle were influenced by feed rate and cutting speed having contribution of 62.89% and 5.15% respectively. Furthermore, minimum standard error between the fitted and observed values for S.R., temperature, CRC, and shear angle were calculated as 0.0149, 7.66, 0.267, and 1.80 units. Finally, the marginal reduction of cutting temperature and surface roughness through utilization of MQL implies the sustainable machining conditions.
17:00-17:15 MA014-A	Laser Measurement Method Based on Self-mixing Interference and its Potential for Monitoring Additive Manufacturing Processes ***Feng Lin,*** *The Chinese University of Hong Kong, Hong Kong* Abstract—Laser-based Wire Directed Energy Deposition (LWDED) is affected by various factors such as process parameters during the layer-by-layer deposition process, and the parts will have serious defects and unstable mechanical properties. Therefore, the real-time monitoring of the processing process can better study the evolution of defects. In particular, the direct measurement of part dimensions and surface defects can better realize the adjustment of process parameters to improve the mechanical properties of parts. However, the existing monitoring methods either use the molten pool morphology to indirectly predict the quality of parts or directly inspect the part with inflexible field-of-view. Hence, this paper proposes a novel monitoring proof-of-concept prototype based on the phenomenon of laser self-mixing to directly inspect for part quality. The system primarily uses a laser diode with a self-encapsulated photodiode which is capable of collecting optical feedback signal once the laser hits a target. And data processing and calculation are performed on the feedback signal to obtain the geometric size and defect size of the target. The measurement object is Fused Deposition Modelling (FDM) single-wall plates similar to LWDED processing technology. The results show that the laser scanning monitoring system can successfully measure the target, and the measurement accuracy of the average size of waviness defects can reach up to 99.36%. To the best of our knowledge, this study is the first to apply the self-mixing phenomenon as a metrology technique for the monitoring of an additive manufacturing process.

ONLINE SESSION

Aug. 20 (Sunday)
09:00-11:15

ZOOM Meeting ID: 858 9310 0994

Onsite Session: Materials Science and Mechanical Manufacturing
Chairperson: Dr. Jiwei Zhou, Heliponix, LLC, USA

09:00-09:15 MA025	Electrochemical Metallization for Enhancing the Quality and Performance of Electric Motor ***Carlos Martinez Llaccohua****, Facultad de Ingeniería, Universidad Tecnológica del Perú, Lima, Perú* *Abstract* — The present research aimed to evaluate the effect of nickel-based electrochemical metallization (EMNi) on the quality and performance of electric motor components, compared to high-velocity oxy-fuel (HVOF) thermal spray coating, the most widely used coating in the mining industry. The experiment was conducted using motor components comprised of 4340 VCN steel, 4140 VCL steel, 1045 steel, and stainless steel, which underwent both treatments. The surface temperature of the components was monitored during the processing stage, followed by evaluations of their Rockwell hardness (HRC) and surface characteristics (taper, ovality, parallelism, finish, wear) at the onset (day 0) and after 2 years of use The results indicate that EMNi delivers electric motor components with superior finishes and extended warranty and service life in comparison to HVOF.
09:15-09:30 MA030	Sustainability Assessment of Lightweight Artificial Aggregates Made from Industrial Waste Using a Double-step Cold Bonding ***Jehangeer Raza****, University of Naples "Parthenope", Italy* *Abstract* — The use of recycled resources in the construction industry, such as lightweight artificial aggregates, has recently gained more and more attention. In the present study, experimental procedures and multi-criteria model were applied to choose among the lightweight artificial aggregates. Mechanical, environmental, and economic factors were examined and integrated to identify the most sustainable lightweight artificial aggregate. Three mixtures containing cement and industrial waste were created for this purpose. While cement content (15%, 10%, 5%) and blast furnace slag (5%, 10%, 15%) changed in the mixtures, fly ash content (80%) was kept constant. The Analytical Hierarchy Process (AHP) was put into place to assist in identifying preferred scenarios in relation to the three mixtures. The outcomes showed that aggregates with 80% of fly ash, 5% of blast furnace slag and 15% of cement are the best choice in terms of sustainability.
09:30-09:45 MA018	Ontology-oriented Modeling of the Vickers Hardness Knowledge Graph ***Hossein Beygi Nasrabadi,*** *Bundesanstalt für Materialforschung und -prüfung (BAM), Germany* *Abstract* — This research deals with the development of the Vickers hardness knowledge graph, mapping the example dataset in them, and exporting the data-mapped knowledge graph as a machine-readable Resource Description Framework (RDF). Modeling the knowledge graph according to the standardized test procedure and using the appropriate upper-level ontologies were taken into consideration to develop the highly standardized, incorporable, and industrial applicable models. Furthermore, the Ontopanel approach was utilized for mapping the real experimental data in the developed knowledge graphs and the resulting RDF files were successfully evaluated through the SPARQL queries.

09:45-10:00 MA020	Development and Evaluation of a Vision Inspection System for Plastic Bottle Measurement ***Jiwei Zhou,*** *Heliponix, LLC, USA* *Abstract*—To quickly adapt to the fast-changing conditions in the modern markets and the global economy, manufacturers are adopting digital manufacturing methods and tools, instead of traditional paper-based processes, to release higher quality products more quickly and at a lower cost. The pharmaceutical industry has a high production standard in the world. Delivering a defective product (or package) can lead to customer complaints and may even result in the entire product series being returned in severe cases. To reach out to the tiny space of products and achieve a high pharmaceutical product dimensional standard, manufacturers must introduce commercial vision inspection systems for the quality inspection process. However, conventional commercial inspection systems are often of a high cost, thus making them unaffordable for micro, small, and medium-sized enterprises (MSMEs), particularly in developing countries. This paper proposes a cost-effective vision inspection system that intelligently measures critical plastic bottle dimensions. The system comprises three 4K industrial cameras, two LED lights, a customized measurement platform, and a laptop, making it more affordable for MSMEs. Under the appropriate illumination setting, a plastic bottle is positioned on the stage and viewed by the laptop screen in real-time. The middle camera captures the bottle image, followed by a series of image processing operations to obtain the region of interest (ROI), such as the snap cap radius and height. Then, extract the target bottle edges with the Canny edge detector. Lastly, the system calculates the pixel-based distance and converts it to the measurement results for records or decision-making. The proposed method demonstrates reliable dimensional detection abilities, offering a potential solution to reduce human workload and improve inspection productivity in measuring pharmaceutical bottles.
10:00-10:15 MA054	Biomechanical Assessment of Axial and Inclined Design with Different Implant Positions in Full-arch Implant Restoration ***Jinyang Zhang,*** *Guangdong CAS Biotechnology Co.,Ltd., China* *Abstract*—Multiple implants need to be placed in different regions of the mandible based on the remaining bone mass assessment and implantation procedure of different patients with complete edentulousness. However, little is known about the impact of the implant sites arrangement on framework, distal implant and surrounding bone stress. The aim of this study was to investigate the biomechanical behavior changes of the implant sites distribution on the framework in the axial design and compared with the inclined design. Arched mandible models with four different implant placement arrangements were built using 4 axial implants. Another alternative inclined design was generated for comparison with the axial design while maintaining an even distribution of the implant positions. A 300 N oblique load at 45° to the occlusal plane was applied to bilateral posterior-tooth area for finite element analysis. For the axial design, the maximum stress occurred in groups with multiple implants adjacently arranged, whereas the minimum peak stress occurred in groups with each implant evenly spaced. Considering these two implant configurations, the inclined design demonstrated lower stress levels on the distal implant and surrounding bone. For full-arch implant restorations, an inclined designed with 4 implants evenly distributed on the mandible is preferred to obtain optimal stress distribution.
10:15-10:30 MA041	Evolution Law and Mechanism of Residual Stress in Ring Components by Cold Ring Rolling Method ***Hechuan Song,*** *University of Science and Technology Beijing, China* *Abstract*—Quenching treatment is usually used to improve the mechanical properties of the age-strengthening aluminum alloy. However, high residual stress is introduced during the quenching process, which seriously affects the subsequent manufacturing and service performance. Therefore, the elimination and homogenization of residual stress are particularly important. Based on this, a new and effective method, ring cold rolling (CRR) stress relief, was proposed in this paper. Taking the 2219 Al alloy ring widely used in the aerospace field as an example, the evolution and distribution of residual stress during CRR were explored. The potential danger of the test ring deformation before and after CRR was analyzed with the strain energy density theory. Based on the experimental results, the internal mechanism of residual stress relief by

	CRR was revealed. The results show that the circumferential and axial residual stress relief rates of the test ring after CRR are 32.35% and 37.86%, respectively, and the degree of residual stress non-uniformity is greatly reduced. At the same time, the strain energy density of the test ring greatly reduces after CRR, and the trend of adverse deformation is effectively reduced. The relief of internal stress is achieved through the initial stage of plastic deformation. Meanwhile, the disordered high-energy defects tend towards a newly ordered low-energy equilibrium. This study can provide theoretical and technical support for the shape control of high-performance ring components.
10:30-10:45 MA044	Efficient Self-Driving Control for Electric Vehicles **Kiwon Yeom,** Sangmyung University, South Korea *Abstract*—Automated self-driving vehicles not only allow of improved energy saving but also better traffic flow. In particular, with the rapid technological advance of autonomous electric vehicles, technical development of energy efficient eco-driving is becoming progressively important due to the limited battery capacity and power of electric vehicles. This paper presents a hybrid approach of Model Predictive Control (MPC) and Deep Reinforcement Learning (DRL) for improving the energy economy of battery electric vehicles. In this study, the MPC algorithm is used to solve the optimal speed profile of the electric vehicles for minimizing energy consumption in a receding horizon, where the terminal cost for the receding horizon is fed into the DRL networks as observed state. Thus, the terminal cost of a state is learned by nearest neighbors and the terminal condition is constrained in a state observed before. The proposed scheme was tested virtually with the high fidelity car simulator (CarSim) and simulation results show the effectiveness of energy.
10:45-11:00 MA039	Laser Scanner-Based Robotic Coordinate Measuring Machine ***Vladimir Gurau,*** *Georgia Southern University, United States* *Abstract*—A robotic coordinate measuring machine (CMM) for digitizing 3D geometry of objects is designed, integrated, and demonstrated for use in reverse-engineering applications. The paper describes the mathematical model, the integration of the light detection and ranging (LiDAR) sensor with the automated positioning system and the programming used to attain the technology. The digital reconstruction of an object's 3D model is achieved by applying forward robot kinematics along with homogeneous transforms to the point cloud detected by the LiDAR. The object's geometric features are determined using 2nd-order polynomial best fitted curves of the scanned point clouds using the bisquare fit method. The CMM has capability to programmatically compensate for geometric positioning errors resulting from deviations in position and orientation of the CMM components during assembly and from deviations in position and orientation of the workpiece when it is located in its mounting device. The instrument is shown to reconstruct with remarkable qualitative accuracy the 3D model of a turbine blade. Using a better-quality detecting sensor, the instrument can be used as well in automated quality control and inspection applications.
11:00-11:15 MA046	Compressive Strength Target Method for Optimal Zero Carbon Concrete Mixture Synthesized from Fly Ash ***Maher M. Hassoon,*** *Al-Nahrain University, Department of Civil Engineering, Iraq* *Abstract*—Due to more variables involved in Zero Carbon Concrete (ZCC) mix design and proportioning compared to normal concrete, ZCC mixture design becomes more complex. Despite the fact that much experimental information is published by various researchers in order to comprehend the variable proportions of ZCC, the absence of standards of practice hinders its general implementation. Design mixture and mixing procedure were mostly according to a trial-and-error method. Thus, this research aims to investigate the impact of molarity concentration and ratio of (Sodium Silicate (SH)/Sodium Hydroxide), which is called R ratio, on the strength of Zero Carbon Concrete (ZCC-FA) manufactured from low Calcium fly ash (FA) Class F. Design of Experiment (DOE) was employed using MINITAB program for test, statistical and analysis of variance (ANOVA) purposes. The finding of the current study proved that increasing the R ratio led to improving the strength. The optimum R ratio was 2.5. Besides, increasing and decreasing the Molarity affected significantly the ZCC strength.

11:15-11:30 MA026	Lean Production Model to Reduce Defects and Achieve Sustainability in a Peruvian Textile SME ***TBA,*** *Universidad Peruana de Ciencias Aplicadas, Peru* *Abstract*—Currently, SMEs are exposed to economic losses due to inadequate internal management, one of the main being "Process Management". This brings consequences to the entire flow of production and sales of the company in a directly proportional way. Also, without the necessary material to produce, there are no products to sell, affecting the level of defective and customer satisfaction. Therefore, the motivation of the article is to design the management by processes and analyze the causes of the increase in the levels of defective in the SMEs of the Peruvian textile sector. To address this challenge, it aims to reduce the level of defective products from 8% to 5% optimal as indicated by the technical gap. The solution integrates Lean tools such as the 5S tool, Autonomous Maintenance and Process Standardization to improve and increase quantitative and qualitative indicators in the company. In addition, the PDCA cycle was integrated as a fundamental contribution and link to the proposed solution model and also as a mechanism to support sustainability that will be implemented and that allows the continuous improvement of processes and product quality, which will increase the competitiveness and profitability of the company in the market.
11:30-11:45 MA1002	The Role of Services Output in Environmental Pollution: Global Evidence from Lean Maintenance Design to Optimize the Manufacturing Process: A Peruvian Textile Company Case ***Jaqueline Cabana,*** *Universidad Peruana de Ciencias Aplicadas, Peru* *Abstract*—In recent years, the textile industry has increased its exports compared to previous years and produces thousands of jobs per year. However, some manufacturing companies in the textile industry experience low efficiency, such as the current textile company under study associated with unplanned machine downtime and idle time. In this sense, this study aims to promote the capacity, productivity, and efficiency of textile companies that manufacture garments. Therefore, a Lean Maintenance model supported by the integration of Lean Manufacturing instruments and techniques such as TPM, 5S, Kaizen is proposed in order to improve machine availability and quality through management metrics. After the implementation of the proposed tool integration, the activities of the operations were standardized, an increase in efficiency was generated, and a favorable change in maintenance metrics was achieved.

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