Centre for Advanced Research on Energy

CARe Newsletter

PUBLISHED SEMI-YEARLY | ISSN: 2289-9871

CENTRE FOR ADVANCED RESEARCH ON ENERGY
Universiti Teknikal Malaysia Melaka

Issue 6, June 2020

HIGHLIGHTS

3D PRINTED FACE SHIELD FOR COVID-19 PANDEMIC FRONT LINERS

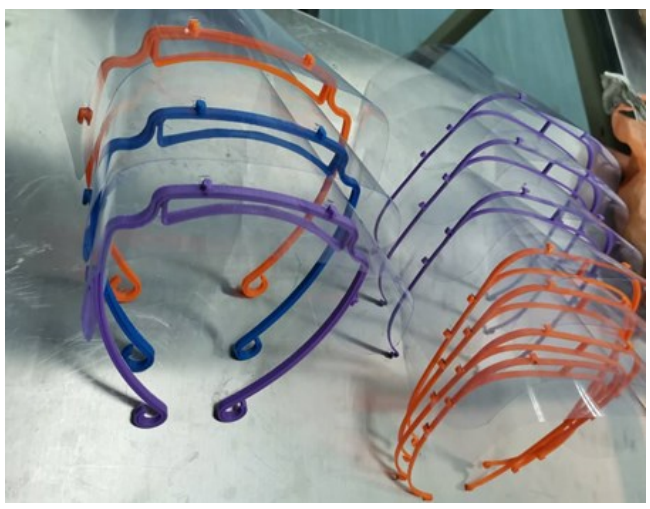
Recent pandemic of COVID-19 that hit worldwide has caused a shortage of medical supplies and personal protective equipment (PPE) that could cause medical front liners at risk. Particularly medical face shield, it is a clear plastic shield used to protect medical front liners from being infected during treatment of COVID-19 patients. A sudden increase in the demand for PPE worldwide has resulted in a critical shortage of face shield. During the pandemic crisis, the world communities have worked together to share their design, resources, and knowledge so that more people are able to produce face shield to help the front liners using various manufacturing processes.

Handing over of face shield to Melaka State Health Department by Vice Chancellor of UTeM and accompanied by representatives from all faculties/COEs

UTeM has initiated a special team together with the Melaka State Health Department to produce face shields for front liners in Melaka. These involve researchers and technical staff across the departments, faculties and centres in UTeM from Office of Deputy Vice-Chancellor (Research and Innovation), Office of Assistant Vice-Chancellor (Industry and Community), Faculty of Mechanical and Manufacturing Engineering Technology, Faculty of Electrical and Electronics Engineering Technology, Faculty of Manufacturing Engineering, Faculty Electrical Engineering, Faculty of Computer and Electronic Engineering, Faculty of Mechanical Engineering and all COEs. Each of the faculties and centres has used their respective expertise, resources, and facilities in producing the face shield.

Researchers from the Centre of Advanced Research on Energy (CARe) and Faculty of Mechanical Engineering have also joined the team that has been set up by the university to produce the face shield using 3D printing technology. There are many types of 3D printing technologies and fused filament fabrication (FFF) is one of the widely used 3D printing technology to fabricate the face shield frame during COVID-19 pandemic period. FFF 3D printing is a process of fabricating part directly from computer-aided design (CAD) data through layer by layer extrusion of semi-molten material without the need for moulds or complicated tools. Recent advancement of open-source 3D printing has made the machine affordable that can be purchased for less than RM1000 depending on the specification. With the sudden increase of COVID-19 cases, many individuals and industries contribute and produce the face shield using the 3D printing.

CARe researchers and technical staff have utilised FFF 3D printing machine manufactured by Flashforge, Createbot, 3D System Cube Pro Duo machines and various open-source/customized machines to fabricate the face shield frame. The fabrication was carried out at the Innovation Laboratory, Rapid Prototyping Laboratory and also by using researchers' personal 3D printing machines at homes. The face shields were delivered to Melaka State Health Department by a delegation headed by Vice-Chancellor, Datuk Wira Professor Dr Raha Abdul Rahim



3D printed face shield frame that has been assembled with plastic cover

COVID-19 has given a valuable lesson to everyone. Despite MCO, limited resources and difficulties, many Malaysian, researchers, academia, administration staff and technical staff have worked together and devoted their time during the difficult time and involved in the project. This shows a clear sign of good teamwork and togetherness especially at UTeM in supporting the country in facing the pandemic crisis.

Report by: Mohd Rizal Alkahari & Mohd Juzaila Abd Latif

CARe Research Group

Advanced Materials **(A-MAT)**

Green And Efficient Energy Technology **(GrEET)**

Green Tribology And Engine Performance **(G-TriboE)**

Innovation and Sustainability In Machine Technologies **(i-SMAT)**

Intelligent Vehicle Systems **(InVeS)**

INFO CARe Lab Facilities

Advanced Materials Lab

Air Conditioning Lab

CAD Studio

Condition Based Maintenance Lab

Control and Electronic Systems Vehicle Lab

Engine Performance Lab

High Performance Structure Lab

Innovation Laboratory

NDT Laboratory

Rapid Prototyping Lab

Structural Health Monitoring Lab

Tribology Lab

Turbo Machinery Lab

Vibration and Acoustics Laboratory

From The Editor

Welcome to the sixth issue of CARe Newsletter. With the recent rapid changes due to the Covid-19 pandemic the world scene has changed. We researchers should embrace these challenges, tapping on technology and scientific discoveries for applications and innovations that contribute to the betterment of our lives. Without a doubt, researchers are creative people and I see this as an opportunity for us to innovate to meet the demands of the new world. Change will lead to new innovation! We hope CARe will achieve more success and further progress post Covid-19.

Greetings from the newsletter team.

Dr. Sivakumar Dhar Malingam

1st GrEET Research Colloquium in the Year 2020

Green and Efficient Energy Technology (GrEET) research group under the Centre for Advanced Research on Energy (CARe) hosted its first 2020 Colloquium on 26th February, at Campus Technology, UTeM. The colloquium aimed to provide a platform for the GrEET members to present their works and share their knowledge with the members and students. The goal was primarily focused on the members' benefit in advancing their research at national and international levels. The colloquium was attended by 22 participants, and three of them were the invited speakers for the day.

The colloquium was kicked off by the GrEET head, Dr. Muhd Ridzuan bin Mansor who delivered the welcome speech, followed by Dr. Mohd Asri bin Yusuff, the first invited speaker. Dr. Mohd Asri presented his work on streamflow predictive models. He explained how the models were used to predict streamflow from Perting River, where the "run-of-river" scheme was considered to suit a small hydropower system. His models are useful to analyze the reliability and availability of the streamflow. The second speaker was Ir. Dr. Mohd Shukri bin Yob, who has vast connections with local industries. His speech titled, "Research Supporting Industry", he shared how he started from scratch and then collaborated with many industrial partners. He preferred to optimize the use of existing laboratory facilities to start his researches, rather than waiting for the funding agencies to offer call. His successful journey inspired the participant to overcome related challenges in their own researches.

The final speaker was Mr. Mohammed Hafiz bin Isa, who is an expert in energy management. He is a Certified Energy Manager and also one of the trainers for the Energy Management Training Course (AEMAS). In his speech, he outlined the importance of the International Performance Measurement and Verification Protocol (IPMVP) and explained on time dependence, regression, and energy-saving analyses. The participants had shown their full supports and interests during all the presentations.

Report by: Fadhilah Shikh Anuar

Apple Professional Learning

Jawatan Jawatankuasa ICT FKM has initiated 14 days of workshop sessions which were hosted using the online meeting platform Zoom and later using Webex.

These series of hands-on workshops were intended to empower educators (teachers, lecturers, education consultants) in developing their teaching and learning contents using iPad. Both synchronous and asynchronous online learning environments were covered to accommodate the online learning during the COVID-19 pandemic where physical face to face meeting is not possible

In total, 14 sessions were conducted every morning started at 9:30 AM and ended at 11:00 AM, from 1st April to 14th April, covering many aspects of content development. The speakers were invited from various institutions and organisation (such as UTeM, UKM, Institut Aminuddin Baki and well as SBP and MARA elite teachers) for one session to share their expertise in utilising the various application in iPad. Educators from various levels of school and institution (mainly from Malaysia, Singapore, Filipina, and Indonesia) have participated in this workshop with a total of 130++ participants for each session.

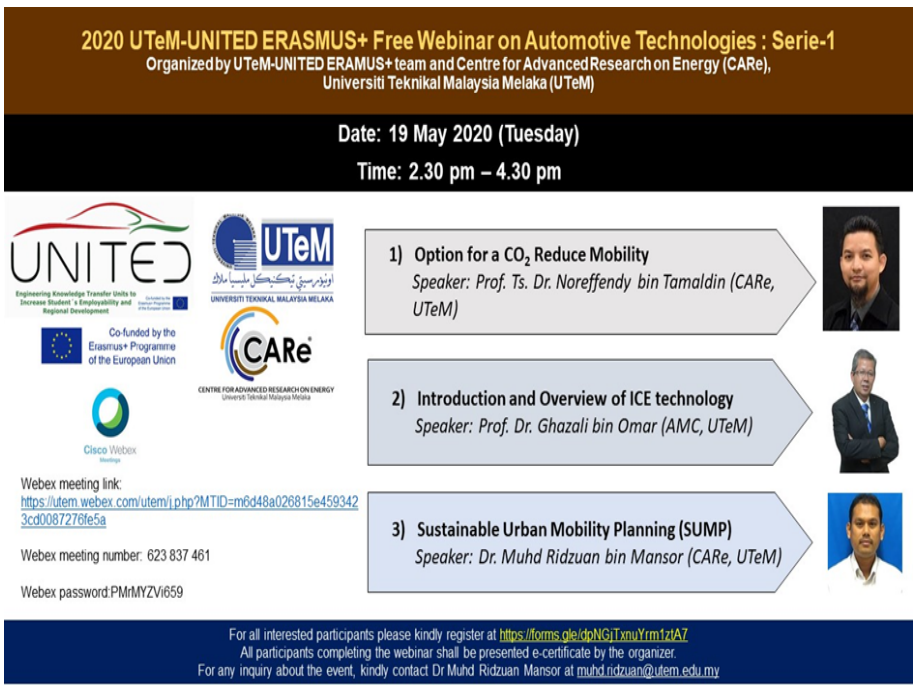
The list of JK ICT FKM involved in these workshops:
PM Dr Azma Putra (Coordinator of the Workshop, Zoom Hosts, Presenter, and Moderator)
Dr Juffrizal Karjanto (Coordinator of JK ICT FKM, Webex Hosts, Presenter, and Moderator)
Dr Nidzamuddin Md. Yusof (Presenter and Moderator)
Dr Zakiah Abd Halim (Presenter and Moderator)
Dr Mohd Zaid Akop (Presenter and Moderator)

Report by: Azma Putra, Nidzamuddin Md Yusof, & Juffrizal Karjanto

2020 UTeM-UNITED ERASMUS+ Free Webinar on Automotive Technologies

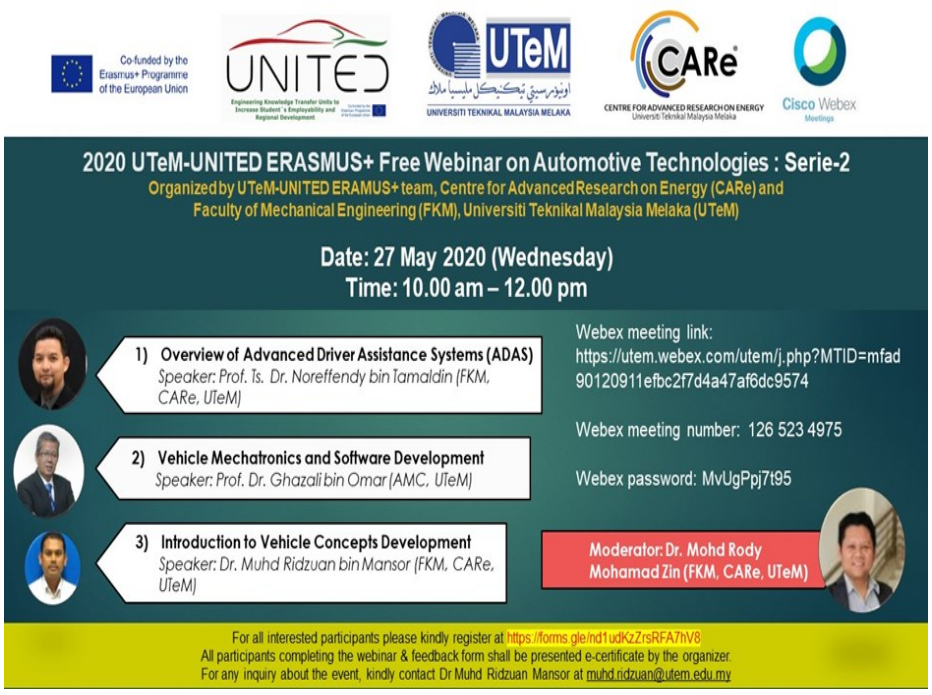
The ERASMUS+ programme is a prestigious international funding scheme by the European Union (EU) to support activities in the fields of Education, Training, Youth and Sport. In November 2017, Universiti Teknikal Malaysia Melaka (UTeM) research members from Centre for Advanced Research on Energy (CARe) and Advanced Manufacturing Centre (AMC) led by Prof. Dr. Noreffendy Tamaldin has been awarded the ERASMUS+ grant worth nearly 1 million Euros under the Capacity Building in Higher Education theme together with its multi-country research partners. The consortium is led by Joanneum University of Applied Sciences (FH Joanneum) from Graz, Austria, and consists of eight (8) other partners from six (6) countries which are FH Aachen (Germany), Politechnico Di Torino (Italy), Universiti Teknikal Malaysia Melaka (Malaysia), Universiti Putra Malaysia (Malaysia), Chulalongkorn University (Thailand), Mahasarakham University (Thailand), Universitas Sumatera Utara (Indonesia), Universitas Udayana (Indonesia), Atipong Motor (Thailand) and DreamEDGE Sdn. Bhd. (Malaysia). The listed consortium partners selected are from nine (9) higher education institutions and two (2) prominent automotive industry players. The topic of the international research project is "Engineering Knowledge Transfer Units to Increase Student's Employability and Regional Development" (UNITED).

In conjunction with the research work scope, the team from UTeM has organized two series of knowledge sharing and dissemination webinar series, held on 19th May 2020 and 27th May 2020. Due to the Covid-19 pandemic affecting the whole country and the world as well as the Movement Control Order (MCO) by the government, the UTeM-UNITED ERASMUS+ team have conducted both series through online webinar method, using Webex as the online platform, under the title of "2020 UTeM-UNITED ERASMUS+ Free Webinar on Automotive Technologies" series 1 and series 2. Both webinars were jointly organized by Centre for Advanced Research on Energy (CARe), UTeM and Faculty of Mechanical Engineering (FKM), UTeM. Both webinar series weres hosted by Ts. Dr. Mohd Azli Bin Salim (UTeM-UNITED team members) and moderated by Dr. Mohd Rody Mohamad Zin from CARe



The topics presented in the 1st webinar session:

1. Option for a CO2 Reduce Mobility – Fuel option for Internal Combustion Engines (ICE) by Prof. Ts. Dr. Noreffendy bin Tamaldin (FKM, CARe, UTeM)
2. Introduction and Overview of ICE Technology by Prof. Dr. Ghazali bin Omar (AMC, UTeM)
3. Sustainable Urban Mobility Planning (SUMP) by Dr. Muhd Ridzuan bin Mansor (FKM, CARe, UTeM).



The topics presented in the 2nd webinar session:

1. Overview of Advanced Driver Assistance System (ADAS) by Prof. Ts. Dr. Noreffendy bin Tamaldin (FKM, CARe, UTeM),
2. Vehicle Mechatronics and Software Development by Prof. Dr. Ghazali bin Omar (AMC, UTeM)
3. Introduction to Vehicle Concepts Development by Dr. Muhd Ridzuan bin Mansor (FKM, CARe, UTeM).

The outcome for both the webinar series held was a great success with participants from Higher Education Institutions as well as industries.

ABOUT UNITED ERASMUS +

The ERASMUS+ programme is a prestigious international funding scheme by the European Union (EU) to support activities in the fields of Education, Training, Youth and Sport . The topic of the international research project is "Engineering Knowledge Transfer Units to Increase Student's Employability and Regional Development" (UNITED).

Report by: Muhd Ridzuan Mansor, Noreffendy Tamaldin, Ghazali Omar & Mohd Azli Salim

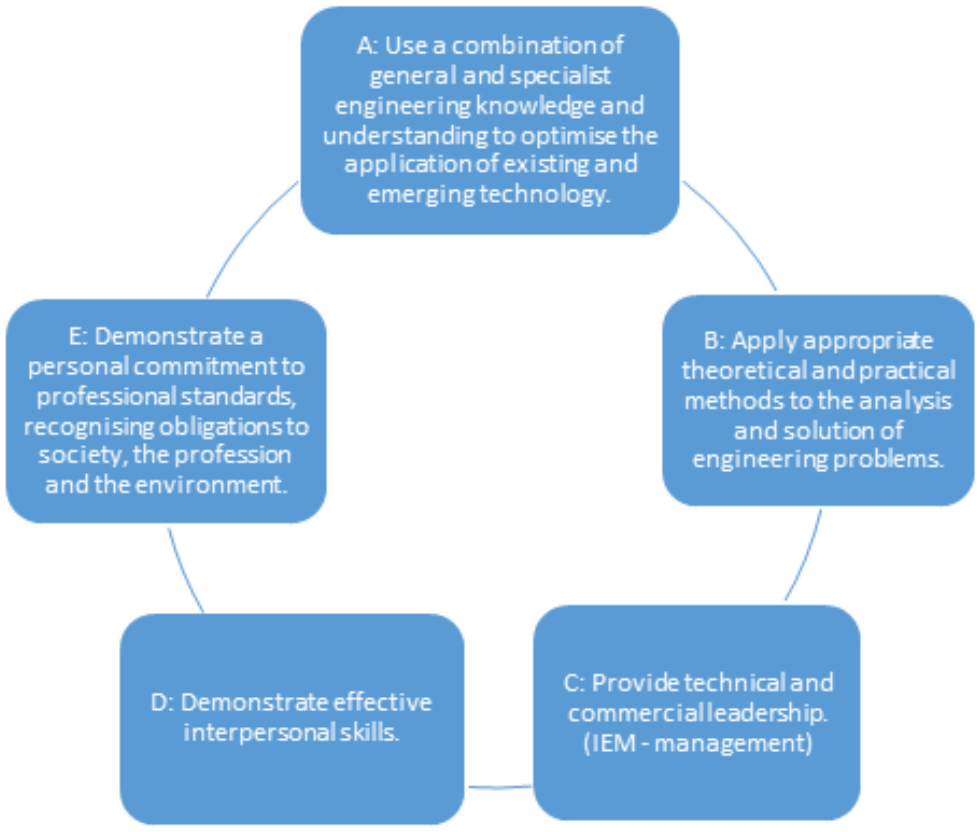
Essential Competencies to become a Professional in Engineering

By:

Rafidah Hasan

For engineering graduates who are practising as engineers; be it in industry, consultancy or academic; there are always rooms for them to achieve the highest recognition in their fields by being awarded as Professional Engineers. For those who are dedicating themselves as Engineering Educators or Academicians, on top of being honoured with PhD degrees, being awarded as Professional Engineers by local or international engineering bodies demonstrates their commitments to provide guidance and experience to the younger engineers to-be.

In Malaysia, the Professional Engineer (PE) is awarded by the Board of Engineers Malaysia (BEM), and those awarded are allowed to perform professional engineering services under the Registration of Engineers Act 1967 (Revised 2015). Meanwhile, one of the established international bodies that award similar professional recognition at the international level is the UK Engineering Council (UKEC), by awarding registered professionals with the Chartered Engineer (CEng). Similar competencies are set across the world, where towards the end, it underpins the systems and processes that ensure the current and future safeguarding of society. The provided Chart highlights the competencies that are required for engineering professional registrations by both the UKEC and the BEM (through the Institution of Engineers, Malaysia – IEM). FKM/CARe UTeM highly encourages its academicians/researchers to be registered as Professional Engineers by providing continuous supports, workshops and training such as the IMechE Workshop that was held recently at Clear Room, FKM.



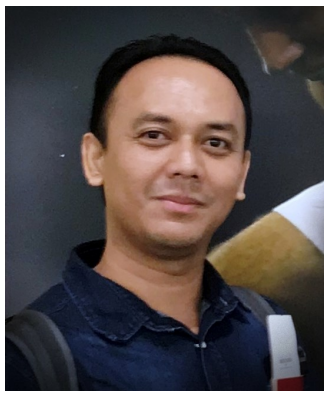
Five competencies for Professional Engineers.

Some participants of the IMechE Workshop at FKM UTeM.

Reference Documents:
Particulars of Log Book Scheme, Institution of Engineers, Malaysia, Engineering Competency Development, 2018 (Malaysia).
UK-SPEC, UK Standard for Professional Engineering Competence, Third Edition, 2013 (UK).

"Chartered Engineer status is a chance for me to contribute more to engineering and society. I would encourage other dedicated engineers with passion in their career to achieve the internationally recognized and prestigious status, in order for them to continuously upgrade themselves for future journeys".
(Words of Wisdom, Rafidah Hasan, October 2017 – Upon being awarded the CEng by UKEC)

By:



Mohd Fadzli Abdollah

Hilmi Amiruddin

YES, YOU READ THE HEADLINE CORRECTLY

-*Palm oil can decrease fuel consumption*-

The trend towards greater energy conservation and the reduction of green-house gases demands that fuel consumption of automotive engines continues to be improved. Improvement of fuel consumption has been one of the most critical challenges for the automotive industry. Although the useful work loss due to engine friction is relatively small for modern engines, the reduction of all parasitic energy losses, including friction, remains as a valuable contribution to overall efficiency improvement. A little gain in fuel consumption, even by 1% over existing levels, is a remarkable achievement. In recent years, the industry has made tremendous strides in decreasing fuel consumption by lowering friction in passenger cars, trucks and buses. The use of liquid lubrication is one of the oldest methods to reduce friction and wear in sliding contacts. Over several decades, the use of mineral oils remained a promising solution to overcome friction and wear of sliding contacts. The issues of non-biodegradability, crude oil depletion led to a paradigm shift in the focus of researchers from nonrenewable to renewable sources of energy. The use of vegetable oil as fuels has further inspired researchers to exploit their potential as bio-lubricants.

Bio-lubricants are typically derived from vegetable oil, such as palm oil, and showed many environmental benefits with regards to their renewability, biodegradability, toxicity, and excellent performance in various applications. Though the bio-based oils show many environmental advantages, some of the vegetable oils like palm oils display imperfect oxidation and thermal stability, get solidified at lower temperatures, show poor fluid flow behaviour and consist of double bonds in their fatty acid carbon backbone, thereby leading to a higher wear rate [1]. These limitations displayed by the vegetable oil could be overcome by using additive mixtures and also by genetically and chemically modifying the base oil [2].

Why palm oil? Palm oil is an unfathomably proficient yield, creating more oil per land zone than some other equal vegetable oil crop. Globally, palm oil supplies 35% of the world's vegetable oil demand on just 10% of the land. To get a similar measure of elective oils like soybean or coconut oil, you would require somewhere in the range of four and multiple times more land, which would move the issue to the world and compromise various natural surroundings and species.

On the addition of nanoparticles to vegetable oils, biodegradability may reduce by 2-8%, which depends upon the type of additives used in the oil. For instance, the use of green additives such as hexagonal boron nitride (hBN) has a very less effect on the biodegradability of vegetable oils, cheap and shows excellent tribological properties when mixed with conventional engine oil. Abdollah et al. [3] show that the dispersion of the hBN nanoparticles in the palm oil affected the palm oil's tribological performance. High hBN nanoparticle concentration increased the coefficient of friction (COF) and decreased the wear rate due to the agglomeration and tribofilm formation that took place. However, the COF value was still lower than the values displayed by the commercially available engine oil SAE 15W40, as shown in Figure 1.

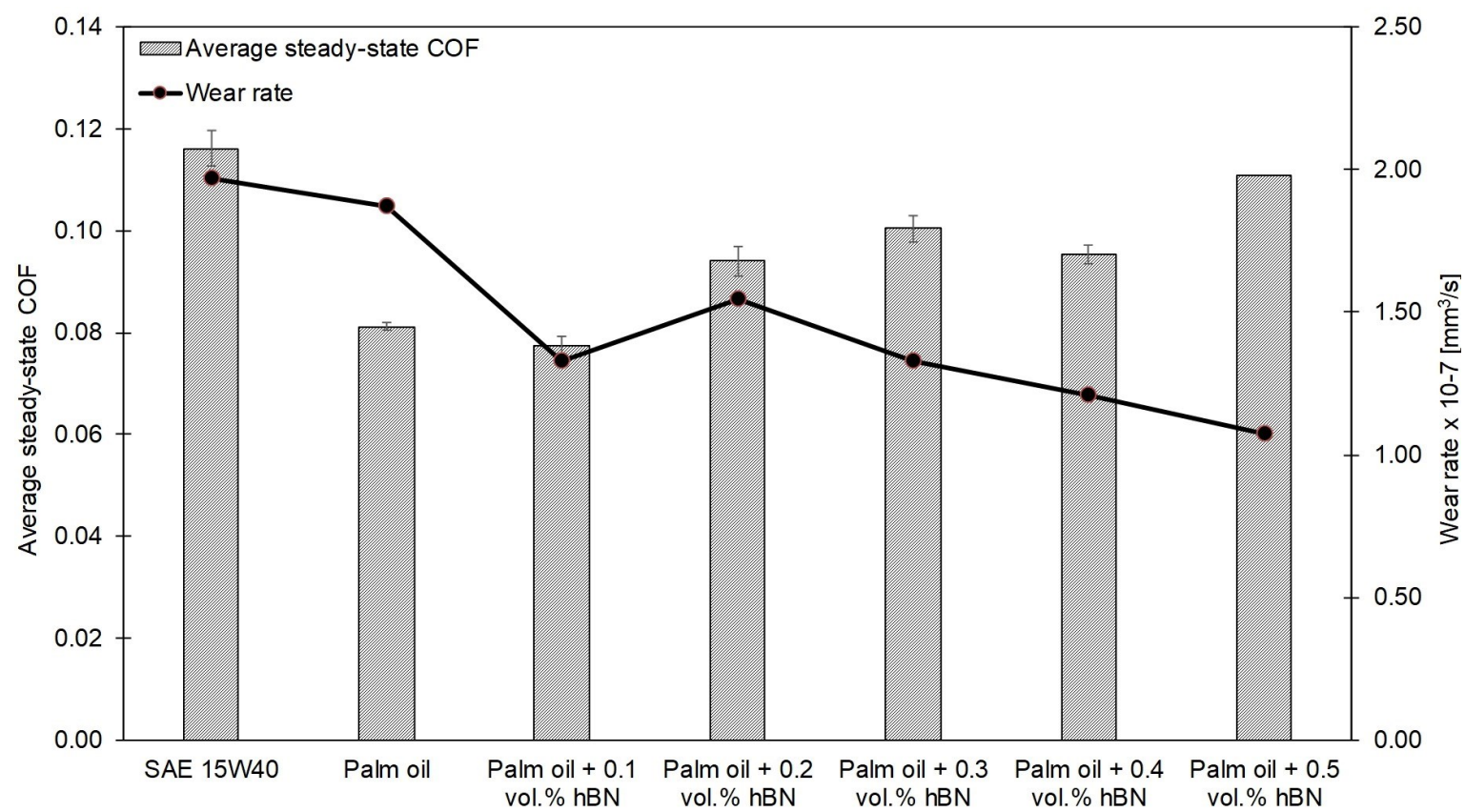


Figure 1 Variations in the COF and wear rate of the palm oil blended with the hBN nanoparticles. The data is collected from [3].

References:

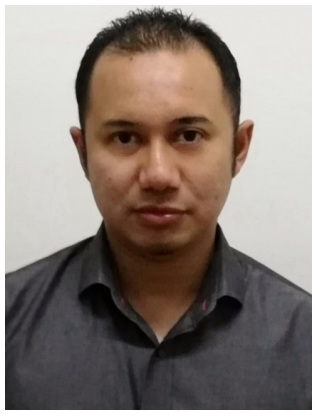
[1] Reeves, C. J., Menezes, P. L., Lovell, M. R., & Jen, T. C. (2013). The size effect of boron nitride particles on the tribological performance of biolubricants for energy conservation and sustainability. Tribology Letters, 51(3), 437-452.

[2] Shashidhara, Y. M., & Jayaram, S. R. (2010). Vegetable oils as a potential cutting fluid—an evolution. Tribology International, 43(5-6), 1073-1081.

[3] Abdollah, M. F. B., Amiruddin, H., & Jamallulil, A. D. (2020). Experimental analysis of tribological performance of palm oil blended with hexagonal boron nitride nanoparticles as an environment-friendly lubricant. International Journal of Advanced Manufacturing Technology, 106(9-10), 4183–4191.

Experimental Techniques to Assess Material In-Plane Deformation

By:



AHMAD FUAD AB GHANI

Over the past years, extensive techniques have been developed to meet the need to assess the deformation and integrity of structures. It can be divided into contact and non-contact methods [1]. Examples of contact methods include the use of strain gauges or piezoelectric materials, while non-contact method utilizes optical physics which include digital image correlation, diffraction and interferometry. Contact methods have drawbacks as they require extensive wiring and installation[2]. Non-contact methods avoid these problems and offer the possibility of making complete measurements of the stress field, without influencing the state of stress of the structure or component under study. One of the most recent contactless experimental methods is based on Scanning Laser Doppler Vibrometry (SLDV). SLDV measures the vibratory velocity and displacement of an object by measuring the Doppler shift of a laser beam frequency due to the velocity of the surface of the object [3]. Figure 1 demonstrates the type of measurement techniques under study including associated sections reviewed in this chapter.

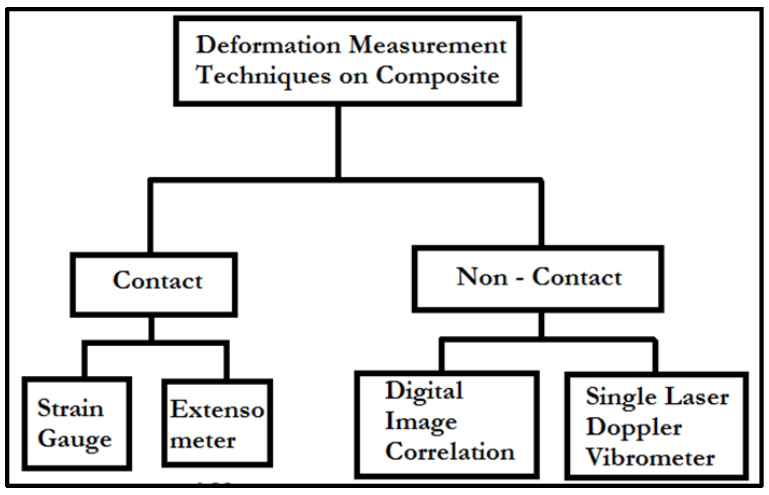


Figure 1 Deformation Measurement Technique on Material

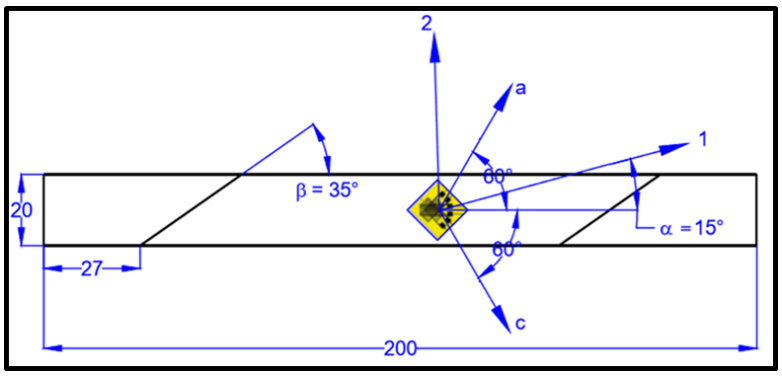


Figure 2 Configuration of The Off-Axis Sample with Oblique End Tab [6]

Strain Measurement

Strain is a relative change in the size of an object in response to an external load. The use of strain gauge devices has become a standard for testing newly developed components in the automotive and aerospace industries, as well as for monitoring the structural integrity of power structures, both naval and civilian. The contact methods have apparent disadvantages and are ideal only for point stress measurements. The development of non-contact optical stress measurement techniques paved the way for full-field field measurements without influencing the state of stress within the studied structure such as Digital Image Correlation (DIC)[4][5].

For example, the shear strains are computed using three strips of strain gauge rosettes, fixed in the middle of the off-axis specimens as shown in Figure 2. The engineering shear strain in the principal material axes (1, 2) is computed by the transformation from strain gauge readings. The off-axis tensile tests were performed using the Instron universal testing machine, with a crosshead speed of 1 mm/min [6].

Digital Image Correlation (DIC) on Material Characterization

Significant advancements have been seen in recent years among researchers in developing new experimental Digital Image Correlation (DIC) methods and post-processing such as image processing and enhancement in the computational algorithms. DIC is a non-contact, optical method which captures digital images of a surface of an object then performs the image analysis to obtain full-field deformation and measurements. This can be achieved by creating different methods like dots, grids and lines among others on the specimen surface. This technique starts with a reference image (before loading) followed by a series of pictures taken during the deformation.

Deformed images show a different dot pattern relative to the initial non-deformed reference image. These patterns difference can be calculated by performing a correlation of the pixels of the reference image and any deformed image, and a full-field displacement measurement can be computed. The strain distribution can then be obtained by applying the derivatives in the displacement field. To apply this method, the object under study needs to be prepared with a random dot pattern speckle pattern to its surface [7]. The reference picture is segmented into smaller zones called subsets. The deformation recorded in DIC system is expected to be homogeneous from each subset, and the deformed subsets with speckle pattern are traced in the current image as illustrated in Figure 3. The illustration shows the sequence of searching initial guess and correlation [8].

For surface deformation computation utilizing 2D Digital Image Correlation (DIC) technique, emphasis should be given on the positioning of the specimen under testing, light intensity and sources as well as the camera lens and its capability/resolution/frame rate of the camera. The accurate measurement relies heavily on imaging system configuration. In principle, a sample with a random speckle pattern sprayed on the surface must be positioned perpendicular to the camera to avoid any out of plane motion.

Continue on page 10

By:

Cheng See Yuan

EXTERNAL FLOW MODELING BY CFD – PART 2: MODELING CONSIDERATIONS

When modelling a flow problem, one should first consider the modelling strategy aimed to achieve the most reliable results and to minimize the computation effort so that the computer resources can handle the simulation. Flow in real life can be very complicated due to its intricate nature. Therefore, flow idealizations (AKA simplifications) are important to make it possible for achieving the aims. Following are the aspects that the CFD user should consider when applying simplifying assumptions:

Transient vs Steady State

While a given flow may be evolving in time, which is essentially a transient phenomenon, other flows that are in equilibrium or have settled down may retain their properties with little change over time, thus, they can be modelled as a steady-state flow.
Flows that cannot be modelled correctly by steady-state simulation are those exhibiting periodic or intermittent separation or vortex shedding, and when the flow system is shifting from one state to another where the flow properties are still changing with time such as during a system startup (or down).

Compressible vs Incompressible

It is easier to handle the incompressible flow simulation due to the more straight forward boundary condition settings. For airflows, if the Mach number is less than 0.3, the effect of compressibility is negligible, thus, it can be modelled as an incompressible flow. Fortunately, most of the real-life applications fall under this flow regime. If the fluid is a liquid, the incompressible assumption is often appropriate since liquid is hardly compressible.

2D vs 3D

Objects that are quasi-two-dimensional (e.g. long cylinder, rotor blade, wing, etc.) can be modelled by a 2-D simulation if their end effects are not part of the scope of the study. Moreover, an axisymmetric object that is subjected to asymmetric flow (e.g. bullet, pipeline, sphere, etc.) can also be modelled by a 2-D simulation. The advantage of modelling a problem by 2D simulation is the enormous reduction in computing time and effort.

Domain

When simulating an external flow, it is common to use a combination of velocity inlet and pressure outlet as the boundary conditions. Thus, the region of the upstream flow where the flow velocity is known would normally be chosen as the upstream extent of the domain and be assigned the velocity inlet boundary condition. The downstream extent of the domain is normally chosen at a location where the flow gradient in the streamwise direction has become insignificant (Fig. 1).

Some external flow types can be modelled by using the symmetric boundary condition to reduce the whole domain to a half domain. One obvious example is the flow past an object that is symmetrical about its centerline.

If the flow configuration involves repetition, the periodic boundary condition can be applied such that only a segment of the full flow field is modelled, thus, conserving computer resources (Fig. 2).

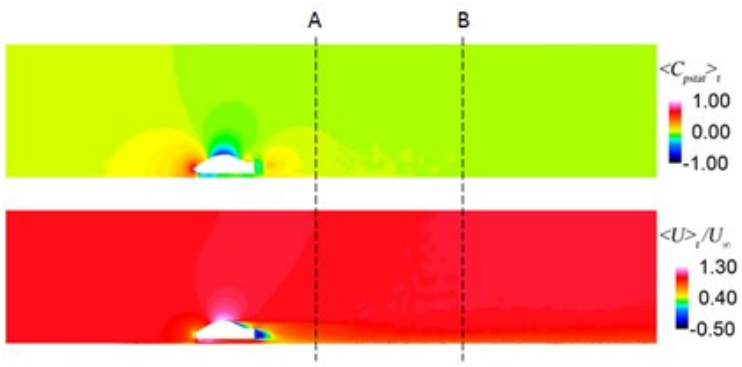


Fig. 1: The distribution of static pressure (upper) and streamwise velocity component (lower) in the symmetry plane of a vehicle-inspired bluff body. The location of the outlet boundary needs to be chosen at a downstream location where the flow gradient has become insignificant (after location B). Placing the outlet boundary within the wake or considerably near to the body would yield unphysical CFD solutions.

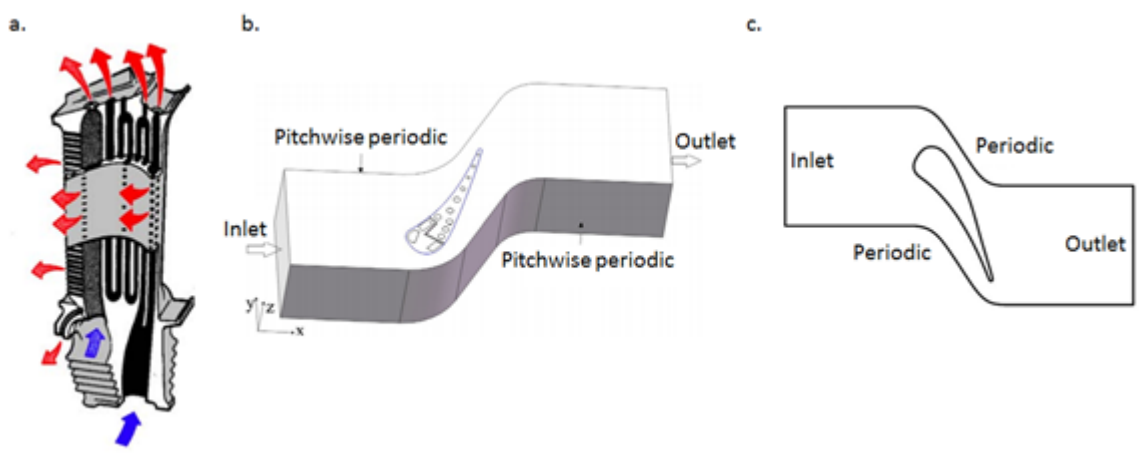


Fig. 2: Numerical domain of NASA C3X. Based on the modelling objective, instead of modelling the firtree (a) [1], it is possible to model only the aerofoil segment (b)[2] or to further simplify the flow configuration to a two -dimensional domain (c)[3].

Continue on page 10

An Insight into Scientific Glassblowing

By:

Rafidah Hasan

Glassblowing may sound unfamiliar to some of us in Mechanical Engineering. Without our notice, we always use the product of this ancient technology (invented by Syrian craftsmen in the 1st century BC, as reported by Britannica). Laboratory apparatus such as petri dish, beaker, tubing for extraction and distillation, and many more laboratory glasswares are produced using the glassblowing technology.

In arts, glassblowing produces some beautiful decorations such as crafts, vase and glass flowers. However, scientific glassblowing connects art and science in interesting ways. A skilled person doing this job is called a Scientific Glassblower. The Glassblower is able to produce scientific custom made glass instrument as well as fixing broken glassware for scientific applications. In Malaysia, the nearest scientific glassblowing facility is available at Nuklear Malaysia, Bangi. The only Glassblower there is Mr. Latip Baba, who has vast experience in producing laboratory glassware. Research works that involve custom made glass apparatus may utilize the facility at Nuklear Malaysia, Bangi.

More interesting information about scientific glassblowing can be found through the link:
https://www.theverge.com/2020/3/10/21172370/scientific-glassblowing-how-to-chemistry-fire-verge-science-video

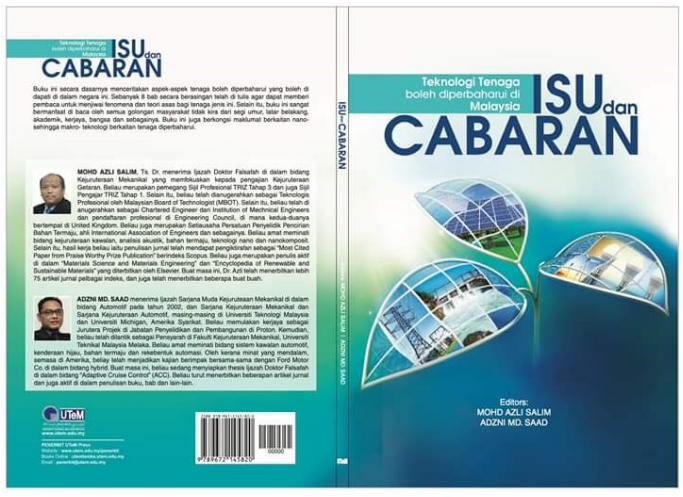
Figure: Some laboratory apparatus.

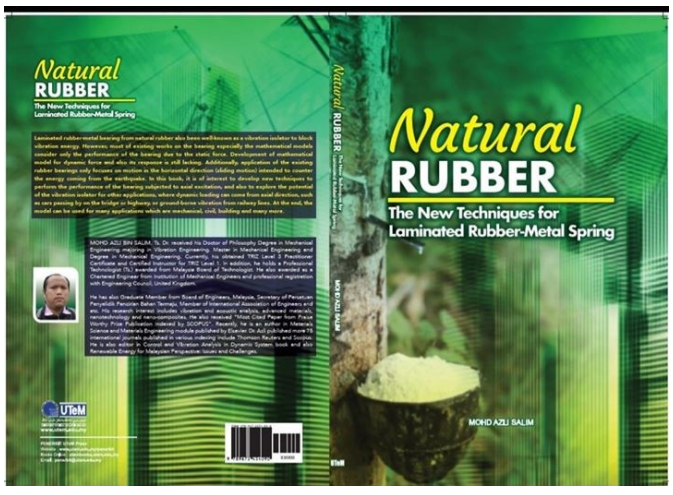
Figure: Nuklear Malaysia, Bangi.

Figure: Various glass tubing at Nuklear Malaysia.

Figure: Mr. Latip Baba with glass making furnace.

New books by CARe members





Continue from page 7

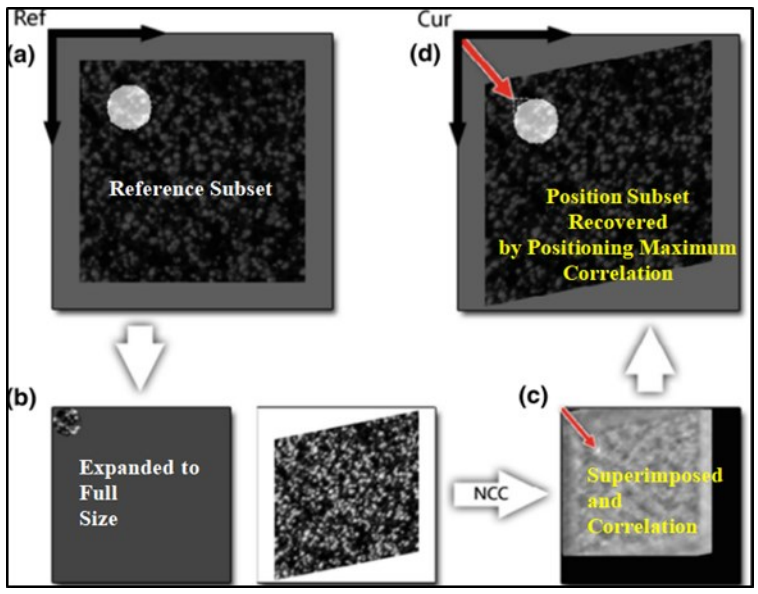


Figure 3 Illustration Shows Sequence of Searching Initial Guess and Correlation [8]

References

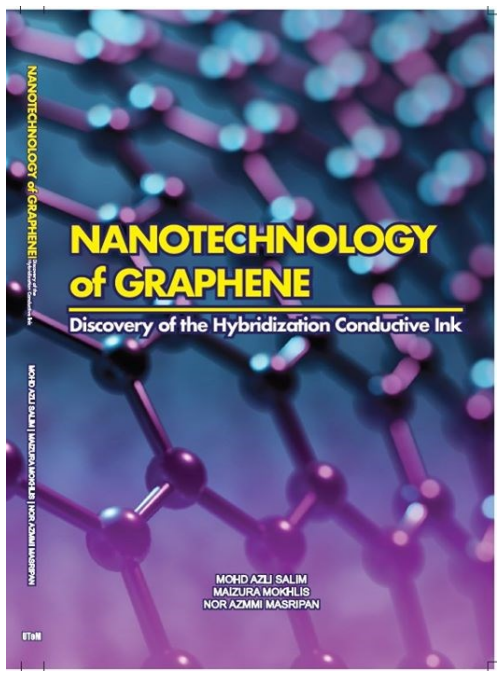
[1] M. Z. Siddiqui, F. Tariq, and N. Naz, "Application of a Two Step Digital Image Correlation Algorithm in Determining Poisson's Ratio of Metals and Composites," 62nd Int. Astronaut. Congr., vol. 62. 2011.
[2]C.S. T. Sze-Wei Khoo, Saravanan Karuppanan, "A review of surface deformation and strain measurement using two-dimensional digital image correlation", Metrol. Meas. Syst., vol. 23, no. 4, pp. 537–547, 2016.
[3] D. Di Maio and D. J. Ewins, "Applications of continuous tracking SLDV measurement methods to axially symmetric rotating structures using different excitation methods," Mech. Syst. Signal Process., vol. 24, no. 8, pp. 3013–3036, 2010.
[4] D. Lecompte, S. Bossuyt, S. Cooreman, H. Sol, and J. Vantomme, "Study and generation of optimal speckle patterns for DIC," Proc. Annu. Conf. Expo. Exp. Appl. Mech., pp. 1643–1649, 2007.
G. Wesolowski, M. Barkanov, E. Rucevskis, S. Chate, A. La Delfa, "Characterisation of elastic properties of laminated composites by non-destructive techniques," ICCM Int. Conf. Compos. Mater., 2009.
[6] J. C. Xavier, N. M. Garrido, M. Oliveira, J. L. Morais, P. P. Camanho, and F. Pierron, "A comparison between the Iosipescu and off-axis shear test methods for the characterization of Pinus Pinaster Ait," Compos. Part A Appl. Sci. Manuf., vol. 35, No. 7–8, pp. 827–840, 2004.
[7] P. L. Reu, W. Sweatt, T. Miller, and D. Fleming, "Camera System Resolution and its Influence on Digital Image Correlation," Exp. Mech., vol. 55, no. 1, pp. 9–25, 2015.

Continue from page 8

Reference:

[1] GUHA, A. 2001 Performance and optimization of gas turbines with real gas effects. Proceedings of the Institution of Mechanical Engineers, Part A: J. of Power and Energy 215 (4), 507–512.
[2] Zhaoqing Ke, Jianhua Wang, "Conjugate heat transfer simulations of pulsed film cooling on an entire turbine vane" Applied Thermal Engineering 109 (2016) 600–609.
[3] Zeinalpour, M., Mazaheri, K., and Irannejad, A. "Turbine Blade Aerodynamic Optimization on Unstructured Grids Using a Continuous Adjoint Method." Proceedings of the ASME 2012 International Mechanical Engineering Congress and Exposition. Volume 1: Advances in Aerospace Technology. Houston, Texas, USA. November 9–15, 2012. pp. 425-431. ASME.

New books by CARe members

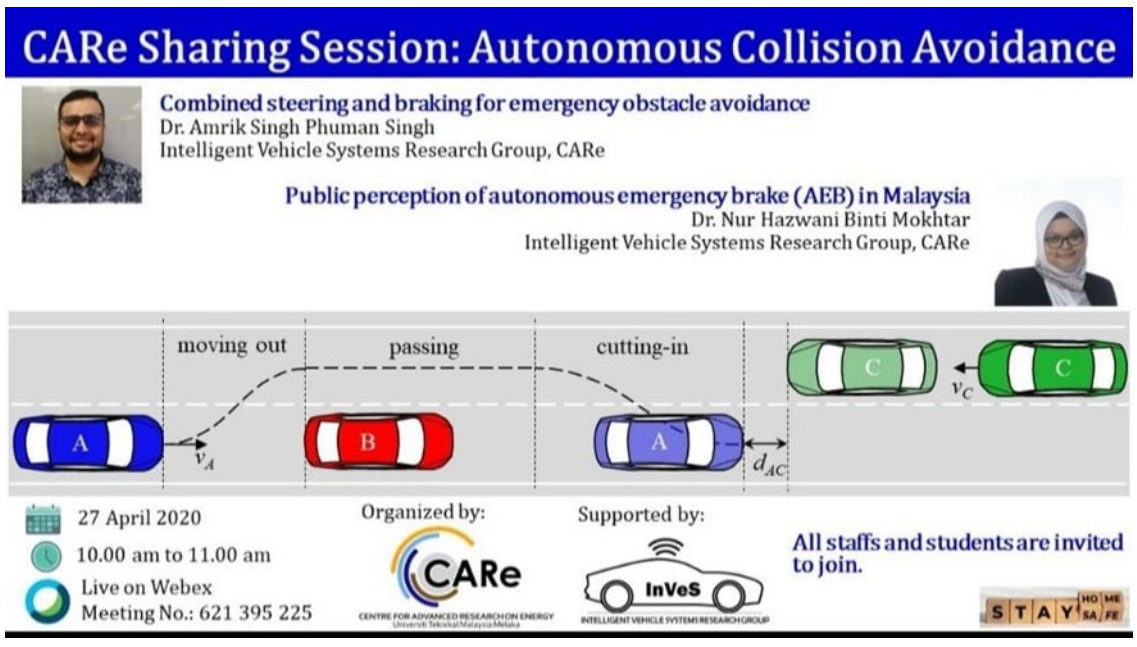


Some of CARe activities

Visit to AFA Technologies Sdn Bhd, Cheng. (2nd June 2020)

UMP delegation for lab visit and potential research collaboration

FRGS Series 1 (2020) proposal workshop by Prof Che Hassan from UKM



SOME OF CARe ACTIVITIES *CONT*

The 2nd United Training Program

Visit our website:
http://www.utem.edu.my/care

Contact us

Centre for Advanced Research on Energy
Faculty of Mechanical Engineering
Universiti Teknikal Malaysia Melaka
Hang Tuah Jaya, 76100 Durian Tunggal, Melaka, Malaysia

Phone : +606 234 6891
Fax : +606 234 6884
E-mail : care@utem.edu.my

www.utem.edu.my/care

ISSN 2289-9871
9 772289 987006