

MANUFACTURING MATTERS

April 2017 | Issue 2

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FEATURE

QUICK MILLING VIBRATION SOLVER ENDS CHATTERING

PRODUCTIVITY MATTERS
GROWING OUR PARTNER'S
BUSINESS

SKILLS MATTERS
BLENDED LEARNING FOR ENHANCED
INDUSTRY SKILLS UPGRADING

RESEARCH SPOTLIGHT
BIO-INSPIRED JOINING STRATEGIES
FOR LIGHTER AIRCRAFT

NOTE FROM EDITOR...

Dear Friends and Industry Partners,

Singapore's manufacturing industry is facing many challenges amid weak global demands and tight local labour market. To maintain the manufacturing industry's 20 per cent contribution to the Singapore economy, the Government has unveiled a national strategy and 6 Industry Transformation Maps (ITMs) to strengthen various clusters in the manufacturing sector, including the Precision Engineering (PE) industry.

The Precision Engineering Centre of Innovation (PE COI), set up jointly with SPRING Singapore in 2007, is a dedicated centre to work with PE companies to develop and adopt technologies for innovation in materials, products, processes, operations and business models. It has carried out more than 530 industry projects and 170 consultancies. The centre has also initiated numerous Collaborative Industry Projects (CIPs), which are cost effective R&D platforms where groups of companies facing similar issues work jointly with SIMTech to develop manpower and technology.

In 2010, PE COI organised the first CIP to bridge the technology capability gaps between MNCs (Demand Drivers) and local suppliers. Since then, SIMTech has initiated more than 20 CIPs. One of these is the Implementation of Machining Dynamics for productivity and quality improvement (See Feature in the opposite page for details).

Swee Heng

Editor, Manufacturing Matters

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QUICK MILLING VIBRATION SOLVER ENDS CHATTERING

Technology and system improve machining productivity and quality for industry

Even though high speed machining and tooling technology have significantly improved over the years, industry engineers face surface quality problem due to machining vibration which limits productivity to meet surface tolerance. As machining shifts to more complex geometry, engineers are unable to establish optimal cutting condition. These deficiencies cause significant delays in time-to-market, increase cost and reduce productivity. Compounded with this industry-wide challenge, local machining companies are short of highly trained engineers who still depend on trial and error approach for solving machining vibration.

To address these challenges, SIMTech developed the Milling Vibration Solver technology and system to implement optimal machining dynamics. There are several benefits of this technology and system. Competency to improve productivity and machining know-how through the identification of optimal cutting condition for higher productivity is achieved. Material cost and machining time are reduced by selecting the right spindle speed and cutting depth. As it is a scientific method, the know-how to solve milling vibration problem through training and toolkit can be transferred easily to engineers.

As this approach eliminates re-machining or polishing processing, machining productivity is improved and chatter marks on workpiece are avoided. Greater machining accuracy such as surface roughness, form error and dimensional error, is achieved. As machining parameters are optimised, tooling/machine tool life is prolonged with less machine downtime due to wear and tear of



spindle unit from machining vibration. Machining performance is improved by avoiding vibration with stable condition.

PLC Industries Experience

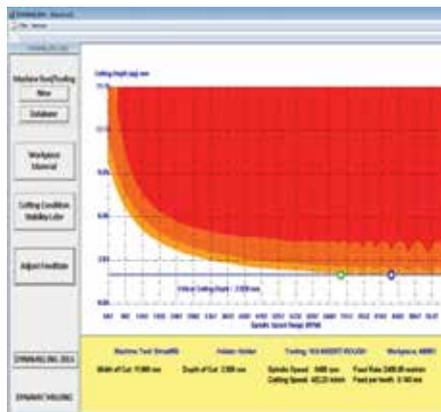
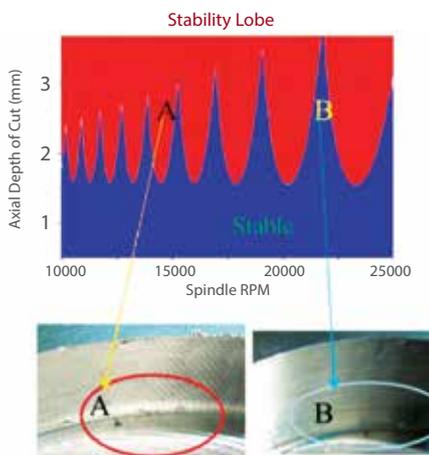
PLC Industries, an ISO 9001-2008 certified company that produces high quality precision parts for

the global markets in biomedical, imaging, equipment and photonics industries, participated in a SIMTech-led Collaborative Industry Project (CIP) to shift from traditional trial and error methods to a scientific approach based on machining dynamic analysis to improve machining performance.

In this CIP to provide technology on machining dynamics and simulation, a customised solution, MILLING DYNAMICS System (quick machining

vibration solver and optimiser), was applied. Technical support and customised training of the system application to achieve optimal machining process parameters at the machine shop floor were provided.

PLC Industries reaps many benefits from the use of the MILLING DYNAMICS System. It enables the company to apply quick and portable machining vibration identifier to configure optimal tooling or workpiece fixtures and spot quickly machining vibration problem sources. Sustainability is achieved against vibration for given cutting conditions. Prediction of the chatter-free milling condition prior to real-time production is now possible. Apart from the prevention of machining vibration, chatter-free cutting condition is attained and surface error reduced through the consideration of cutter deflection. The trial and error approach is eliminated, leading to the application of first part correct technology, resulting in higher machining productivity and performance for company's high value-added components.



On-site application of machining dynamics technology and system at PLC Industries

“ The combination of the latest intelligent software with high technology hardware enables us to increase productivity and product quality which also allows us to machine material from standard aluminium to exotic metal. Machining time has reduced by 25 per cent and productivity correspondingly improved using scientific approach instead of trial and error ”

Mr Esmond Lim, CEO, PLC Industries

For enquiries, please contact
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 Web: www.SIMTech.a-star.edu.sg/PECOI

PE COI Precision Engineering
 Centre Of Innovation
 Sustaining and Advancing PE Industry



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INNOVATION IN ADVANCED FORECASTING AND PLANNING SUPPLY CHAINS

Forward end-to-end looking, visibility, coordination, collaboration, and combination of simulation and optimisation are key Supply Chain drivers that lead to fulfil current customer high demands and relieve Supply Chain stress. An intelligent advanced forecasting system, iForecaster™, equipped with an ample pool of state-of-the-art forecasting algorithms, was jointly designed and developed by SIMTech and iCognitive, a Singapore-based SME, specialising in supply chain management and optimisation, with international presence in Asia and Europe.

As a continuation of this collaboration, SIMTech and iCognitive worked on creating a winning analytics ecosystem around iForecaster™ with a strategic extension on Sales and Operations Planning (S&OP). To eliminate organisational and technical bias, strategic planning and S&OP are critically important for companies today due to market velocity and volatility. Alignment within a company to satisfy the customer demand is critical for its business growth. Cementing the internal coordination and collaboration within the purchasing, sales and marketing, production and distribution through an institutionalised S&OP process systemises and synchronises the communication between the different functions to serve the customer better at lower cost. In this regard, SIMTech and iCognitive created two new Master Classes: Supply Chain Analytics Master Class and S&OP Master Class to link companies' plan to execution. The aim is to support SMEs in their digitisation journey, and enhance their capabilities.

“ **The benefits are evident. Customer service level achieves 95 to 99 per cent, sales grow 25 to 30 per cent, inventory reduction reaches 10 to 25 per cent and operating cost reduces 5 to 10 per cent** ”

Mr John Paul, CEO, iCognitive

For more information, please contact **Mr Foo Yeong Han** at yhfoo@SIMTech.a-star.edu.sg

INNOVATION THROUGH T-UP

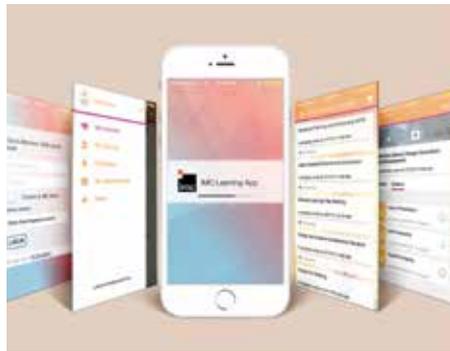
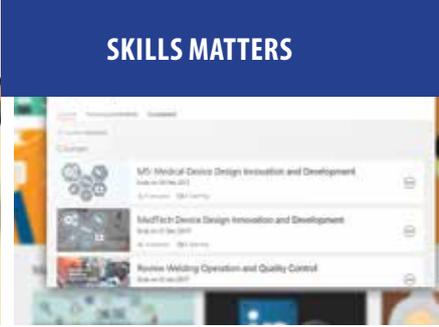
Thanks to the T-Up of a SIMTech researcher, the material selection of a non-metallic drum to be used with an induction heating system was developed to be incorporated in an evaporating sludge drying equipment for Singnergy Corporation, a Small and Medium Enterprise specialising in sludge/food waste drying equipment. The existing conventional dryer saves more than 35 per cent of energy consumption and can be powered by a wide variety of energy sources such as LNG, LPG, biogas, diesel, fuel oil or electricity. The development of a new heating method using an induction system with a non-metallic drum aims to maximise energy savings when powered by electricity and is expected to save about 45 per cent of energy as compared to conventional dryers.

This technology has a ground-breaking impact on the current sludge drying and food waste market

The researcher assisted in the simplification of Singnergy's initial design to a more robust solution while employing a systematic approach for the selection of suitable materials and its manufacturing processes. The new drum material provides effective insulation and ensures maximum heat energy transfer to the heating belt. This enhances heat distribution within sludge, drying rate and consumes less energy. The direct heating of the metal belt is only possible when used concurrently with the non-metallic drum as it effectively removes the drum as an energy transfer media. Target temperature can now be reached within seconds onto the belt surface. This T-Up has resulted in a patent on the selected drum material and design.

*Note: The T-UP initiative, a multi-agency effort by A*STAR, the Economic Development Board, SPRING Singapore, IE Singapore and the then Infocomm Development Authority, involves seconding RSEs to local enterprises to enable them to access the pool of R&D talent in the Research Institutes.*

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BLENDED LEARNING FOR ENHANCED INDUSTRY SKILLS UPGRADING

Blend E-Learning with classroom training, mentoring and labs practice

Tapping on technology and innovation, SIMTech aims to transform case study-based classroom training into a blended learning culture that is flexible, just-in-time and relevant to learners' and industries' needs. This is in line with SkillsFuture Singapore (SSG) iNLEARN 2020 to have all its full Workforce Skills Qualifications (WSQ) courses via blended learning.

Blended learning, supported by various learning innovation and technologies, seamlessly integrates online learning, classroom training, and workplace training and practising, which enables flexible learning to fulfil skills competency needs. The e-learning platform provides support for self-directed learning and assessment via quizzes, tracking of learning, discussion forums, chat, video conferences and other latest technologies to enhance the learning experience as well as flexibility.

SIMTech has started blended learning with a few topics and planned to expand to all courses by end 2017. E-Learning operating in various platforms includes different web browsers, mobile devices, hand-held devices and smart phones.

Learners can play, pause, continue learning the topic anytime, anywhere. Topics Leaders can be E-Facilitators to provide online support to learners' questions and track learners' progress. Quizzes are used to recap and review some learning objectives. The system also provides detail reporting for tracking, analysis which are important for future improvement.

SIMTech's E-Learning is hosted in www.LearningSpace.sg. To run the E-Learning on the mobile device, learners can either run it using the existing mobile web Browser or download mobile application "IMC Learning App" from Android's Play Store or Apple's App Store. Off-line version of E-Learning Objects can also be made available for any site without internet access.

Ms Gloria Chia, who has attended the first E-Learning module under PE WSQ Graduate Diploma in MedTech Technologies, commented, "The lecturer went beyond the typical classroom activities, such as online digital e-module lessons, to creating educational systems that had a more lasting impact for the working adults. With digital lessons, we learn at our

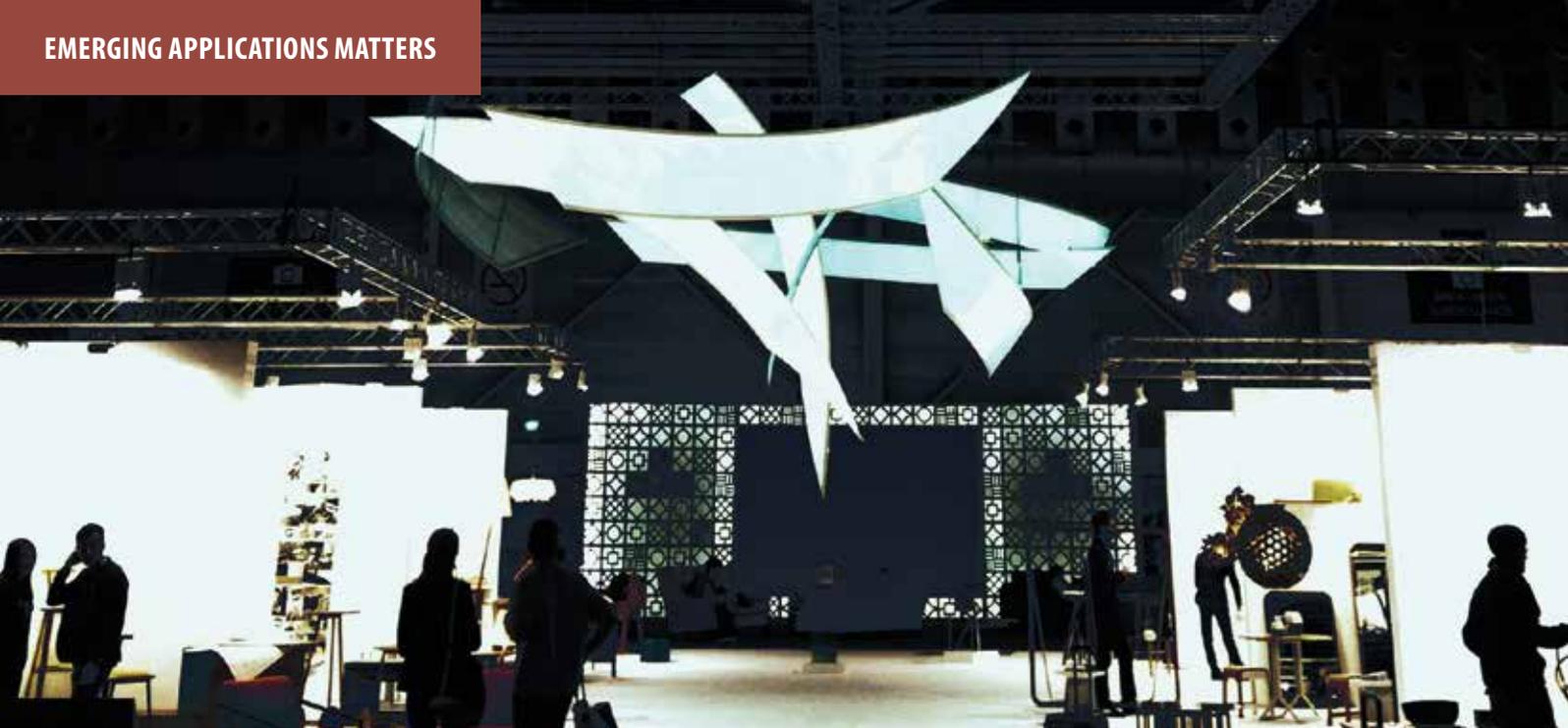
pace - login to the system on our mobile phone and/or laptop to study - and come to class with readiness to learn as a team. In class, we get personal guidance from the lecturers, tackle problems and build prototype models of the projects to ensure it works. For the digital lessons, there are brilliant ideas for pop-ups, pullouts, detailed medical device design images that showed how all the individual parts are dovetailed together with the concepts, fundamentals and medical application, and how these complex design innovations and developments were initiated, designed and manufactured. More importantly, the lessons correlate to what we learned in other modules, and at the same time, reveal something new."

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KTO Knowledge Transfer Office
Enriching Industry Training



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SMART FURNITURE AND HOME PRODUCT INNOVATION WITH PRINTED ELECTRONICS & OTHER EMERGING TECHNOLOGY

Printed electronics capabilities development through Collaborative Industry Project

Printed electronics, a set of printing methods used to create electrical devices on various substrates, deposit electrically functional electronic or optical inks on the substrate, creating active or passive devices. Its low cost, thin-form, flexibility, stretchability, portability, and rollability is ideal for use in furniture, interior design and buildings. The Singapore furniture industry is important. It has a market share of S\$6.22B or 1.05 per cent of global consumption. Comprising the manufacturing, contract manufacturing, retailers, designers and supporting sectors, the 2000-strong local furniture industry has a global footprint in 80 countries (Source: SFIC annual report 2015).

This CIP was launched in collaboration with the Singapore Furniture Industry Council

To rejuvenate and grow the Singapore furniture industry, SIMTech is assisting this cluster to tap on printed electronics technology to add value to existing products or create game changing lifestyle markets for industry players. SIMTech has helped a SME in developing and implementing printed lighting on acrylic tiles for mood lighting and night time illumination applications. For another SME, SIMTech developed printed lighting strips for building interior. To increase the adoption of this technology, SIMTech launched a Collaborative Industry Project (CIP) on Application of Printed Electronics in smart furniture and smart home products utilising printed lighting and printed electronics and other emerging technologies from SIMTech. The CIP scope encompasses:

- training on design guidelines for application of printed electronics and printed lighting
- development of various product possibilities

- optimise integration of printed electronics in these applications
- cost modelling for application of printed electronics

This CIP also includes printed lighting strip, printed segmented lighting, printed touch, printed pressure sensor, blue tooth, 3D printing, natural fibre composite, various types of surface coating technologies and system design or functional integration in various products for awareness to create new furniture, interior design and building façade.

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EAC Emerging Applications Centre
 Seeding and Growing Emerging Industries



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GROWING OUR PARTNER'S BUSINESS

FITPRISE Enterprise Management System is for use in many industries

Enhanzcom Pte Ltd, an IT solutions provider, developed and commercialised a software technology jointly with SIMTech that creates business management systems easily. The partnership created UCA (Unified Configuration Architecture), a web-based software development platform, which was licensed to Enhanzcom from ETPL, A*STAR's commercialisation arm.

Enhanzcom built on the UCA technology and developed the FITPRISE Enterprise Management System (EMS), a scalable web-based Enterprise Resource Planning (ERP) system designed to fit and integrate business operations workflow in any industry.

Compared to an off-the-shelf ERP system, FITPRISE addresses individual company needs and offers customised system modules to integrate a company's business workflows, making the whole automation process less disruptive to current business operations. Its flexibility allows for quick integration into companies, while its easy-to-use functions and simple user interfaces allow users to quickly adapt and maximise the system's capability. FITPRISE benefits companies, especially SMEs, to

overcome productivity challenges by centralising data, ensuring information accuracy, improving documentation processes, reducing manual effort and the time spent on locating data at affordable investment costs.

LanTroVision (S) Ltd, a company specialising in IT infrastructure cable installation, structured cabling systems and components, benefitted from adopting FITPRISE. It adopted FITPRISE when the company faced project management challenges in tracking all their projects status. The substantial lag time in responding to their customers' needs and queries, lack of project visibility also hindered LanTroVision from being an effective service provider.

After an intensive study of LanTroVision's operation processes, Enhanzcom developed, in about 3 months, the FITPRISE system comprising over 100 system modules supporting the entire operation. The team's dedication, coupled with the UCA technology, resulted in almost 50 per cent reduction in development time as compared to a typical customised ERP system development. With FITPRISE currently centralising data and integrating transactions across

LanTroVision's operations, tracking projects and making informed strategic decision have become much easier.

For SMEs, FITPRISE system's shorter implementation time is beneficial, as increased productivity is achieved faster. In current market conditions, SME's ability to respond to changes means any technology adoption has to be nimble and fast. FITPRISE EMS, with its scalable system architecture, fits this requirements to meet changing business needs with minimum coding effort.

As part of SIMTech's initiative to encourage SMEs to adopt technologies to improve productivity, the institute is working jointly with Enhanzcom to facilitate mass adoption of FITPRISE EMS. SIMTech helps to configure the technology application as common applications that can be used in many industries. To date, SIMTech has partnered Enhanzcom to deploy FITPRISE to more than 100 companies of which 90 per cent are SMEs.

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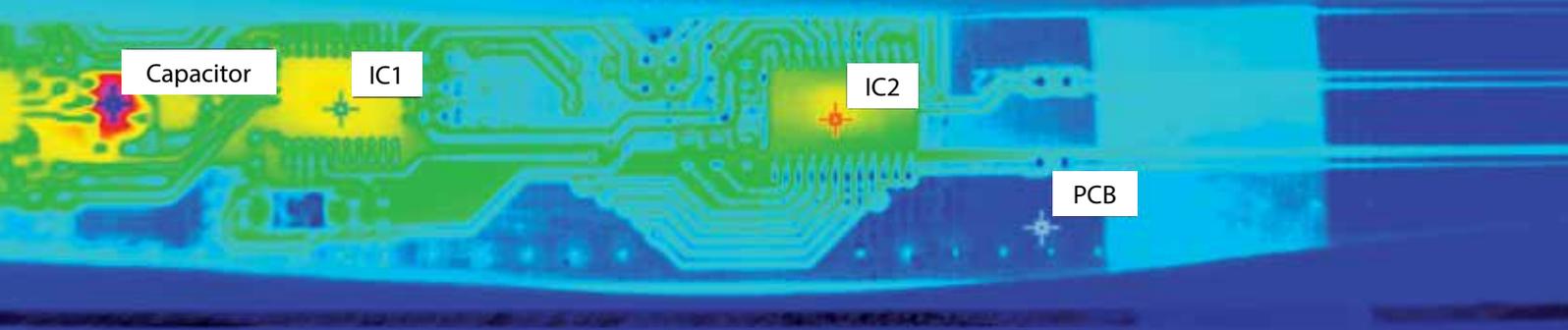
“ SMEs that are hesitant to implement any ERP systems in any area of their business operations can use FITPRISE as a test bed as it works in a modular fashion. FITPRISE can be used in almost every industry and has a total of 18 templates that caters to its diverse range of users ”

Mr Edwin Seah, Chief Executive Officer, Enhanzcom

MPTC Manufacturing Productivity
 Technology Centre
 Enhancing Manufacturing Productivity



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Infra-red imaging of LED device driving electronics

LED ASSESSMENT METHODOLOGY IMPROVES PERFORMANCE & RELIABILITY

A systematic approach to identify LED product weakness

The poor thermal design of LED luminaire, coupled with Singapore's tropical climate lead to high reported failures of LED luminaires in retail malls and sport hubs which bear incurring high maintenance costs. LED suppliers also face high replacement rate for defective LEDs.

Some examples of defective LEDs are due to inferior materials or less robust encapsulation (see Figure 1 and 2) measured based on companies' on-site samples. Figure 1 shows the diminishing levels of phosphor elements, vital for light emission. Figure 2 illustrates inferior encapsulation materials that

degrade very fast in humid and tropical climate, significantly reducing LED light emission. Another major source of failure is the thermal stress induced due to temperature difference between Printed Circuit Board and device electronic components (picture above). The root cause is the inferior soldering of the electronic components (Figure 3) which gives rise to local hot spots that accelerate device degradation.

products as well as provide thermal management consultation. In addition, a test method to evaluate the thermal performance and reliability assessment of LED luminaire was also transferred to the industry.

To-date, SIMTech has successfully worked with the end-users such as LendLease, Mapletree, Hyundai Construction, SportHub Singapore, and Dragages, to implement the measurement methodology. TÜV SÜD PSB, our collaboration partner, commented that the methodology has tackled reliability issues for adopters of LED lighting by obtaining performance testing of LED luminaires.

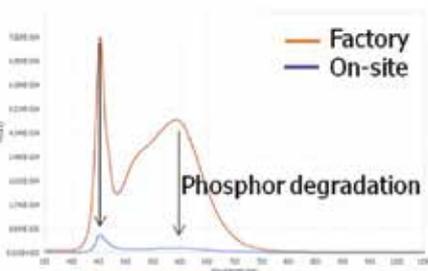


Figure 1: Diminishing phosphor element reduces LED's emission power

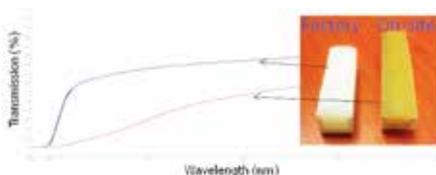


Figure 2: Inferior encapsulation materials (right, on-site sample) degrade earlier than expected lifetime

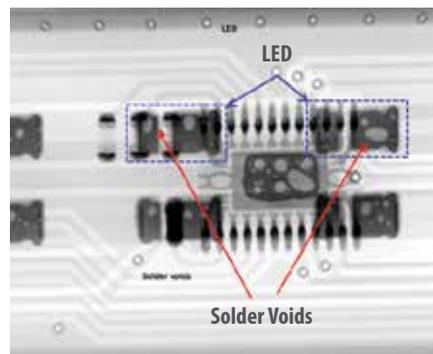


Figure 3: Bubbles of void due to inferior soldering during manufacturing

Using SIMTech's LED assessment methodology, the performance and reliability of LED lighting systems can be improved. This methodology involves accelerated reliability testing, identification of root cause failure, and material/performance degradation analyses. With this approach, SIMTech has helped companies to identify their product's weakness and introduce mitigation measures, evaluate the performance and reliability of their

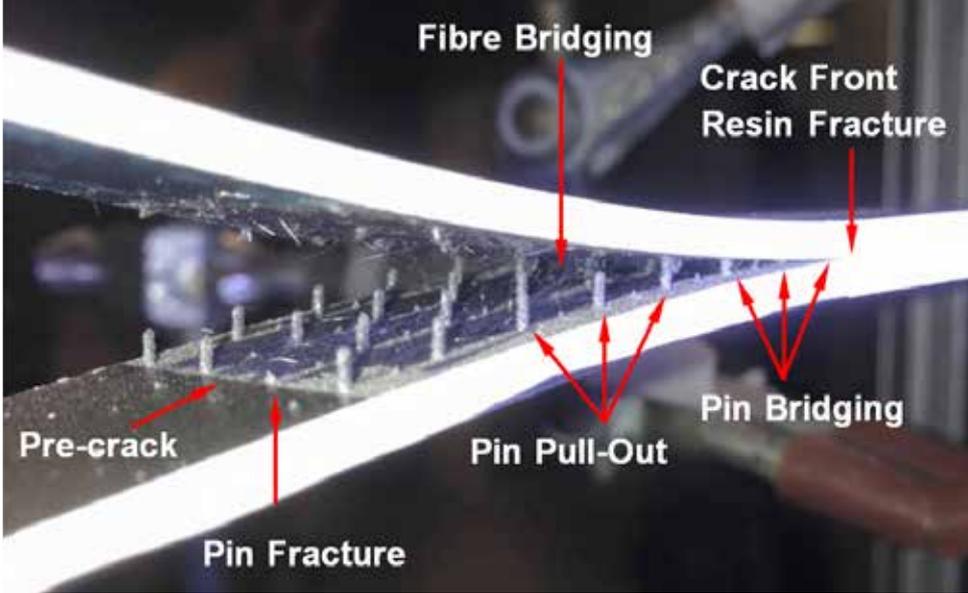
This test method has been adopted for many LED lighting implementation

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SMC Sustainable Manufacturing Centre
 Embracing Sustainable Manufacturing



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BIO-INSPIRED JOINING STRATEGIES FOR LIGHTER AIRCRAFT

From English Ivy plants to metal-composite joints

New generation aircraft utilise lighter and stronger materials to improve the environment and cost efficiency in the transport sector. Thus, aircraft manufacturers are moving toward lightweight composite materials made from light, stiff and strong fibres, such as carbon or glass, and more flexible polymer systems orienting and holding the fibres tightly together. Problems arise when metallic parts are connected to these novel materials by drilling and securing thousands of titanium fasteners throughout the aircraft body. This adds weight and significant manufacturing cost. A novel joining method is preferred.

A collaborative research team including Dr Stefanie Feih from SIMTech and Associate Professor Adrian Orifici, Professor Milan Brandt and PhD student Alex Nguyen from RMIT

University, Australia, has successfully demonstrated the benefits of using bio-inspired joining strategies to connect composite structures to metal parts with properties far exceeding standard adhesive bonding methods. Their research mimics the English Ivy plant, which joins materials together via tenacious interlocking mechanisms active at different scales.

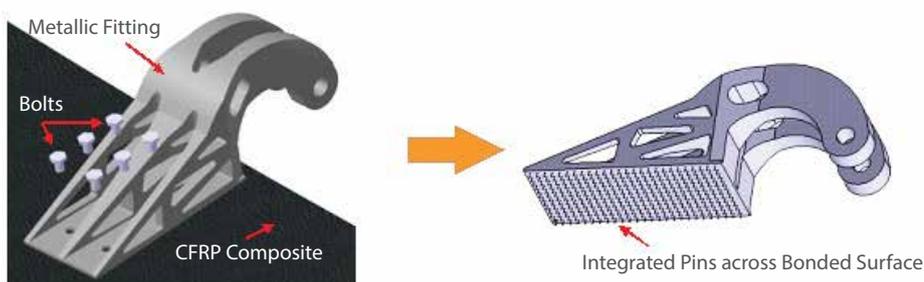
This inspiration has led to an innovative design strategy utilising metallic pins protruding from the metallic surface and interlocking with the composite material. In this work, the titanium metal component including its surface pins was manufactured with a 3D printing process, selective laser melting (SLM), where a laser beam is used to melt and fuse layers of metal powder until the part is completed. The team demonstrated that the titanium surface roughness created by SLM is ideal

for microscale bonding ($< 50\mu\text{m}$). As such, the pins that protrude into the composite at the macroscale ($>500\mu\text{m}$) have a tenacious attachment, and this synergy produces very high strength and absorbed energy as the pins pull out of the composite.

The new joint designs result in significantly higher amounts of absorbed energy during failure compared to traditional adhesive joints. This slows down crack growth and allows reliable joint inspection. The new joints have properties far exceeding standard adhesive bonding or bolt fastening methods and additionally allow for significant manufacturing cost savings due to potential part reduction through integrated assembly.

This work won the best paper award at the Composites Innovation Conference 2016 in Melbourne, Australia

For more information, please contact
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A number of events were organised in 2017 to engage the industry and forge partnerships

Seminar on Applications of Printed Lighting, Printed Electronics and Other Emerging Technology for Smart Home and Building Facade, 20 Jan

SIMTech jointly organised this seminar with Singapore Furniture Industry Council to share various opportunities to apply printed electronics and other emerging technologies such as printed lighting, printed touch, printed pressure sensor, 3D printing, natural fibre composite, printed circuitry for Internet of Things and other emerging technology for smart home/smart furniture to inspire the industry in furniture and home design, interior design and architectural design.

The 144 attendees visited SIMTech facilities, and also learnt more about a work-in-progress Collaborative Industry Project (CIP) on printed electronics. Arising from this event, a CIP was launched in late March (see page 6 for details).



SIMTech Membership Networking Night 2017, 8 Feb



Close to 250 SIMTech partners; industry representatives from trade associations and government agencies attended the networking event. Reinforcing the commitment for closer collaboration, industry leaders from Singapore Precision Engineering and Technology Association, Singapore Manufacturing Federation, Singapore Business Federation, Singapore Industrial Automation Association, Print and Media Association, Association of Aerospace Industries Singapore, Singapore Food Manufacturers' Association, Singapore Furniture Industry Council, Singapore Transport Association, Workforce Advancement Federation, NTUC Learning Hub and representatives from SIMTech, A*STAR, Economic Development Board, Jurong Town Corporation, Skillsfuture Singapore, SPRING Singapore and Workforce Singapore turned up in full force to network. SMS Networking Night is also an opportunity to update the guests on SIMTech's activities and Special Interest Groups. At this event, ten industry partners who have worked closely with SIMTech for the past 3 years were honoured.

Collaborative Industry Projects (CIPs) are cost-effective R&D platforms, where companies facing similar issues work jointly with SIMTech, to develop manpower and technology

3D Additive Manufacturing (AM) Capabilities of Metal and Polymer Parts

Launch date: May 2017

This CIP aims to demonstrate 3D AM process capability from design and process optimisation, material preparation and handling, product processing to secondary operations, and to provide a platform for quicker adoption of 3D AM technology.

For enquiries, please contact **Mr Tan Lye King** at tanlk@SIMTech.a-star.edu.sg

X-ray Sterilisation for the Medical and Pharmaceutical Industries

Launch date: May 2017

This CIP aims to demonstrate the effects of using low energy x-ray with mild heat for sterilisation; define and develop protocol to establish sterilisation process for a defined product; to carry out sterility validation and benchmarking.

For enquiries, please contact **Mr John Lim** at kylim@SIMTech.a-star.edu.sg

Integrated Tool Grinding, Edge Polishing and In-situ Measurement System

Launch date: May 2017

This CIP aims to enhance the effectiveness of local companies in interrupted cutting, drilling and boring of corrosion resistant alloys with innovative integrated grinding, polishing and in-situ measurement of high performance carbide tooling, drills and inserts.

For enquiries, please contact **Dr Lim Beng Siong** at bslim@SIMTech.a-star.edu.sg

High Speed, Deep Penetration Hybrid Laser-Arc Welding (HLAW) for Thick Structures and Pipelines

Launch date: June 2017

This CIP aims to reduce the cycle time and operating cost (manpower, consumable and fixtures) in the fabrication of large panels or pipelines with thick-wall structures by using a newly developed High Speed, Deep Penetration Hybrid Laser-Arc Welding.

For enquiries, please contact **Dr Lim Beng Siong** at bslim@SIMTech.a-star.edu.sg

High Deposition, Vertical, Dual Hot Wire Laser Cladding for Fabrication and On-site Repair of Large Structures

Launch date: July 2017

This CIP aims to increase the throughput and turnaround time in the fabrication and repair of large critical assets (FPSO, pressure vessels, crane base, tankage, cooling towers) with an innovative single pass, dual hot wire large area laser cladding and welding system.

For enquiries, please contact **Dr Lim Beng Siong** at bslim@SIMTech.a-star.edu.sg

Scalable Mobility Platform (SMP) for Mobile Robots

Call for Participation

This CIP aims to promote the adoption of mobile robot for automating the material transfer through a platform technology. Such platform technology features modular powered caster wheels that enable the development of customised mobile platform to cater for different needs. This CIP allows System Integrators as well as SMEs to understand such technology and to prepare them for developing the mobile robots with desired specification requirements.

For enquiries, please contact **Mr Tan Chee Tat** at cttan@SIMTech.a-star.edu.sg

Protective Coating and Corrosion Assessment

Call for Participation

This CIP aims to develop and apply advanced surface coating processes via Physical Vapour Deposition coating, Thermal Spray coating, Electrochemical processes, anodising, electroplating, conversion coatings, etc, to create new desired surface protection and/or to improve existing protective performance pertaining to surface quality and morphology.

For enquiries, please contact **Dr Mehrdad Zarinejad** at mehrdad@SIMTech.a-star.edu.sg

PE COI Annual Conference 2017

4 April 2017 | 10.00am – 4.30pm | Singapore Expo, Peridot 204 & 205, Level 2

To be held alongside with MTA 2017, this event continues to showcase the success stories of how SIMTech has helped local SMEs build new capabilities in bringing business growth. The theme is Growing Singapore's Precision Engineering Industry through Technology Innovation.

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SIMTech Annual Manufacturing Forum 2017 (AMF'17)

27 July 2017 | 8.30am - 5.00pm | Grand Copthorne Waterfront Hotel, Ballroom, Level 4

Join us for SIMTech AMF'17 as leaders in Flexible Hybrid Electronics give valuable insights on the emerging technology, its development, applications and new exciting diverse market opportunities for industry.

For enquiries, please contact **Mr Rick Yeo** at rickyeyo@SIMTech.a-star.edu.sg



Scan for more events

PE WSQ Graduate Diploma in Manufacturing Operations Management (MOM)**Module 2: Operations Analysis**

3 April 2017 | 6.30pm - 9.30pm, Fusionopolis Two

PE WSQ Graduate Diploma in Mechatronics**Module 2: Enhance Control Performance of Precision Machines**

3 April 2017 | 6.30pm - 9.30pm, Fusionopolis Two

PE WSQ Improve Manufacturing Productivity through Energy Usage Pattern Monitoring and Analysis

3 April 2017 | 6.30pm - 9.30pm, Fusionopolis Two

PE WSQ Operations Management Innovation Programme (April Batch)

5 April 2017 | 8.30am - 12.30pm, Fusionopolis Two

PE WSQ Operations Management Innovation Lean Improvement Towards Excellence (OMNI-LITE)

5 April 2017 | 8.30am - 12.30pm, Fusionopolis Two

PE WSQ Implement LEAN Manufacturing (Batch 17)

7 April 2017 | 1.00pm - 5.00pm, Trends360

PE WSQ Implement LEAN Manufacturing (Batch 18)

11 April 2017 | 8.30am – 12.30pm, Seng Heng Engineering

PE WSQ Graduate Diploma in MedTech Manufacturing**Module 2: MedTech Manufacturing and Quality System**

11 April 2017 | 6.30pm - 9.30pm, Fusionopolis Two

PE WSQ Implement Manufacturing Data Mining Techniques

20 April 2017 | 6.30pm - 9.30pm, Fusionopolis Two

PE WSQ Graduate Diploma in Manufacturing Operations Management (MOM)**Module 3: Manage Manufacturing Execution System**

3 July 2017 | 6.30pm - 9.30pm, Fusionopolis Two

PE WSQ Graduate Diploma in Mechatronics**Module 2: Enhance Control Performance of Precision Machines**

3 July 2017 | 6.30pm - 9.30pm, Fusionopolis Two

For course details and registration, please visit <http://kto.SIMTech.a-star.edu.sg>

For general enquiries, please contact
Tel: 6501 1800 or email: KTO-enquiry@SIMTech.a-star.edu.sg



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About SIMTech

The Singapore Institute of Manufacturing Technology (SIMTech) develops high-value manufacturing technology and human capital to enhance the competitiveness of Singapore's manufacturing industry. It collaborates with multinational and local companies in the precision engineering, medtech, aerospace, automotive, marine, oil & gas, electronics, semiconductor, logistics, and other sectors.

SIMTech is a research institute of the Agency for Science, Technology and Research (A*STAR). With a pool of more than 400 researchers, we are committed to serving the manufacturing industry to develop the human, intellectual, and industrial capital in Singapore.

