CONFERENCE PROGRAM

Eastern European Time (EET) **UTC +2**

ICMMM 2021

2021 8th International Conference on Mechanical, Materials and Manufacturing

With Workshop

TMAE 2021

2021 3rd International Conference on Trends in Mechanical and Aerospace

September 25-27, 2021 | Virtual Conference

Co-sponsored by CAPITOL Technology University

Supported by GEORGIA SOUTHERN UNIVERSITY

BAKERSFIELD COLLEGE

Technically Assisted by RMIT UNIVERSITY

www.icmmm.org | www.tmae.org

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#CONFERENCE MATERIALS

- Zoom Guidance (click) *For new users.*
- Virtual Background.jpg (click)
- Electronic Banner.jpg (click)

1 WELCOME MESSAGE

Dear colleagues and friends,

On behalf of the conference organizing committees, we are delighted to welcome you to 2021 8th International Conference on Mechanical, Materials and Manufacturing (ICMMM 2021) with its workshop 2021 3rd International Conference on Trends in Mechanical and Aerospace (TMAE 2021), to be held during September 25-27, 2021, co-sponsored by Capitol Technology University, USA.

After serious consideration, the committee decides to have ICMMM 2021 and TMAE 2021 as a virtual conference this year again. As you have been aware, COVID-19 is still out of control for many countries, and the safety and well-being of our participants is of paramount importance to us. The objective of the conference is to provide a premium platform to bring together researchers, scientists, engineers, academics and graduate students to share up-to-date research results. We are confident that during this time you will get the theoretical grounding, practical knowledge, and personal contacts that will help you build a long term, profitable and sustainable communication among researchers and practitioners in the related scientific areas.

This year's program is composed of 3 parallel sessions, and 4 keynote speeches delivered respectively by Prof. Dr. Osamu Tabata (FIEEE, Kyoto University of Advanced Science, Japan), Prof. Dr. Chris Yuan (ASME Fellow, Case Western Reserve University, USA), Prof. Alan Lau (FIEAust, Swinburne University of Technology, Australia), and 1 plenary speech given by Asst. Prof. Haijun Gong (Georgia Southern University, USA). We would like to express our gratitude to all the speakers in this conference. Special thanks to all of our committee members, all the reviewers, and the attendees for your active participation. We hope the conferences will be proved to be intellectually stimulating to us all.

Finally, we wish you a very successful conference!

Yours Sincerely

ICMMM & TMAE 2021 - Conference Organizing Committee

2 MEETING AGENDA

Essential Information

Please make sure you are aware of the following details before the conference.

Meeting ID

MI: 966 2081 6089 (Room A)
MI: 892 4387 6477 (Room B)
Room will be open 30 mins in advance.

Test Session

Check details of the testing time on **Saturday, Sep 25**, and please make sure to show up on time.

Name Setting

Keynote Speaker: Keynote-Name
Committee: Position-Name
Author: Paper ID-Name
Listener: Listener-Name

Time Zone

UTC+2:00
Eastern European Time (EET)
Please be aware of time difference between this and your region/country.

2 MEETING AGENDA

Room A: 966 2081 6089
Meeting Link: https://zoom.us/j/96620816089

Saturday
25.09.2021.

Zoom Test Sessions

12:00-12:40	12:40-13:20	13:20-14:00	14:00-14:30	14:30-15:00
M013	M027	M1001	Keynote / Plenary Speakers	**[Waiting Time]** for all participants who are unavailable at allocated time.
M025	M008	M0014		
M011	M018	M004		
M023+M024	M007	M0018		
M003+M006	M019	M0007		
M012	M020	M017		
M015	M0005	M0013		
M026	M016	M0016		
/	M031-A	M009		
/	M0017	M1001 (TMAE 21)		

Pre-test for next 2-day Formal Session

- We will test screen sharing, audio, video, and how to "Raise Hand" in Zoom. Please get your presentation slides and computer equipment prepared beforehand.
- All the presenters are required to join the Zoom test sessions on Sep.25, to ensure the next two-day meetings run smoothly.
- It may only take you 3min to complete the test session, then free to leave.

Please note that times provided in the programme are according to the Eastern European Time (EET).

2 MEETING AGENDA

Room A: 966 2081 6089
Meeting Link: https://zoom.us/j/96620816089

Sunday
26.09.2021.

TIME	ACTIVITY	PRESENTER
Chairman: Prof. Ian McAndrew, Capitol Technology University, USA		
14:00-14:10	**Opening Remarks**	**Prof. Ian McAndrew - Conference General Chair** Capitol Technology University, USA
14:10-14:55	**Keynote Speech I** Top-down Meets Bottom-up: Way to Explore the Plentiful Room at the Bottom	**Prof. Dr. Osamu Tabata** Fellow of IEEE / Kyoto University of Advanced Science, Japan
14:55-15:40	**Keynote Speech II** Sustainable Manufacturing of Lithium Ion Battery for Electric Vehicles	**Prof. Dr. Chris Yuan** Fellow of American Society of Mechanical Engineers / Case Western Reserve University, USA
15:40-16:00	**Group Photo / Break Time**	
16:00-16:45	**Keynote Speech III** Aircraft Composite Repair - Fundamental to Structural Health Monitoring	**Prof. Alan Lau** Fellow of Institution of Engineers, Australia / Swinburne University of Technology, Australia
16:45-17:20	**Plenary Speech** Mechanical Properties of 3D Printed High-Performance Plastic Polyether-ether-ketone (PEEK)	**Asst. Prof. Haijun Gong** Georgia Southern University, USA

- Please note that times provided in the programme are according to the Eastern European Time (EET).
- Each keynote talk includes a 5-minute Q&A session.

2 MEETING AGENDA

Monday

27.09.2021.

TIME	ACTIVITY	MEETING ROOM
09:00-11:45	**Session 1: Materials Science and Constructional Engineering** Presentations: M013 M025 M011 M023 M003 M012 M024 M015 M006 M026 M027	**Room A: 966 2081 6089** Meeting Link: https://zoom.us/j/96620816089
11:45-13:00	**Session Group Photo / Break Time**	
13:00-15:15	**Session 2: Metal Processing and Manufacturing Technology** Presentations: M008 M018 M007 M019 M020 M0005 M016 M031-A M0017	**Room A: 966 2081 6089** Meeting Link: https://zoom.us/j/96620816089
13:00-15:30	**Session 3: Mechanical Engineering and Aerospace Technology** Presentations: M1001 M0014 M004 M0018 M0007 M017 M0013 M0016 M009 M1001(TMAE)	**Room B: 892 4387 6477** Meeting Link: https://us02web.zoom.us/j/89243876477

- Please note that times provided in the programme are according to the Eastern European Time (EET).
- Each oral presentation includes a 3-minute Q&A session.

3 INTRODUCTION OF SPEAKER

Prof. Dr. Osamu Tabata
FIEEE
Kyoto University of Advanced Science, Japan

Prof. Dr. Chris Yuan
ASME Fellow
Case Western Reserve University, USA

Prof. Alan Lau
FIEAust
Swinburne University of Technology, Australia

Asst. Prof. Haijun Gong
Georgia Southern University, USA

Please note that times provided in the programme are according to the Eastern European Time (EET).

3 KEYNOTE SPEAKER I

Please note that times provided in the programme are according to the Eastern European Time (EET).

Sunday
26.09.2021.

Prof. Dr. Osamu Tabata
FIEEE

Kyoto University of Advanced Science, Japan

14:10-14:55

Speech Title: Top-down Meets Bottom-up: Way to Explore the Plentiful Room at the Bottom

Abstract: In 1982 two papers in particular were published. One is recognized as the bible of Silicon micromachining, which is a typical top-down approach to miniaturization, and the other is known as the origin of DNA nanotechnology, which is a typical bottom-up approach to realizing nanoscale objects. Almost 40 years later the former is still the key to MEMS and the latter is the key to molecular machines. Both of these are recognized as powerful technologies and yet there remains a significant gap between them. In this talk I begin by introducing the historical aspects of these two approaches to exploring the world at micro and nano scales. I then survey the current status of MEMS and DNA nanotechnology before discussing one challenging goal that remains to be addressed.

Bio: Osamu Tabata received his M.S. and Ph.D. degrees from Nagoya Institute of Technology, Japan, in 1981 and 1993, respectively. He is currently engaged in research on micro/nano processes, MEMS, DNA nanotechnology.

Prof. Tabata was a guest professor at the Department of Microsystem Engineering, University of Freiburg, Germany from September to December 2000, a guest Professor of ETH Zurich, Switzerland from January to March 2001, a visiting senior international scientist of the Chinese Academy of Science in 2010, a guest Professor of Huazong University of Science and Technology, China from July 2011 to July 2014, a senior research fellow at the Freiburg Institute for Advanced Studies (FRIAS) from May 2010 to September 2012, a distinguished visiting researcher of American University in Cairo in 2016 and a visiting Professor of Tsinghua University China from November 2018. He is a senior editor of the IEEE Transactions on Nanotechnology (TNANO), an associate editor of the ASME/IEEE Journal of Micro Electro Mechanical Systems (JMEMS), and an editorial board member of the Elsevier Journal Sensors and Actuators. He is as a member of Award Committee for EDS. He is also a program committee member of many important International Conferences in his area of expertise. He is a Fellow of Institute of Electrical and Electronics Engineers and Institute of Electrical Engineer Japan.

3 KEYNOTE SPEAKER II

Please note that times provided in the programme are according to the Eastern European Time (EET).

Sunday
26.09.2021.

Prof. Dr. Chris Yuan
ASME Fellow

Case Western Reserve University,
USA

14:55-15:40

Speech Title: Sustainable Manufacturing of Lithium Ion Battery for Electric Vehicles

Abstract: Electric vehicles (EVs) are widely promoted as clean alternatives to conventional vehicles for reducing greenhouse gas emissions from ground transportation. However, the lithium ion batteries (LIBs) used in current EV are with limited capacity, short battery life and large environmental impacts, which are rooted in the battery materials, manufacturing processes and operating conditions. In this talk, our research on battery materials, battery manufacturing, battery performance modeling and life cycle assessment of lithium battery technologies for electric vehicles will be presented. High capacity battery electrode materials includingg Si, MoS2 and Sulfur are designed and fabricated. Multiphysics electrochemical models have been developed for predictive modeling of battery life on electric vehicles. Water-based manufacturing of lithium ion batteries is studied in comparison with conventional manufacturing processes. Life cycle assessment models have been developed to evaluate the environmental impacts of lithium ion battery technologies.

Bio: Prof. Yuan currently holds the Leonard Case Jr. Professorship in Department of Mechanical and Aerospace Engineering at Case Western Reserve University. He is the Director of the Laboratory for Sustainable Energy Manufacturing and Director of the DOE-funded Industrial Assessment Center at CWRU. His research activities are focused on the forefront of sustainable manufacturing, industrial energy efficiency and clean energy manufacturing. So far he has published over 170 research papers and book chapters on these topics. In 2017 his research won First Place in the U.S. RAMP National Research Competition on Sustainable Manufacturing. In 2018, he is the recipient of the American Society of Mechanical Engineers' Chao and Trigger Young Manufacturing Engineer Award. He received the National Science Foundation Career Award in 2014, The Gustav Olling Outstanding Young Manufacturing Engineer Award from the Society of Manufacturing Engineers (SME) in 2013, and the LEO Best Paper Award from the 2013 CIRP International Conference on Life Cycle Engineering. He served the Chair of ASME Life Cycle Engineering Technical Committee during 2013-2015, and served over 50 times for conference program chairs, track chairs, symposium chairs, session chairs, scientific committee, etc., for various ASME, IEEE, and CIRP conferences.

He is a Fellow of American Society of Mechanical Engineers.

3 KEYNOTE SPEAKERS III

Please note that times provided in the programme are according to the Eastern European Time (EET).

Sunday
26.09.2021.

Prof. Alan Lau
FIEAust
Swinburne University of Technology, Australia

16:00-16:45

Speech Title: Aircraft Composite Repair - Fundamental to Structural Health Monitoring

Abstract: Advanced composites have been widely used in all engineering sectors owing to their high specific strength to weight ratio, non-corrosive properties and ease of manufacturing components in a piece without excessive use of fasteners that introduce additional weight and possibly, risks of generating corrosion with metallic components. Many practical examples have proved that the composites can be used in safe, in terms of their better fracture resistance characteristics. However, damage inspection and repair scheme for composites remain a critical issue for the aircraft engineering industry. Lacking knowledge of frontline technicians and engineers on these materials have always caused human errors in handling and fabricating composite components. Special environments and proper handling and manufacturing procedures should be followed to minimize the introduction of internal flaws, like voids and micro-cracks. Subsequent structural health monitoring and onsite damage detection are important to accurately identify flaws or damage that could not be seen from the surface of composite components.

In this seminar, Professor Lau will provide an overview on the applications of composites for different engineering sectors, as well as the key factors that affect the quality of composite repair, including the structural health monitoring of composites structures, after being repaired.

Bio: Professor Alan Lau is Pro-Vice-Chancellor (Research Partnership and Digital Innovation) of Swinburne University of Technology. Professor Lau has received numerous research and teaching awards in the past 20 years. His published articles have received citations over 23,000 times (H-index 73) to date. In 2008, he was appointed World Class University Chair Professor by the Ministry of Education, Korea. He is Fellow of the European Academy of Science and Arts and a Fellow of many professional organizations. He was elected as International Vice President of the Institution of Mechanical Engineers (IMechE) from 2013 to 2019. In 2019, he was named as Australia's Research Theme Leader in Composite Materials. Since 2014, he was appointed Independent Non-Executive Director of King's Flair International (Holdings) Limited. Currently, he is Director of Oceania Cybersecurity Centre Ltd. And Stawell Underground Physics Laboratory Company.

3 PLEANRY SPEAKER

Please note that times provided in the programme are according to the Eastern European Time (EET).

Sunday
26.09.2021.

Asst. Prof. Haijun Gong

Georgia Southern University, USA

16:45-17:20

Speech Title: Mechanical Properties of 3D Printed High-Performance Plastic Polyether-ether-ketone (PEEK)

Abstract: Polyether-ether-ketone (PEEK) is commonly used for aerospace, automotive, and medical fields, as a high-performance thermoplastic material. PEEK's outstanding properties are reflected in various aspects such as high heat resistance, high chemical resistance, high water resistance, and high wear resistance. Compared to the traditional manufacturing process, 3D printing offers a flexible and economical approach to make PEEK parts. 3D printing not only lowers the initiating cost of making PEEK parts, but also fulfills specific requirements of geometrical complexity. However, the mechanical properties of 3D printed PEEK materials are not well recognized. This study investigated the mechanical properties of PEEK materials fabricated using the fused deposition modeling (FDM) based 3D printing process. Tensile test, hardness test, and impact test were conducted to the PEEK samples, in compliance with ASTM standards for plastic materials. The testing results were summarized and discussed, compared to the conventionally manufactured PEEK materials. This study also provides insights on employing FDM 3D printing process for making PEEK parts, based on its special mechanical properties and failure mode.

Bio: Dr. Gong's research interest concentrates on characterizing the material properties of metal additive manufacturing product including titanium alloy, cobalt chrome, aluminum alloy, etc., as well as simulating their laser or electron melting and solidification process. He is interested in applying the knowledge of additive manufacturing materials for the advanced manufacturing processes. Dr. Gong is also interested in additive manufacturing and 3D printing process development, aiming to fully incorporate this technology into the modern manufacturing process.

4 ABSTRACT OF PARALLEL SESSION

01

No-Show Policy

A paper not presented will be removed from the final conference proceedings.

No refund will be approved to authors of those papers.

02

Duration of Presentation

15min

12min for presentation, and 3min for Q&A.

Presenter's certificate will be sent out by email, one week after the meeting.

03

Report File

a. PowerPoint file
b. PDF file
c. Pre-recorded video

are all acceptable.

Please join Zoom conference at least 10min before your session starts to get prepared.

04

"Best Presentation" Award

It will be selected from each virtual session by the session chair.

Please visit our website a week after the meeting for info.

The presenter will receive a certificate of "Best Presentation".

Please note that times provided in the programme are according to the Eastern European Time (EET).

4 ABSTRACT OF SESSION 1

Session 1: Materials Science and Constructional Engineering	Time: 09:00-11:45 || Room A: 966 2081 6089
Session Chair: TBA	Meeting Link: https://zoom.us/j/96620816089

Time & ID	Presentation
09:00-09:15 M013	Environmental Assessment of Concretes Containing Construction and Demolition Waste **Ivan Moccia**, University of Naples Parthenope, Italy Abstract—The recycling of construction and demolition waste (CDW) is currently of growing interest. Starting from such waste products it's possible to produce recycled aggregates for construction purposes providing environmental and economic advantages. Life-cycle assessment (LCA) is a valuable tool to evaluate the environmental impact at end of life of CDW and improve the employment of recycled aggregates in concrete. In this research a life cycle evaluation of concrete mixtures made with CDW is performed to assess their environmental impacts considering various scenarios related to recycling sites with different conveying distances. The advantages of replacing natural aggregates with recycled ones are evaluated using a combination of LCA model and Life-Cycle Impact Assessment to estimate the environmental effects for all the considered scenarios. The results highlighted the highest environmental impact for the scenario with total landfill as well as an increasing impact for increasing distance from the demolition site.
09:15-09:30 M025	Surface Design of 3D-printed PEEK by controlling Slicing Parameters **Carlo S. Emolaga**, Industrial Technology Development Institute, Department of Science and Technology, Philippines Abstract—Additive manufacturing of high-performance materials such as polyether ether ketone (PEEK) is constantly gaining attention because of its applications in diverse fields. PEEK is a semicrystalline thermoplastic that exhibits superior mechanical properties, biocompatibility, and wear resistance that makes it suitable for biomedical and other industrial applications. Most of these applications call for surface designs where roughness and porosity are a major consideration. In this study, PEEK samples with different surface designs were prepared by modifying slicing parameters such as wall line, infill density, and raster angle. The samples were printed using fused deposition modelling and were characterized using a non-destructive method, X-ray micro computed tomography (X-ray micro-CT). X-ray tomograms and void content analysis show that voids usually occur at the junction between the walls and the infill for all three designs. Reducing the infill travel path by adding inner walls resulted to higher defect volume ratio. Defect volume ratio increased from 0.06% to 0.36% after the addition of inner walls. Reduction in infill density further increased the defect volume ratio. These results show that different surface and internal designs can be prepared by modifying slicing parameters and its defects/void content can be readily evaluated by X-ray micro-CT.

4 ABSTRACT OF SESSION 1

Time & ID	Presentation
09:30-09:45 M011	Environmental Friendly Lightweight Artificial Aggregates through Industrial Waste Stabilization **Cinzia Salzano**, University of Naples Parthenope, Italy Abstract—The production of lightweight artificial aggregates proposed in this study derives from industrial waste recovery activities, such as fly ash (FA) and ground granulated blast furnace slag. The aim is to reduce the compromise of the environment and human health, through the recycling of special waste. The use of inert aggregates from recovery from industrial waste encourages the reduction of soil consumption, the waste of natural aggregates, consequently limiting the consumption of waste materials from quarries, as well as facilitating the recovery of waste that would inevitably end up in landfilled or abandoned in the environment. Specifically, in the present work, the lightweight artificial aggregates were produced by cold bonding granulation technique. All the mixtures, made by 80% of FA with various composition of cement and granulated blast furnace slag, were characterized by density values ranging from 1.63 to 1.66 g cm-3 suggesting their suitable classification as lightweight aggregates (LWAs). Water absorption capacity (WAC) and open porosity values decreased with the increase of the percentage in cement. The impact test results indicate that all the aggregates have proved to be suitable as filling for road pavements. The best crushing strength values (1.86 MPa) were observed for the mixture contain the highest amount of cement. Aggregate leaching tests indicated a significant release of chlorides and sulphates while the release of heavy metals was lower than the limits set by the standard UNI 10802.
09:45-10:00 M023	Adsorptive Removal of Multi-Metal Ions in Wastewater Using Electrospun Cellulose Acetate / Iron-Modified Nanozeolite Nanofibrous Membrane **Blessie Ambata Basilia**, Mapua University, Philippines Abstract—In this undertaking, nanofibrous membrane of cellulose acetate (CA) with varying concentrations of iron-modified nanozeolite (Fe-MNZ) were produced through electrospinning technique for the simultaneous adsorption of Ni2+, Co2+ and Cu2+ heavy metal ions in wastewater. The electrospun nanofibrous membranes (ENMs) produced underwent different characterization techniques to determine the effect of Fe-MNZ addition on the ENM of CA in terms of porosity and adsorption capacity. Porometry results and contact angle measurements confirmed the increase in fiber diameter through the decrease in pore size and increase in the wettability of the ENMs produced. The adsorption experiment showed that ENM blend 2, M2, containing 1.0 wt.% Fe-MNZ had the highest removal efficiency for Ni2+ ions at around 79.20%, while ENM blend 3, M3, which contained 1.2 wt.% Fe-MNZ had adsorbed most of the Co2+ and Cu2+ ions with removal efficiencies equal to 54.04% and 100%, respectively. Adsorption of Ni2+ and Co2+ ions was governed by Freundlich isotherm and pseudo-first order kinetics, whereas the adsorption data of Cu2+ ions best fitted both Langmuir and Freundlich isotherms, and pseudo-second order kinetics. Lastly, the adsorption of the heavy metal ions was verified by the results of SEM-EDX.

4 ABSTRACT OF SESSION 1

Time & ID	Presentation
10:00-10:15 M003	Hybrid Reinforced Aluminium Composites using Reduced Graphene Oxide Fabricated via Powder Metallurgy Technique **Belal Nassef**, Faculty of Engineering, Alexandria University, Egypt Abstract—Recently, carbonaceous materials, such as graphene, have proven to be promising additives that show considerable improvements in mechanical and tribological properties of aluminium-based composites. In this present investigation, novel aluminium based hybrid composite specimens of various RGO and Al2O3 contents are prepared using powder metallurgy technique. The composite specimens have been tested in wear and microhardness. The results show that the hybrid composite containing 0.3 wt.% RGO -5 wt.% Al2O3 experiences the highest wear resistance with a hardness of about 76 HV among the tested composite specimens. The improvement in properties in the optimized hybrid composite was found to be much higher when compared to hybrid Aluminium Composites in literature fabricated using other techniques.
10:15-10:30 M012	Eco-friendly Concretes with Recycled Plastic Aggregates **Marco Ruggiero**, University of Naples Parthenope, Italy Abstract—Every year, in the world, the produced quantities of plastic amount to approximately 400million tons. This implies a high level of plastic pollution and a growing decrease of available naturalresources. Therefore, seems to be clear that there is a need to act in such a way as to reduce plasticpollution, safeguard natural resources and prevent the disposition of great quantities of waste in landfillsor, even worse, the discharging into marine waters. This explains the need to implement processes ofrecovery and recycling of this plastic waste and their reuse in operable and practical products. Manystudies analyzed the chances of employing plastic waste to produce cement and concrete, but theresearch about the use of polyolefins for the production of lightweight concretes is still limited. Thisstudy shows that the use of recycled polyolefins as substitutes of natural aggregates is a viable solutionfor the production of lightweight concretes by analyzing the influence of this kind of plastic onmechanical, physical and thermal performance, through experimental tests performed on four samplescontaining different amounts of plastic aggregates.

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4 ABSTRACT OF SESSION 1

Time & ID	Presentation
10:30-10:45 M024	Synthesis, Characterization and Electron Beam Curing of Poly(glycerol sebacate methacrylate) **Blessie Ambata Basilia**, Mapua University, Philippines Abstract—Poly(glycerol sebacate) pre-polymer was synthesized and methacrylated to different degrees (PGSm-0.1, PGSm-0.2, PGSm-0.4) to impart processability using radiation technology. Spectroscopic analyses (FTIR and 1H NMR) confirmed the presence of ester linkage in the poly(glycerol sebacate) chain and the methacrylate group in the derivatives. The degree of methacrylation (DM) computed from the 1H NMR signal integration ranged from 0.1 to 0.4. The molecular weight and polydispersity increased with an increase in DM. The DSC thermograms suggested better elastomeric properties at ambient temperature, while the TGA showed no significant shift in the degradation parameters of PGS upon methacrylation. Electron beam curing of the PGSm samples was employed, and the resulting films were characterized for gel content, surface topography, and wettability. The crosslinked PGSm-0.2 and PGSm-0.4 samples exhibited high gelation at doses 5-50 kGy. However, no gelation above 15 kGy occurred in PGSm-0.1, suggesting that main chain scission reactions prevailed. The surface properties of the films obtained from the AFM and contact angle measurements revealed high surface roughness and wettability.
10:45-11:00 M015	Analytic Results on the Minimal Mass Design of Tensegrity Bridges **Narinder Singh**, Dept. Civil Engineering, University of Salerno, Italy Abstract—This paper deals with an analytic study of the minimal mass problem of tensegritybridges under yielding and bucking constraints. The given results reveal that substructurebridges require less mass than superstructure-type systems. They also highlight that theoptimal complexity (number of elements) of the bridge approaches in nity, when dealing withsuperstructure bridges, and while ignoring the joint masses. More convenient is the substructure-type bridge in terms of mass savings. The outcomes of this study provide useful directions forthe conceptual design and technical applications of tensegrity bridges.

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4 ABSTRACT OF SESSION 1

Time & ID	Presentation
11:00-11:15 M006	Effect of Graphene Addition to Lithium-Based Grease on the Performance of Rolling Element Bearings **Belal Nassef**, Faculty of Engineering, Alexandria University, Egypt Abstract—Recent research attempts have shown that graphene as a lubricant nano-additive provides excellent tribological behaviour in mechanical applications due to its outstanding properties represented in its self-lubricating nature. In this work, a set of deep groove ball bearings lubricated using lithium-based grease mixed with different contents of reduced graphene oxide (rGO) were tested through a specially designed test rig under different loading conditions. The rGO additions were varied to include 0.5, 1, 2, 3.5, and 5 wt.%. The consumed power is introduced for the first time as a measure of lubrication efficiency. The results demonstrate that the addition of rGO reduces the consumed power required to drive the rotor under the applied test load. The most considerable power saving is obtained after adding 2wt.% rGO to grease, which has reduced the consumed power down to about one-fourth of that consumed using grease only. Also, the vibration levels were measured and analysed for each lubrication and loading condition.
11:15-11:30 M026	Characterization and Antibacterial Potential of Melt Compounded Acrylonitrile Butadiene Styrene/Copper Nanoparticle Composites **Persia Ada N. de Yro**, Mapua University, Philippines Abstract—Copper Nanoparticle (CuNP) is mixed as nanofiller to Acrylonitrile Butadiene Styrene (ABS) to produce a material that can control bacterial growth on material surfaces and improve antibacterial performance. The nanocomposite is produced via melt compounding using a twin-screw extruder. Three samples are prepared with 0%, 1.5% and 3% Copper Nanoparticle loading. The samples are extruded, placed in a mold and processed in a compression molding machine. The samples were characterized using Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), Dynamic Mechanical Testing (DMA) and Antibacterial Testing. Results from FTIR shows presence of molecular vibrations of Acrylonitrile, Butadiene and Styrene groups with the presence of foreign substances identified as an additive used in commercial ABS production. XRD showed the incorporation of copper nanoparticles in the nanocomposites. DMA results shows that the incorporation of copper nanoparticles into the ABS matrix results to diverse effect on its mechanical and thermal property. Lastly, antibacterial test showed that both 1.5 wt% CuNP and 3 wt% CuNP exhibited high effectivity on inhibiting Escherichia coli.

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4 ABSTRACT OF SESSION 1

Time & ID	Presentation
11:30-11:45 M027	Comparative seismic behavior the retrofit of 60year old hospital between CFRP materials and Concrete Walls by nonlinear static analysis **Xiomara Criales**, Peruvian University of Applied Sciences (UPC), Peru Abstract—The Casimiro Ulloa Hospital is a confined masonry structure more than 60 years old that does not satisfy the requirements of the Peruvian seismic code E.030 and it is located at high seismic zone. Therefore, this hospital is susceptible to collapse and becomes an essential deficient structure. Therefore, the present study is based on a comparative analysis between reinforced concrete wall and CFRP sheets through the nonlinear Push Over method in order to obtain which is the best reinforcement in structural capacity. The reinforcement with eight L-shaped concrete walls of 15 cm thick located at the corners of the structure, increased the strength of the hospital by 115% in longitudinal direction (Axis X) and 108% in transversal direction (Axis Y), and also increased the ductility by 3% and 117% in the directions respectively. The other reinforcement was carried out with CFRP sheets and anchors. The sheets were designed with a width of 9 inches and were placed in an X-shape in the masonry load-bearing walls and the anchors were implemented in the corners of the laminate walls in order to ensure adequate load transfer between the sheets and the surface. This reinforcement increased the strength of the structure by 345% in axis X and 150% in axis Y and increased the ductility by 59% in longitudinal direction and 331% in transversal direction.

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4 ABSTRACT OF SESSION 2

Session 2: Metal Processing and Manufacturing Technology **Session Chair:** TBA	**Time:** 13:00-15:15 || **Room A:** 966 2081 6089 **Meeting Link:** https://zoom.us/j/96620816089

Time & ID	Presentation
13:00-13:15 M008	Power-based Model for Temperature Prediction in FSW **Danilo Ambrosio**, Laboratoire Génie de Production, INP/ENI Tarbes, 65016 Tarbes, France Abstract—This paper describes a thermal numerical model accessible to all users for predicting temperature in friction stir welding from the power, material thermal properties, process parameters, tool, and plate dimensions. Starting with the information obtained from the machine, power or torque, the heat flux is modeled as a circular moving source with a diameter equal to that of the shoulder. The model calibrated in a specific setup (CNC machine) successfully predicted without recalibration the weld temperature field in another one (robot). The simple thermal model was applied without recalibration to data available in the literature to test its effectiveness. The results obtained with this model are promising, although more tests are needed to cover all possible varieties of tool geometries and material thickness. If extended over a broader range of configurations (i.e., process parameters and tool-workpiece geometries), it could be a handy tool for all FSW users. The tool may help study the thermal cycles in the heat affected zone that influence final mechanical properties and make it easier to identify optimal parameters if the desired optimal peak temperatures are determined.
13:15-13:30 M018	Investigation about the Influence of Selective Laser Melting Process Parameters on the Microstructure and Mechanical Properties of 18Ni-300 Maraging Steel **Wee King Law**, University of Nottingham Malaysia (UNM), Malaysia Abstract—The influence of SLM process parameters (i.e. laser power, scanning speed, and hatch spacing) on the microstructure and mechanical properties of 3D printed 18Ni-300 maraging steel was investigated. In experiments on 3D printed scan tracks, better fusion of powder material was achieved in parameter configurations with higher linear energy density (i.e. LED ≥ 375.00 J m-1). A higher LED indicates that more laser energy is transferred to the powder material, resulting in complete melting of the powder and the creation of a microstructure with less defects. In experiments on fully built samples, higher relative density was achieved when the hatch spacing was increased or the scanning speed was decreased. Fully built samples produced using parameter configuration B-2 (300 W, 700 mm s-1, 0.10 mm) have higher relative density and ultimate tensile strength as compared to the other parameter configurations.

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4 ABSTRACT OF SESSION 2

Time & ID	Presentation
13:30-13:45 M007	A Cloud-Fog Continuum Computing Architecture for Cyber-Manufacturing Systems **Zhengyi Song**, Syracuse University, United States Abstract—Cyber-Manufacturing System (CMS) is a vision for the factory of the future, where physical components and processes are seamlessly integrated with computing processes to form highly adaptive and responsive manufacturing operations. In CMS, manufacturing resources and capabilities are digitized and shared with users and stakeholders through a local area network (LAN) and the Internet. CMS aims to utilize the manufacturing data obtained during all product lifecycle phases to provide agile and scalable manufacturing solutions. Currently, a centralized cloud-based computing environment supported by the distributed Internet of Things (IoT) devices network is used to enable the typical functionalities—such as manufacturing resource sharing and large-scale manufacturing collaborations. However, facing the explosion of manufacturing data from factory floors, cloud-based computing solutions show limitations in providing low-latency services, performing real-time state analysis, configuring the machines, and controlling other executors in the physical manufacturing end. Furthermore, private production data and technical details cannot be appropriately masked in the public cloud platform. In this research, a Cloud-Fog Continuum Computing Architecture is introduced to better utilize and govern the manufacturing data for manufacturing enterprise stakeholders and customers in CMS. A Hadoop-Raspberry Pi computing system is presented as a proof-of-concept of the proposed continuum computing mechanism to provide machining services in CMS.
13:45-14:00 M019	Effects of Cooling Conditions on Mechanical Properties and Wear Performance of JIS S45C Steel Coated by Wire Arc Spray **Montri Sangsuriyun**, Department of Industrial Engineering, Nakhon Phanom University, Thailand Abstract—The study of the effects of cooling conditions on mechanical properties and wear performance by coating AISI S45C steel with Chrome Nickel Amorphous wire arc spray showed that the average surface hardness of specimens under different cooling conditions such as SCCW, SCCO, SCCS and SCCNT was 601.6 HV, while the surface hardness of HAZ of SCCS and SCCW specimens decreased to 80-90 HV. The tensile test revealed that the average ultimate tensile strength of coated specimens was 706 MPa which was slightly higher than that of uncoated specimens. This is consistent with Tukey's one-way ANOVA method, which found significant difference in tensile strength values at 0.05 and 0.01 levels. For wear resistance, coated specimens showed higher wear resistance compared to that of uncoated specimens. In overall, the results of this study showed that wire arc spray coating could increase the strength and stress and decrease %elongation of the specimens. This technique is therefore suitable for maintenance work to increase the strength of steel in the industry.

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4 ABSTRACT OF SESSION 2

Time & ID	Presentation
14:00-14:15 M020	Mechanical Characterization of AA 6061-T6 MIG Welded Aluminum Alloys using a Robotic Arm **Elsadig Mahdi Ahmed Saad**, Qatar University, Qatar Abstract—Aluminum alloys are of particular interest in the design of lightweight structures in different applications. Accordingly, welding aluminum alloys (AA) is a critical issue; for example, welding defects could arise during the traditional welding of aluminum alloys. This paper investigates the effects of welding using a robotic arm on the mechanical properties of 6061-T6 Aluminum alloy, as plates joined by Metal Inert Gas (MIG) welding. The tensile behavior and mechanical properties were investigated using tensile testing, hardness testing, and impact testing. The tensile behavior of AA- 6061-T6 un-welded and welded specimens showed a decrease in the tensile strength of the welded specimens due to the fusion of the welded zone and the partially melted zone (PMZ). The hardness test showed an increase in the hardness values away from the welded zone, attributed to voids and defects in the welded and HAZ zones. In addition, the impact behavior showed that the maximum impact is in the base metal zone, and the minimum is in the HAZ. Scanning electron microscopy was used to investigate the welded and un-welded Aluminum microstructures. The mechanical properties of AA 6061-T6 Aluminum alloy were sensitive to the novel welding process.
14:15-14:30 M0005	Primary Research on Influence of Workpiece Cooling on Efficiency of Inconel's 625 Alloy Elecrodischarge Milling in Carbon Dioxide **Agnieszka Zyra**, Cracow University of Technology, Poland Abstract—Inconel alloys one of the most cost intensive materials to machine with conventional machining methods. It is connected with its mechanical properties, as well as low thermal conductivity and also high material losses during machining. An alternative to conventional machining is electrodischarge machining (EDM), which enables to machine all the materials which are conductors or semi-conductors regardless its chemical composition and mechanical properties. There are three main dielectric types which can be used for EDM machining. The eco-friendly are gaseous ones. It is still hard to use gaseous dielectrics in the industrial applications, however it seems that this dielectrics are the future. The main aim of this research was to determine an influence of EDM milling in carbon dioxide used as dielectric in two configurations – with and without external workpiece cooling with deionized water on the EDM technological parameters (material removal rate, electrode wear) as well as technological surface integrity and surface structure.

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4 ABSTRACT OF SESSION 2

Time & ID	Presentation
14:30-14:45 M016	Morphing Air Foil NACA 6412 Inverted Using Flexure Hinges **Adolfo Perez**, ITESM, Mexico Abstract—In this paper a NACA 6412 regulated shape will be inverted to understand the behaviour of the air flow around the shape, this with the intention of convert the lifting effect to a downforce and braking effect changing the shape of the wing, displacing the trailing edge approximately 100mm over the first stage position. Using analysis as Computational Fluid Dynamics (CFD) and Finite Element Analysis (FEA) to depicts the operational parameters of the two stages of the inverted NACA 6412 air foil. To reach this displacement, the main idea is using a flexure hinge designed as a M-Shape beam, this flexure hinge works as a spring to allows to the morphing wing moves around the 100mm of trailing edge displacement and the spring-beam effect creates an inverse force, when the wing moves close to the110mm and does not exceed the yield strength of the Acrylonitrile butadiene styrene (ABS) of 74Mpa. As a result of this motion parameters, we could integrate a flexure hinge to an inverted air foil regulated to reach braking and downforce forces in order to slow down vehicles or aerodynamic devises.
14:45-15:00 M031-A	Fuel Consumption Estimation In Heavy Duty Vehicles Using Machine Learning **Sasanka Katreddi**, West Virginia University, United States Abstract—Fuel Consumption management is key to manage the cost and identifying fuel frauds in fleet transportation. Identifying the key parameters that affect fuel consumption can help save a lot of fuel costs. Fuel Consumption in Heavy-Duty Vehicles is affected by various external and internal factors. The external factors include weather conditions, road conditions, traffic, time of the day, and the internal factors include load, vehicle parameters, engine parameters, distance, speed. Drivers' behavior such as gas pedal position, brake pedal position, steering angle, etc. also affects the fuel consumption of vehicles. However, the availability of dynamic data that affects fuel consumption based on the on-road trip is scarce and difficult to model fuel consumption based on real-time data.In this paper, Multi-Layer Perceptron (MLP) is used to model fuel consumption based on drivers' behavior parameters collected during on-road vehicle testing. Multi-variate time series data is collected dynamically at 1Hz frequency during on-road vehicle testing of heavy-duty trucks. The data is preprocessed to minimize potential errors by eliminating missing data and scaling data. An MLP with 3 hidden layers containing eight neurons in each hidden layer is trained on preprocessed data. The results indicated that MLP can predict the trend of fuel consumption accurately and total fuel consumed close to real-time data based on parameters given.

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4 ABSTRACT OF SESSION 2

Time & ID	Presentation
15:00-15:15 M0017	Follow me droney! Will UWB Technology Do It Right? **Krzysztof Hanzel**, Electronics and Computer Science, Silesian University of Technology, Poland Abstract—Object tracking for consumer drones is currently a rapidly developing technology. Its implementation is currently carried out with the use of object-in-image detection, which often limits the latest possibilities of this technology. The disadvantage of such a solution is also the increase in energy demand and the need to provide additional computing power, or delays resulting from the transfer of this operation to the control device. The proposed solution to this problem in this article is the use of UWB (Ultra-wideband) technology, which is increasingly appearing in consumer devices. The possible yield related to the accuracy of determining the position of the object as well as the experimentally determined frequency of receiving information about the position was presented. Additional advantages, such as resistance to NLOS (non-line of sight) conditions, were also presented.

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4 ABSTRACT OF SESSION 3

Session 3: Mechanical Engineering and Aerospace Technology **Session Chair: TBA**	**Time:** 13:00-15:30 || **Room B:** 892 4387 6477 **Meeting Link:** https://us02web.zoom.us/j/89243876477

Time & ID	Presentation
13:00-13:15 M1001	The Relationship between Forward Speed of Micro-robot and Spiral Angle of Flagella **Hongbo Qian**, University of California San Diego, USA Abstract—The translational speed of the micro-robot driven by a flagella is related tothe spiral angle of the tail. With traditional Resistive Force Theory, the force and torqueon the body and tail can be deduced. By fixing the parameters except spiral angle, therelationship between the forward speed and the spiral angle can be obtained. In orderto verify the correctness of the theory, a scaled model of micro-robot was made, andthe spiral angle was used as the only independent variable to conduct experiments.Comparing the results of theoretical calculations with the experimental results, it isfound that there is an optimal spiral angle for best swimming performance, and theexperimental and calculated results are consistent for micro-robot of the same size. Itis helpful to the design of micro-robot in liquid.
13:15-13:30 M0014	Research on Guidance Method of Multi-missile Cooperative Combat **Zhongxu Zheng**, National University of Defense Technology, China Abstract—Based on the missile-target three-dimensional relative motion model, a lead-follow missile coordinated three-dimensional guidance law is designed for attacking a stationary target. The lead missile adopts the augmented proportional guidance law control in the pitch channel and the yaw channel, while the follow missiles adopt the augmented proportional guidance law control in the pitch channel and the yaw channel adopts dynamic inverse control. By maneuvering in the yaw channel, adjusting the missile's attack time and comparing with the results of only using augmented proportional guidance, the simulation results show that the lead-follow coordinated three-dimensional guidance law can achieve the lead-follow missiles coordinated attack and high hitting accuracy, which verifies the correctness and superiority of the algorithm.

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4 ABSTRACT OF SESSION 3

Time & ID	Presentation
13:30-13:45 M004	Model Optimization of Kinematic Redundant Feed Drive Systems Using Sailfish Optimization Algorithm **Mohamed Galal Ali Nassef**, Industrial and Manufacturing Engineering Department, Egypt-Japan University of Science and Technology, Egypt Abstract—Kinematic redundant systems as part of machine tools reduce the dynamic requirements for feed axes and aim to increase the productivity. Yet, optimization of the system dynamic behaviour demands a deep understanding of how the dynamic coupling between the axes influences the tracking accuracy at the tool center point. This can be achieved through minimizing the discrepancies between the model output and physical measurements. One way is by optimizing the values of the dynamic coupling model parameters. In the present research, a heuristic algorithm, inspired by sailfish optimization algorithm, is developed to identify the stiffness and damping parameters of the investigated dynamic coupling model. Minimum RMS error is selected as the objective function parameter. Tests are conducted using different step and rectangular functions. Simulation results demonstrate the effectiveness of the proposed method to improve the model accuracy in simulating the vibrational response of kinematic redundant axes to jerk forces.
13:45-14:00 M0018	CanSat Payload with Autogyro for Descent in Experimental Rocket Flights: Development, CFD Analysis and Preliminary Test on Free-fall **Alejandro David Ventura Ventura**, Aerospace Peru Team – CTIC UNI, Universidad Nacional de Ingeniería, Lima, Peru Abstract—This research work develops the design of a CanSat payload assisted with an Autogyro system for controlled descent in experimental rocket flights. The design, development, Computational fluid dynamics (CFD) analysis and a preliminary test on free-fall had been carried out. The data obtained from this study and test allowed us to determine the relation between the drag coefficient and the projected geometry of the CanSat by using CFD simulation and data such as speed and acceleration from the free-fall test. The results allowed us to propose an estimation for the drag coefficient behaviour on the speed range studied.

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4 ABSTRACT OF SESSION 3

Time & ID	Presentation
14:00-14:15 M0007	A Numerical Simulation Study for A Dual Thrust Solid Propellant Rocket Motor Nozzle **Alaa R AbdelGawad**, Beihang University, China Abstract—CFD simulation through the rocket motor nozzle is an important issue as it gives a better understanding of the flow behavior and shows the evolution of the parameters along with the nozzle. CFD simulations using ANSYS FLUENT were conducted to model the flow through an experimental dual thrust solid rocket motor nozzle at two pressure values representing the two pressure levels. A two-dimensional axisymmetric numerical simulation was carried out using a pressure-based solver to solve the governing equation and the standard k-ε model to model the turbulence through the motor nozzle. The hot gas properties used in the simulation model were calculated using the CEA software (chemical equilibrium with applications). The parameters marched out from simulations were used to calculate the thrust values for each case. The results calculated through the numerical models compared with the experimental measurements and showed an acceptable level of accuracy.
14:15-14:30 M017	Mechatronic Design of Two-Jaw Pleating End-Effector for Large-Scale Carbon Fibre Reinforced Polymer Manufacturing **Delun Chen**, The University of British Columbia, Canada Abstract—Large-scale composite manufacturing processes, particularly vacuum injection moulding, are often hampered by expensive labour costs and low-levels of automation. The current process of manufacturing carbon fibre reinforced polymers (CFRP) for airplane fuselage workpieces requires experienced workers to spend hours manually placing, pleating and migrating multiple layers of fabrics in order to produce the desired composite part. A promising solution is to utilize robot platforms as assistants to alleviate the physical demands of the tasks. In this paper, we present the design and evaluate the performance of our novel Vacuum Infusion Moulding End-Effector (VIMEE) prototype in the pleating procedure of a simulated CFRP manufacturing vacuum bagging process, where our gripper system performs pleat loading, height detection and migration tasks. Experimental results show successful manipulation of nylon pleats by our mechatronic systems design. These results are promising, demonstrating our VIMEE design's potential value in vacuum injection moulding.

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4 ABSTRACT OF SESSION 3

Time & ID	Presentation
14:30-14:45 M0013	Design and Verification of Small Solid Rockets Navigation Algorithm Test Platform **Xiaoshuai Fan**, National University of Defense Technology, China Abstract—Aiming at the navigation system of small solid rockets, a navigation algorithm test platform with real time simulator and flight control computer is designed. The inertial navigation algorithm is taken as an example to test the effectiveness of the platform. The flight dynamic model of a small solid rocket is established in a real time simulator, and the test is carried out in the working environment of a small test rocket to simplify the model. The acceleration and angular velocity data generated by the simulation is sent to the onboard computer to calculate the attitude of the rocket in real time, which verifies the correctness of the data communication link, real time solution and navigation algorithm between the onboard computer and the real time simulator. The test results show that the test platform is easy to use and can test the rocket navigation algorithm quickly and effectively.
14:45-15:00 M0016	Aerodynamic Studies of Small Box-Wing Unmanned Aerial Vehicle Using CFD **Danupol Sutthison**, Navaminda Kasatriyadhiraj Royal Air Force Academy, Thailand Abstract—This paper presents a computational fluid dynamics (CFD) simulation study of a small unmanned aerial vehicle (UAV) with airfoil s3010 and 245 mm chord length at a cruising speed of 17.5 m/s, compared with the aerodynamic characteristics of a 3D conventional fixed-wing UAV from a commercial RC airplane modified with a box-wing configuration. Simulation results showed that at an angle of attack of 0°, the lift coefficient increased by 60.005%, drag coefficient increased by 58.3299% and L/D ratio increased 1.0578%. The box-wing UAV had higher lift-to-drag ratio than the fixed-wing UAV. The fuselage shape of the box-wing UAV in this study can be redesigned to shorten the rear area for drag reduction.

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4 ABSTRACT OF SESSION 3

Time & ID	Presentation
15:00-15:15 M009	Numerical Characterization of the Mechanics of Bézier-based Lattice-beams **Alberto Álvarez-Trejo**, Tecnologico de Monterrey, School of Engineering and Sciences, Mexico Abstract—Metamaterials are controlled arrangements of material structures in which their mechanical properties can be tailored by tuning their geometrical parameters. A parametrization based on cubic Bézier curves is employed here to generate cantilever lattice-beams by changing the position of a free control point. The apparent stiffness of these lattice-beams is numerically analyzed by means of tensile, bending, and free vibration simulations. Results expose the influence of shear deformation in the mechanical behavior of beams made from a cellular material; different degrees of variation depending on the loading conditions and lattice topology are observed and discussed.
15:15-15:30 M1001 (TMAE 21)	A Novel Concept of Low-orbit Space Debris Removal **Wenjun Hu**, National University of Defense Technology, China Abstract—In view of the growing threat of space debris and the limitation of current debris removal method. A novel conceptual solution for multiple space debris removal is proposed, and a low-cost and miniaturized removal system is designed in this paper. And the structural composition of this removal system is designed and the space debris removal process is introduced, the system can be divided into two components including satellite platform and many mission CubeSats. The mission CubeSats can be re-launched into the transfer orbits of different space debris through a push-launch method, and the fuel consumptions on the removal mission for three space debris, using the proposed multiple removal system and traditional removal system are calculated and compared. The compared results demonstrated that the proposed solution for multiple space debris removal and the designed removal system can decrease the fuel consumptions effectively.

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