

Gulzar Group of Institutes, Ludhiana

Department of Mechanical Engineering

MechTech

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Covering latest researches and developments in

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Sharpening Minds. Brightening Tomorrow.

GULZAR GROUP OF INSTITUTES

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➤ **Researches and developments in Mechanical Engineering:-**

1. Heterogenous bubble nucleation model on the heated surface based on free energy analysis

Dr. Hongsheng Yuan and Professor Sichao Tan in collaboration with their colleagues developed a nucleation model based on Gibbs free energy in conjunction to the nucleation model based on the chemical potential. According to the authors, the experimental results showed the great similarity of the theoretical data. For instance, the trend of theoretical values of heat flux and superheat with pressure and heat transfer coefficient is in good agreement with experimental results. Thus, due to its added simplicity through the elimination of the initially used assumptions, the developed Gibbs free energy method will advance different application in prediction of the bubble nucleation.

2. Welding for Long Life Fatigue

In a recent publication in *International Journal of Fatigue*, East China University of Science and Technology scientists: Wei-Chang Zhang, Professor Ming-Liang Zhu, Kai Wang and Professor Fu-Zhen Xuan investigated tensile and high cycle fatigue behaviors of dissimilar weld joint comprising of 9%Cr steel, CrMoV steel and 9%Cr-CrMoV at 500 C. They elucidated the failure mechanism, their prevention, and applications in the practical design of high-quality weld joints. According to the authors, fatigue design for high-quality and long-lasting welded joints must impose a strict optimization of the welding parameters as well as a thorough knowledge on the significance of the filler metal relative to the base metal. The procedure also has to take into consideration the soft-zone and micro defects that are resulted from welding. Therefore, the study provides a platform and a basis for the next generation high-quality welding for the production of longer life structures and components.

3. Low gain magic: Control of linear systems with distributed infinite input delays

The study by City University of Hong Kong scientists is the first to successfully solve stabilization problems of linear systems with distributed infinite input delays based on low gain feedback controllers. The effectiveness and efficiency of the proposed low gain controllers are validated through numerical simulations in two engineering systems. Their new method provides a powerful and useful basis in further study of systems with infinite delays and also provides a great potential for their applications in real-world systems.

4. Advanced numerical tool for fatigue and humidity degradation prediction in adhesive joints

The study by Dr. Marcelo Costa and his colleagues at the University of Porto will advance modeling of joints subjected to different degradation and fatigue conditions thus an effective way of minimizing joints and structural failures. It will also enable the design of specific joints with desired requirements and precision. The proposed technique can also be used for modeling an array of experimental conditions as well as a platform for including additional loading modes and further fatigue considerations.

5. An interesting discovery of the influence of wrinkles on the overlapping fusion in metal droplet printing

An effective method for promoting the remelting process of the droplets by decreasing solidification angles and eliminating the ripples by using a lower thermal conductivity substrate is verified. The research forms the basis for minimizing internal defects and thus

improving the metallurgical bonding during droplet-based 3D printing. Therefore, it will advance the use of 3D printers in the various field for manufacturing of complex parts especially metal structures.

6. Welding process for manufacturing industries

Arc welding and additive manufacturing are hugely important for creating large metal components relatively inexpensively and quickly. New research led by Professor Hongbiao Dong from the University of Leicester's Department of Engineering has shown how to optimize this process to improve efficiency and cost. The research, which was a collaboration between the University of Leicester, Delft University of Technology, Diamond Light Source, University College Dublin and TATA Steel Research UK was recently published in *Nature Communications*. It explores the internal flow behavior in additive manufacturing of metals and arc welding -- the most widely used welding process in modern manufacturing. The work focused on examining the melt pools that are created during the welding process

7. Mechanical engineers develop a process to 3-D print piezoelectric materials

The team has printed and demonstrated smart materials wrapped around curved surfaces, worn on hands and fingers to convert motion, and harvest the mechanical energy, but the applications go well beyond consumer electronics. Zheng sees the technology as a leap into robotics, energy harvesting, tactile sensing, and intelligent infrastructure, where a structure is made entirely with a piezoelectric material, sensing impacts, vibrations and motions, and allowing for those to be monitored and located. The team has printed a small smart bridge to demonstrate its applicability to sensing the locations of dropping impacts, as well as its magnitude, while robust enough to absorb the impact energy. The team also demonstrated their application of a smart transducer that converts underwater vibration signals to electric voltages.

➤ Updates from the Automobile Sector

1. 2019 Mahindra XUV300 official fuel efficiency figures revealed

On the ARAI test cycle, the XUV300 petrol is claimed to do 17 kpl, while the diesel has a fuel efficiency figure of 20 kpl. The turbo-petrol's figure is level with the figures for the petrol versions of the Tata Nexon and Ford EcoSport, and interestingly, more efficient than the Hyundai Creta's 1.6-litre unit. It becomes all the more impressive when you note the fact that the XUV300's petrol engine offers significantly more torque than all of its above mentioned rivals. As for the diesel XUV300, its 20kpl figure is lower than that of almost all of its rivals. The Nexon diesel returns 21.5kpl, the EcoSport diesel does 23 km to the litre, the Creta's 1.4-litre diesel does 21.3kpl and the king of the segment, the Maruti Suzuki Vitara Brezza, sits at the top of the pile with a fuel efficiency figure of 24.3kpl. That said, once again, the XUV300 boasts a major torque advantage over all these SUVs – its 1.5-litre diesel makes a full 100Nm more than the Vitara Brezza's 1.3-litre engine – and also has more torque than the Creta's 1.6-litre diesel, while being marginally more efficient.

2. Toyota-badged Baleno confirmed for launch in 2019

With its own version of the Maruti Suzuki Baleno, Toyota aims to offer a different buying experience to the customers; launch in second half of 2019. This model-sharing exercise will go beyond mere badge-engineering, and Toyota's version of the Baleno is likely to sport soft part changes as well, including a new grille, redesigned bumpers, and lights. Raja, however, has confirmed that product changes will be kept to a minimum.

3. 2019 Maruti Suzuki Baleno facelift launched in India, priced at Rs 5.45 lakh

Maruti Suzuki has launched the Baleno facelift, which is priced from Rs 5.45 lakh to Rs 8.77 lakh (ex-showroom, Delhi). The hike in prices ranges from Rs 7,000 to Rs 21,000 for the petrol and diesel manual variants, and between Rs 30,000 to Rs 44,000 for the CVT variants. As the official pictures reveal, the Baleno facelift sports a more aggressive front-end, with a new front bumper, a 3D design for the grille and LED projector headlights with DRLs (which are now standard from the Delta variant onwards). Revised face aside, the Baleno facelift also gets new dual-tone 16-inch alloy wheels, but that's about it in terms of exterior changes.

4. Indian Motorcycle trademarks two new names

Back on December 17, 2018, the name 'Indian Raven' was trademarked. Rumours suggest that the 'Raven' could be based off the Indian FTR 1200, but there is no official information that suggests this. This was followed by the company trade marking the name 'Indian Renegade' on January 3, 2019. Another US based manufacturer, UM Motorcycles, already uses the name Renegade for its line-up of cruisers and it will be interesting to see what Indian Motorcycle has in store with this name.

5. 2019 MG Hector SUV to get a largest-in-class touchscreen, sunroof

The MG Hector SUV is scheduled for launch in the second quarter of 2019. And going by the information we've just got our hands on, MG will load the SUV with lots of goodies. Exterior details will include 17-inch dual-tone alloy wheels as well as LED projector headlights with Audi-like 'swiping' LED indicators. But more than anything else, it will be the MG Hector's comfort features that will distinguish it from the competition. While lower variants will get a single sunroof, top-spec Hectors will feature a massive panoramic sunroof that would be the largest in class. The MG Hector will go one up on the 'largest in class' title, with a 'largest in India' tag for its touchscreen. The portrait-oriented Hector touchscreen will measure 10.4 inches. The unit will be the go-to control for the infotainment system as well as the climate control.

6. Next-gen Mahindra Thar to get new 2.0-litre diesel engine

Mahindra is currently developing the next-generation Thar and is expected to launch the model in India in 2020. The new Thar will be powered by Mahindra's new 2.0-litre diesel engine which will be compliant with BS-VI emissions regulations (unlike the current 2.5-litre unit). Power and torque will see a big jump from the current Thar's 105hp/247Nm figures. Expect the new Thar to make 140hp and upwards of 300Nm of torque. The higher output will not only help on rough terrains but also give it the necessary go on the highway.

7. IRF asks the government to pass Motor Vehicle Amendment Bill

The International Road Federation (IRF) is a Geneva-based global road safety body that works towards a goal of better and safer roads worldwide. Now the organization has urged the Indian government to enact the Motor Vehicle Amendment Bill in the upcoming session of the current parliament without including the clauses opposed in the bill by some states and organizations.

8. Toyota bets on body-on-frame construction

Body-on-frame vehicles are typically heavier, costlier and less fuel-efficient than monocoque constructions. Thus, it is not the form preferred by carmakers for their medium to small-sized models – and to some extent, even for large vehicles. However, Masakazu Yoshimura, managing director, Toyota Kirloskar Motor, says that the Japanese carmaker does not plan to move away from body-on-frame vehicles anytime soon.

9. Volkswagen Group retains top spot in global auto sales

The Volkswagen Group, which comprises Volkswagen, Audi, Bentley, Bugatti, Porsche, Lamborghini, and Skoda, has retained its leadership spot amongst global automakers in 2018, seeing a cumulative sales figure of 10.83 million units sold. The group saw a growth of 0.8 percent, as compared to the 10.76 million units it sold in 2017. Not too far behind is the Renault-Nissan-Mitsubishi alliance that has sold 10.76 million vehicles. They saw an increase of 1.4 percent as compared to the 10.61 million units sold in 2017, despite being rocked by controversy in November 2018 with the arrest of CEO Carlos Ghosn who is facing charges of financial impropriety.

10. Toyota to make more performance cars

Toyota recently unveiled its new Supra at the Detroit motor show, a sports car that was co-developed by the company's performance division, Gazoo Racing (GR), in conjunction with BMW. It seems that the GR Supra was only the start, as there are plans to create an entire range of performance vehicles under the GR nameplate. Toyota has not announced any specific models that will be part of the GR performance line-up but speculation suggests that the GT86, and the Yaris (as it is used in World Rally Cross) and Corolla hatchbacks (to compete with the Honda Civic Type R and VW Golf GTi in Europe) will be likely contenders. A few months back we had reported the possibility of Toyota bringing back the MR2 as an electric sports car. It is very likely that if they do revive the MR2, the GR division will have a hand in developing it, just like the new Supra.

➤ Researches and developments in General Engineering:-

1. Multimodal imaging technology by integrated scanning electron, force, and microwave microscopy

The University of Oldenburg and CNRS-IEMN scientists successfully presented a hybrid technology developed by integrating several microscopy modalities which enabled them to extract multiple information of sample surfaces by detection of electron, light, microwave interaction and atomic force. In general, a study of micro-scaled capacitors was undertaken so as to evaluate the developed instrumental platform and show the potential of the resulting multimodal technology. Altogether, their setup demonstrated here allows for simultaneous observation of the region-of-interest with scanning electron microscopy resolution, while imaging and characterization with evanescent microwaves and atomic forces.

2. Powered prosthetic knee users able to walk in minutes

People fitted with a powered prosthetic knee could walk comfortably in minutes rather than several hours thanks to an intelligent system for 'tuning' powered prosthetics. The system, developed by researchers from North Carolina State University (NC State), the University of North Carolina and Arizona State University (ASU), is said to be the first to rely solely on reinforcement learning to tune the robotic prosthesis. Robotic prosthetic knees need to be tuned to accommodate the people they are fitted to. According to NC State, the new tuning system tweaks 12 different control parameters, addressing prosthesis dynamics, such as joint stiffness, throughout the entire so-called gait cycle.

3. Tension structure of anticlastic membranes with barrel vaulted arches

The study successfully developed design aid charts for a variety of irregular anticlastic membranes. It uncovered various parameters that are important for the optimization and design of efficient membrane structures. For instance, it is realized that for all the panels, the maximum stress is reached across the transverse dimension in the midspan region regardless of the arch curvature. This is due to the dependence of the inclination angle to the width only. The limitations associated with the inclination angles could be easily identified from the chart. The study will, therefore, advance the design and use of spatial membrane structures in various fields.

4. All that glitters is not silver: Modern surface spectroscopies applied to the study of ancient artifacts

The study by Dr. Rana Sodhi and colleagues presented and devised a protocol by which greatest amount possible of information could be obtained while minimizing the amount of damage that would inadvertently be incurred in such an analysis in rare and ancient artifacts. In general, results of depth profiles in the bulk of the chosen areas were presented in order to ascertain the distribution of the

various chemical components for the coin used. Altogether, both ToF-SIMS and XPS have provided valuable information on the differences in chemistry and composition at the surface. This is a work-in-progress, with 2 further tetradrachms dated respectively to the time of Tiberius (14-37 AD) and Nero (54-68 AD) currently under investigation. To quote Dr. Sodhi, “*We are very excited about applying modern surface analytical techniques to ancient artifacts as well as the cross-disciplinary nature of the work, and further, hope to apply this methodology to other items of cultural heritage.*” He said in a statement to Advances in Engineering.

5. Considering the fibre-orientation of reinforced polymers in structural simulations

Swedish scientists successfully presented a methodology that uses different material properties in every material point with one material definition. They emphasize that by using more advanced material models, potential weight reductions in industrial components is made possible. Altogether, the presented material model can support design engineers in making more informed decisions, allowing them to create smarter products without the need for excessive safety factors, leading to reduced component weight and environmental impact.

Have a great day!

