MANUFACTURING MATTERS

July 2019 | Issue 3

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FEATURE
MANUFACTURING YOUR FUTURE MEDICINE: CELLS

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PRECISION MATTERS
OPTIMISED PROCESS MAKES HIGH GRADE PRODUCT

RESEARCH SPOTLIGHT
NATURE-INSPIRED LIGHT AND STRONG LATTICE STRUCTURES

NOTE FROM EDITOR...

Dear Friends and Industry Partners,

The world has advanced rapidly. We can now manufacture personalised medicine to fight cancer—through Cell Therapy. Cell Therapy is a form of medicine in which living cells are taken from the body and enhanced to treat diseases. The intact living cells are injected, grafted or implanted into a patient to treat diseases such as eliminating cancerous tumours.

The Cell and Gene Therapy market is emerging and expanding rapidly worldwide. In Singapore, local companies such as Tessa Therapeutics and Lion TCR are progressing into clinical trials.

Manufacturing of Cell Therapies is a complex process. Currently, cells are mostly manufactured manually using open plastic cultureware in Good Manufacturing Practice facilities. However, the product quality can vary widely between individual operators. This situation is further exacerbated by the high variability in the quality of the cell source. As a result, a scalable production process and affordable treatments remain a critical global challenge in personalised Cell Therapy.

Help is available now. The Singapore Institute of Manufacturing Technology (SIMTech), a research institute of the Agency for Science, Technology and Research (A*STAR), working closely with its collaborators, the National Cancer Centre Singapore, Cal-Comp Precision Singapore and MClean Technologies, has developed an automated bioreactor system for manufacturing cells with good quality and scalability.

The pioneering and exciting journey to achieve this is featured in this and the opposite pages.

Swee Heng
Editor, Manufacturing Matters
Email: shlee@SIMTech.a-star.edu.sg

MANUFACTURING YOUR FUTURE MEDICINE: CELLS

Bioreactor technology innovation for manufacturing living cells

A step in the right direction

Cell Therapy is a form of medicine in which living cells are taken from the body and enhanced to treat diseases. Following the first CAR-T cell therapy approval in 2017 [1], the Cell and Gene Therapy market had expanded rapidly worldwide. The Stem Cell Therapy market alone is poised to grow at a Compound Annual Growth Rate of 23.27 per cent from 2017 to 2021 [2]. Since its inception in 2014, the Bio-Manufacturing Programme (BMP) at SIMTech has been working on innovative bioreactor technologies for manufacturing cells with good quality and at large scale. The developed technologies are aimed not only at improving the safety and efficiency of the Cell Therapy manufacturing process, but also a potential reduction in costs through minimising footprint and incorporating intelligent automation. SIMTech has since filed a patent application on its first bioreactor technology (WO2018/182533 A1).

Collaborations with partners

One important step of the technology development process is for SIMTech to work with partners in the Cell Therapy value chain and build effective relationships with different key players in the field, including Cell Therapy developers and device manufacturing suppliers.

National Cancer Centre Singapore (NCCS), a pioneer in Cell Therapy in South East Asia, has developed an antigen-specific T-cell therapy for

> **"While cellular therapies for cancers have demonstrated their therapeutic potential, their widespread adoption in the clinic is still very limited. The generation of the cellular products are still very laborious manual processes, often causing the products too costly to produce. It is very critical for us to develop bioreactors that allow automated processing of different cell types to break this barrier. The NCCS-SIMTech collaboration, which began in 2014, enables us to work towards this goal"**
>
> Dr Peter Wang, *Senior Research Fellow, National Cancer Centre Singapore (NCCS)*

patients suffering from Nasopharyngeal Cancer. SIMTech collaborated with NCCS to better understand the Cell Therapy production process and gather critical feedback on the bioreactor technologies that SIMTech has developed. NCCS has, meanwhile, licensed their Cell Therapy technology to Tessa Therapeutics and the therapy is currently at late stage clinical trials. The collaboration continues to flourish, and NCCS and SIMTech remain close collaborators, working towards the goal of producing safe, cost-effective Cell Therapies.

On the other hand, the production of bioreactors faces stringent requirements as the cells are cultured in the bioreactors for weeks, sometimes months. The bioreactors need to be moulded, cleaned, and assembled in clean rooms prior to packaging and sterilisation. Quality control in biocompatibility and robustness for both material and protocol throughout the bioreactor production process must comply with regulatory guidelines. Hence, the production of the bioreactors deviates from conventional plastic-ware that industries are more familiar with. To produce quality bioreactor prototypes for performance testing, SIMTech tapped into the expertise of local device manufacturing community.

> **"This collaboration offers greater exposure in new development technologies and challenges. At the same time, Cal-Comp is able to penetrate into the exciting Cell Therapy market, creating more business opportunities and recognition for us"**
>
> Mr H Ikeda, *Managing Director, Cal-Comp Precision (Singapore)*

> **"From this partnership, we extended our cleaning services, from largely hard disk and semi-con, to the medical and pharmaceutical industries. It reinforces our belief that there are many opportunities in micro contamination cleaning services. I am proud that we helped a locally designed product from birth to mass market"**
>
> Mr Bert Chow, *Chief Operation Officer, MClean Technologies*

Cal-Comp Precision (Singapore), specialising in precision parts manufacturing, provided a one-stop solution to the fabrication of the bioreactors. MClean Technologies, a precision cleaning and surface treatment provider, assisted in the cleaning and assembly of the bioreactor in their clean room facilities.

By working closely together with local companies to produce high quality bioreactors, SIMTech has now progressed to pre-clinical validation studies with NCCS. This series of validation studies, which involve samples from donors with Institutional Review Board (IRB) approval, is due for completion in Q3 2019.

At the national level, the government is injecting $80 million over the next five years to support R&D efforts towards Cell Therapy manufacturing in Singapore [3,4]. The funding demonstrates the nation's strong commitment to advancing Cell Therapy manufacturing, and unwavering trust in local research institutes and industries to lead the way.

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Web: www.a-star.edu.sg/SIMTech-EAC

EAC Emerging Applications Centre
Seeding and Growing Emerging Industries

Scan for more information on Emerging Applications Centre

Notes:
[1] https://www.biopharma-reporter.com/Article/2017/10/20/Gilead-ramping-up-CAR-T-clinics-after-US-FDA-Yescarta-approval
[2] https://www.researchandmarkets.com/reports/4392588/global-cell-therapy-market-2017-2021
[3] https://www.straitstimes.com/singapore/80m-boost-for-programmes-to-manufacture-living-cells-as-medicine
[4] https://www.businesstimes.com.sg/government-economy/singapore-to-invest-more-in-digital-food-tech-cell-therapy-rd

MOVING IN SYNC

Real-time coordinated control for large hydraulic operated mechanism

A small and medium enterprise (SME), specialising in marine and offshore lifting equipment, embarks on a journey to develop their own products to sustain and grow their business. Their first product is a large hydraulic operated multi-joint mechanism consisting of a series of prismatic and rotary joints.

The company has hydraulic system experts and years of experience in the design of hydraulic systems. However, it lacks knowledge and technology on the control system that is key to the automatic maneuver of the multi-joint mechanism. The company decided to collaborate with SIMTech for the development of the control system by leveraging on SIMTech's competency in robotics, real-time control and control software development. A collaborative project involving teams from both parties has been initiated to tackle the technical challenges. To strengthen the collaboration, a SIMTech researcher is attached to the company under the T-Up scheme for technology development and transfer.

During this T-Up, a systematic approach was adopted to model and control the hydraulic operated multi-joint mechanism both at the component level and the full system level. The dynamic characteristics of each hydraulic cylinder are identified by a proprietary system identification approach. The kinematic and dynamic model of the system was achieved successfully to refine the prototype design of the hydraulic system for different operating conditions.

The attached SIMTech researcher plays a critical role in the development of the product prototype and successful transfer of SIMTech technology, know-how, with timely support from both SIMTech and the company's project teams. One key challenge in the prototype development is preventing conflicting oscillations in parallel operations of the joints. Through this T-Up, two cylinders carrying the prototype are now well synchronised by integrating SIMTech's customised control methodology and the company's improved hydraulic system design. This marks a critical milestone of the project and lays down the critical foundation for the next stage of the product development.

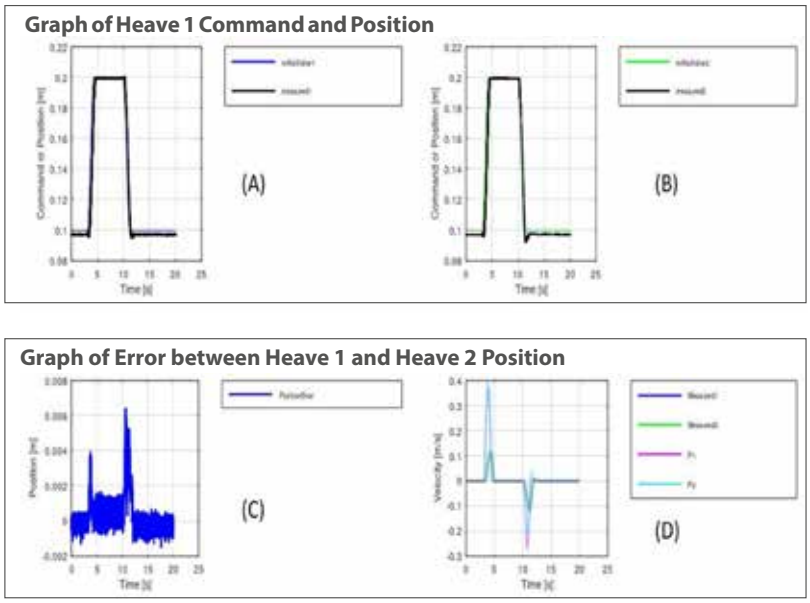

Figure 1 **(A)** The position(black) and command(blue) of hydraulic cylinder 1. **(B)** The position (black) and command(green) of hydraulic cylinder 2. **(C)** The position error between hydraulic cylinder 1 and hydraulic cylinder 2. **(D)** Measured velocity of hydraulic cylinder 1 and 2

With an understanding of the control system, the company can now design more mechanisms using hydraulic cyinders

For more enquiries, please contact
***Dr John Yong,** Director,*
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*Note: The T-Up initiative, a multi-agency effort by A*STAR, the Economic Development Board, SPRING Singapore (now Enterprise Singapore), IE Singapore (now Enterprise Singapore), and the Infocomm Development Authority (now Media Development Authority), involves seconding RSEs to local enterprises to access the pool of R&D talent in Research Institutes.*

OPTIMISED PROCESS MAKES HIGH GRADE PRODUCT

SME overcomes challenges of stainless steel use for product

Previously, Dot Design Pte Ltd could not improve its chokeless sink strainer's durability by switching its product material to stainless steel. The local Small and Medium Enterprise (SME), which designs and manufactures a range of sink drainage covers, in using an existing process to stamp the current strainer design from stainless steel led to part failure due to the complex product design. The chokeless sink strainers can only be produced by plastic injection moulding process prior to the collaboration with SIMTech. To overcome the limitations, part design modification and proper sheet forming process were carried out with SIMTech.

SIMTech optimised the opening patterns of the strainer and concurrently developed a stamping process which is acceptable for part functionality and durability (Figure 1). Several grades and gauges of stainless steel sheets and brass were assessed for formability. It was determined that SS304 and SS316L with 1.0mm thickness have sufficient formability to form the strainer. Through process design, stamping analyses, and forming trials, a stamping process sequence and optimised initial blank designs were developed. The process development was carried out for part prototypes of 3 designs. These were developed, produced and delivered to Dot Design for further evaluation, and for production (Figure 2).

> **"Dot Design always wanted the chokeless sink strainer in metal since it was invented in 2006. Due to the limitation of the stamping technology and lack of know-how, it was not possible. With the help from SIMTech, stainless steel version of chokeless sink strainer is now possible. Now, the production moulds are done and fully functional with high production yield"**
>
> Mr Ho Yeong Cherng, *CEO/Inventor, Dot Design Pte Ltd*

Overall, Dot Design benefited from the collaboration. Part formability is increased. The stamping process sequence design and development for the stainless steel product were verified, validated through simulations and forming trials. The product improvement from plastic to durable stainless steel strainer created premium products. Knowledge was transferred to a local stamping company for mass production. This project has enabled the manufacturing of unique chokeless strainers in Singapore for the local and overseas market. It also strengthened Dot Design's Intellectual Property to further develop high-value Made-in-Singapore product.

Figure 2: Final stainless steel "chokeless" strainer product

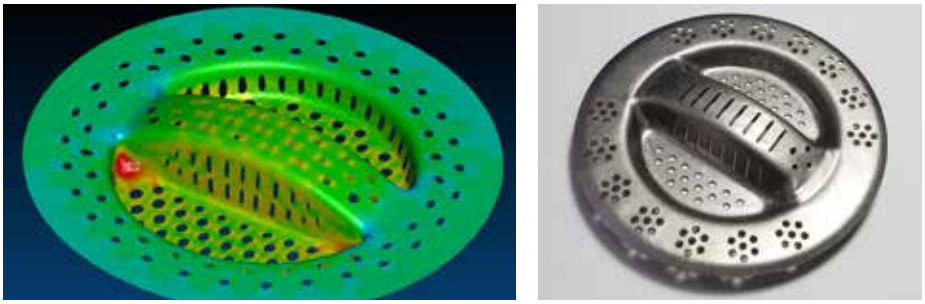

Figure 1: Development of metal "chokeless" strainer design and processing steps through simulation modelling (left) and stamping trials – a stainless steel strainer prototype with opening features optimised for stamping process steps (right)

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

Scan for more information on Precision Engineering Centre of Innovation

OEEMS implementation

WORKING SMARTER

Implemented Smart Manufacturing Operations Management System and Overall Equipment Effectiveness Management System benefited Banshing

To gear up its production capability to pave the way for additional business, Banshing Industrial Company Ltd implemented the Smart Manufacturing Operations Management System (S-MOM) and Overall Equipment Effectiveness Management System (OEEMS) through SIMTech to support its existing SAP system. Established in 1975, Banshing is a custom mould maker and moulder with sub-assembly capabilities for the precision engineering plastics industry serving the telecommunications, medical and automotive industry with manufacturing services in this region.

The implemented S-MOM, a production planning, scheduling and shop floor tracking system, tracks and monitors all the production orders on Banshing's production floor. A supporting software was added to govern Production Orders (PO) processing and facilitate order expediting.

S-MOM benefits Banshing in many ways. The S-MOM generated Lot Traveller and Work Order with routing information, replacing the manual version, improves the visibility and traceability on the production shop floor.

S-MOM implementation

As S-MOM governs the execution and parts movement on the manufacturing shop floor, parts are systematically moved according to the pre-defined quantity per lot, reducing movement wastes by 40 per cent and better control of WIP parts, reducing these missing parts by 100 per cent.

As real-time production monitoring is now possible, capturing turnaround time for completed work order, important statistics for continuous production improvement are available. With all the data captured in S-MOM, customised reports can be generated. An example is a customisable scrap report, eliminating manual data entry. This report serves as a document to approve scrap disposal, providing better scrap control.

S-MOM helped Banshing avoid human errors from the manual approach of production monitoring, saving time by 100 per cent from paper work.

Banshing also implemented an integrated OEEMS for 8 machines to provide visibility and maximise machines utilisation. Arising from this, idle time loss was reduced from 112 hours per month to 4 hours monthly, a 96 per cent improvement saving the company $23,800 monthly. Value-add throughput increased from 2,330 pieces daily to 4,093, a 75.6 per cent jump, yielding $31,000 per month. Happy with these improvements, Banshing intends to extend OEEMS to more machines.

By investing in OEEMS and S-MOM as well as integrating these with its existing ERP system, Banshing is taking their first step in their Digital Transformation journey, enabling the convergence of Operational Technology and Information Technology.

> **"Banshing Industrial is grateful for its partnership with SIMTech over the years. Since first engaging SIMTech in T-Up programmes in 2013 to implementing SIMTech's OEEMS and S-MOM programmes in 2018, Banshing is better prepared to face the current and future challenges and opportunities of the manufacturing industry"**
>
> Mr Alvin Cheng,
> Director, *Banshing Industrial Co Pte Ltd*

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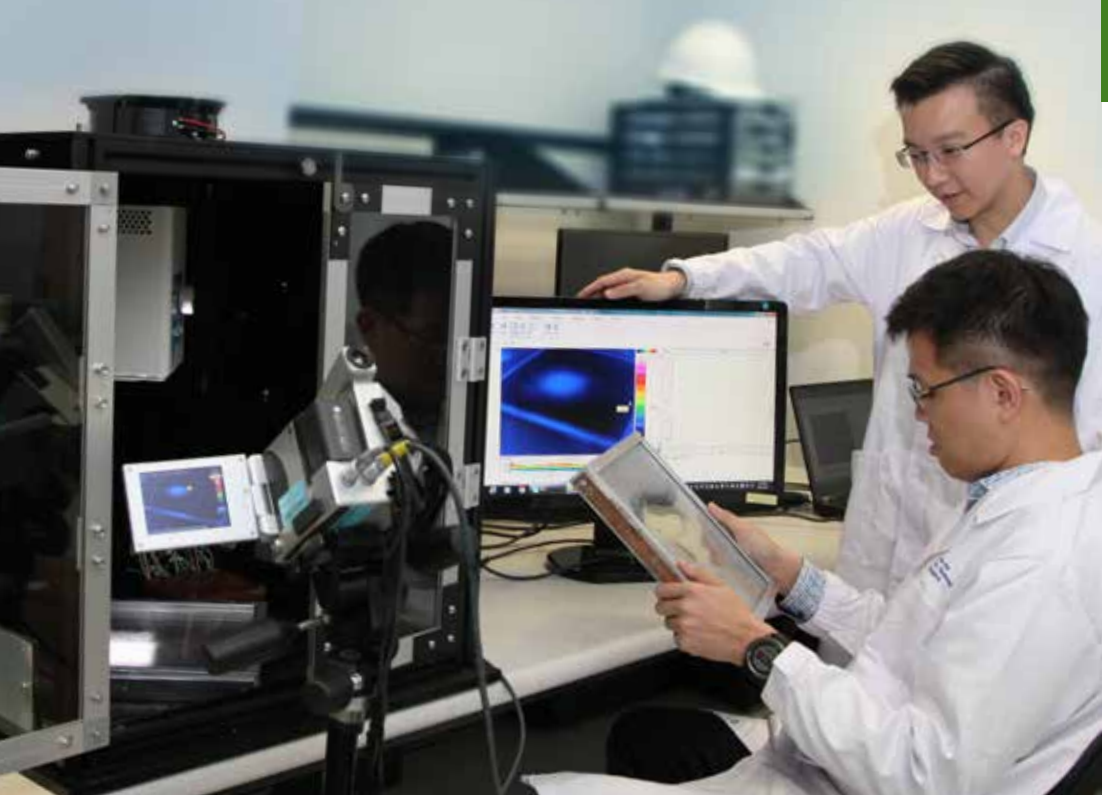
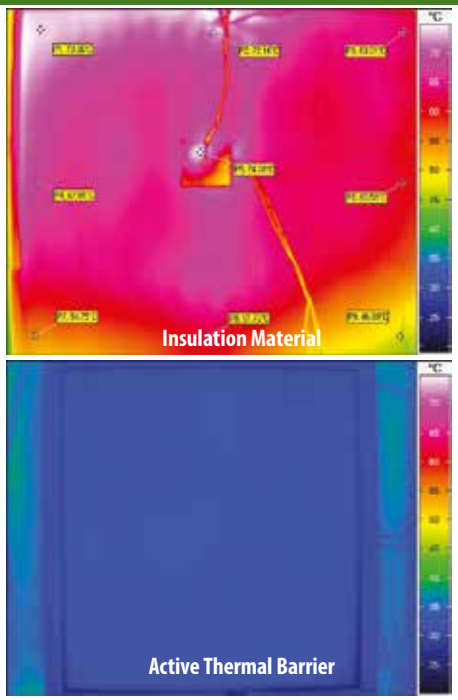
MPTC Manufacturing Productivity Technology Centre
Enhancing Manufacturing Productivity

Scan for more information on Manufacturing Productivity Technology Centre





Surface Temperature Measurement

COOL TECHNOLOGY

Thermal management solution for better human thermal comfort in the work environment

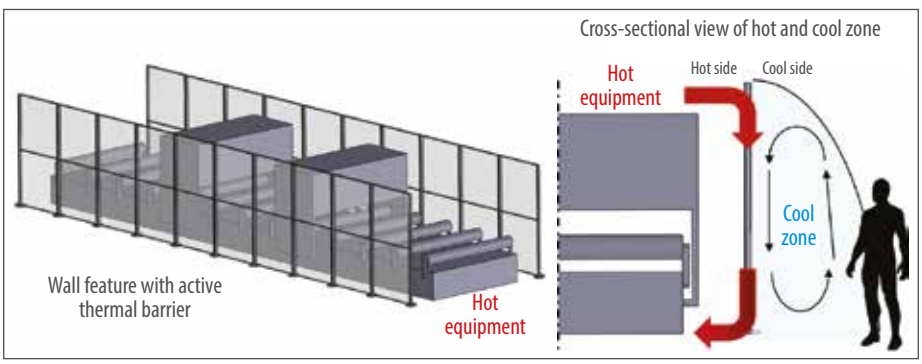
Heat and moisture loss from equipment causes high temperature and humidity in the work environment. Currently, it is inefficient to capture the heat and moisture flowing into the work environment after diffusion from the heat source. It is also inefficient to deliver cool/conditioned air to the work environment due to diffusion of the cool air from the source. These natural processes cause high energy consumption in the air conditioning systems designed to provide human thermal comfort in work environment.

Now, an active thermal management solution is able to redirect equipment heat loss away from the work environment and generate localised cooling to maintain human thermal comfort near the equipment.

An active thermal barrier has been developed in SIMTech which acts as a heat shield while at the same time providing localised cooling effect. As the barrier is modular in design and comes in panel form with external dimensions of up to 0.5m by 0.5m in shielding area, the barrier is configurable into a feature wall which separates the hot and cool zone in the work environment. The active thermal barrier absorbs heat from equipment on one side and maintains a cool temperature on the other side. The cooler surface provides cooling and induced airflow in the targeted work environment for human thermal comfort.

By reducing the heat transmission to the work environment and reducing the surface temperature on the cool side of the active thermal barrier below the ambient temperature, cooling of the work environment can be achieved.

With automatic regulation of air temperature in the work environment and the creation of a cool zone, workers sweat no more and companies save utilities cost. The energy efficient solution is ready for industry adoption



Separation of the hot and cool zone in the work environment

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SMC Sustainable Manufacturing Centre
Embracing Sustainable Manufacturing

Scan for more information on Sustainable Manufacturing Centre

3D ADDITIVE MANUFACTURING COURSE FOR INDUSTRY

Graduate Diploma course fills skills gap of manufacturing industry using Learn-Practise-Implement model

Building 3D objects layer-by-layer, commonly known as 3D Additive Manufacturing, is one of the most sought after manufacturing technologies today for high value-add engineering applications.

SIMTech offers 3D Additive Manufacturing (AM) course to provide a holistic understanding of its concept and fundamentals. Participants will be taught by SIMTech trainers based on practical additive manufacturing-related research and development projects with industry.

In five modules, the highly practical and intensive course with hands-on lab sessions with various AM systems covers:

- **Smart Additive Manufacturing System** – provides an overview of 3D AM, and the advantages of 3D AM to manufacture complex and customised functional parts. Participants will appreciate 3D AM technology uniqueness, the importance of digital manufacturing and the understanding of necessary design requirements for AM. Knowledge to integrate AM and implement procedures and operations according to Workplace Safety and Health standards and requirements will be acquired.

- **Powder-bed Additive Manufacturing Processes for Complex Functional Metallic Components** – covers metal powder fabrication as feedstock for powder-bed 3D AM systems and the powder characteristics critical for AM processing. Key powder-bed metal AM processes like Selective Laser Melting (SLM), Electron Beam Melting (EBM) and metal Binder Jetting (BJ) technologies, to manufacture complex functional metallic parts will also be addressed. These industrial applications and relevant post-processing will also be shared through industrial case studies.

- **High Speed Additive Manufacturing Processes for Metallic Components** – covers electron beam-based and laser-based AM technologies which enable the manufacturing of large format metallic components. These include wire-fed, powder-blown and hybrid processes that allow high speed manufacturing. These parts industrial applications and relevant post-processing will also be shared through industrial case studies.

- **Polymer-based Additive Manufacturing Processes for Flexible Mass Customisation** – introduces the fundamental concept and knowledge of polymer-based AM processes to address high-mix low-volume production for applications. Participants will acquire knowledge and skills on material and polymer AM selection to fulfil specific functional requirements. Polymer-based AM processes like stereolithography, selective laser sintering, fused deposition modelling, polymer jetting and other upcoming polymer AM processes will be shared. The module includes industrial case studies and practical lab sessions.

- **Plan and Manage Project for Implementation** – covers application of methods for planning, executing and managing projects for developing technology, products and processes.

The course is relevant for PMETs in the aerospace, biomedical, medical technology, electronics, precision engineering, automotive and general manufacturing industry

The fourth module on "Polymer-based Additive Manufacturing Processes for Flexible Mass Customisation" started on 2 July 2019 and the second course batch will start in September 2019.

For enrolment details and course fees, please visit ***https://www.a-star.edu.sg/kto/Courses/Graduate-Diplomas***

Funding is available for Singaporeans and Permanent Residents to cover up to **95 per cent of the course fee**. *For details, please contact* ***KTO-enquiry@SIMTech.a-star.edu.sg***

For more information, please contact:
Dr Sharon Nai *at mlnai@SIMTech.a-star.edu.sg*

Original aircraft fuel line holder design (0.59 kg)

Lattice optimised design (37 per cent mass saving)

NATURE-INSPIRED LIGHT AND STRONG LATTICE STRUCTURES

SIMTech approach overcomes current design constraints

Topology optimisation is a powerful tool for the generation of non-intuitive and complex structural concepts. However, conventional manufacturing techniques, such as casting and machining, place significant constraints on the designs that can be fabricated.

Recent advances in additive manufacturing are now enabling the full realisation of such complex designs. Micro-architectured lattice structures, having both high strength and stiffness, are the ultimate synergy between recent advances in numerical optimisation and additive manufacturing. The ability to realise these complex cellular designs in both polymer and metal printing processes is made possible by highly accurate printing of geometries down to the sub-mm length scale.

Highly optimised designs containing lattice structures are receiving significant interest from the aerospace, automotive and medical industries, amongst others. These lattices can be used for a wide range of applications including impact absorbent materials and sandwich structures. However, the fundamental design principles for generating truly optimal lattice meta-materials are still not well established.

By mimicking structures seen in nature, generated by natural selection, SIMTech has developed a numerical optimisation method that aligns lattice trusses with load bearing directions. The structures generated have striking similarities to nature's patterns seen in the cellular arrangements inside trees, corals and bones. Such designs are ideally suited to additive manufacturing processes, which are largely unconstrained by design complexity.

The method developed at SIMTech combines topology and size optimisation to generate these optimal lattice arrangements. This approach allows the size, shape and orientation of each lattice truss to be tailored, significantly reducing the stress between neighbouring lattice cells and efficiently placing the available material where it is most needed.

A patent application has been filed to protect the optimisation method [1] and results have been subsequently published [2]. SIMTech is currently applying this technology in a joint project with ST Engineering Aerospace.

The stiffness and strength of lattice structures optimised with this SIMTech approach have been compared with commercially available software used in the industry. Stiffness and strength improvements of up to 300 per cent, without increasing structural mass, have been experimentally validated

[1] WO2018/117971A1

[2] https://doi.org/10.1016/j.matdes.2017.04.082

*For more information, please contact **Dr Stephen Daynes**, Forming Technology Group at dayness@SIMTech.a-star.edu.sg*

A number of events were organised in 2019 to engage the industry and forge partnerships

Exhibition & Seminar on Smart Wearable Innovation and Eco-system Development for wellness monitoring & productivity improvement, 2 May

The event, focusing on Smart Wearable Product innovation Collaborative Industry Project (CIP), attracted 79 participants from companies and trade associations. A new CIP on Smart Wearable Tech Product Innovation for wellness monitoring and productivity improvement (Phase 2), supported by various government grants, starts in July 2019. Wearable Tech offers big business opportunities. To seize this, the seminar provided the overview of all the wearable technologies and topics covered under the 8-month CIP programme and platform for development. An array of wearable products was also showcased at the event.

PE COI Annual Conference 2019, 8 May

With its theme, **PE COI: Beyond 10 Years Supporting the PE Industry – on Internationalisation",** the event organised in collaboration with the Singapore Precision Engineering and Technology Association (SPETA) attracted 115 attendees from companies and trade associations such as Association of Electronic Industries in Singapore (AEIS) and SME Centre at Singapore Chinese Chamber of Commerce and Industry (SCCCI).

The conference helps PE companies understand the needs and challenges when undertaking international business operations. To gain competitive advantage over today's strong business competitors and to internationalise, companies need to innovate for product and service differentiation.

The conference, divided into four sessions, is aligned to topics specific to a PE ITM (Industry Transformation Map) pillar – Innovation, Productivity, Jobs and Skills, and Internationalisation. Mr Kenichi Inoue, General Manager of Global Research & Innovative Technology Center (GRIT), Hitachi Metals shared the full scope of the advanced metal powder opportunities and the manufacturing technologies for application in a wide variety of industries. SPETA presented awards and appreciation letters to companies in recognition of their effort and commitment in supporting the PE ITM roadmap.

An exhibition participated by companies and SIMTech showcased the products, services and technologies to the industry. Conference attendees also benefited from the networking and sharing of companies' experiences in their PE ITM journeys.

Collaborative Industry Projects (CIPs), initiatives, programmes and ready-to-go technologies are available to assist industry

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

This programme 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*

Advanced Machining Dynamics Analysis Technology for Productivity and Quality Improvement

This programme aims to improve the machining productivity and quality of local manufacturing industry in precision machining of steel and non-ferrous metals through technology transfer and customisation.

*For enquiries, please contact **Ms Charlotte Lim** at charlotte-lim@SIMTech.a-star.edu.sg*

SIMTech Scalable Mobile Platform (SMP) Programme

This programme aims to enable the development of customised mobile platform to suit different needs, and to realise high mobility critical for easy maneuvering in cramped spaces and for effective docking.

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

Inventory Planning

This programme aims to facilitate the decision-making and development of inventory policy to control rightsized inventory with the evolution of data & analytics techniques to maximise inventory performance.

*For enquiries, please contact **Mr Chai Lai Sing** at lschai@SIMTech.a-star.edu.sg*

Functional Coatings for Glass and Ceramics

SIMTech's portfolio of functional coatings for glass and ceramics with easy-clean, IR-shielding, anti-microbial and anti-mould properties help asset owners, glass suppliers or maintenance providers to better manage maintenance cost, supply chain and quality. The collaboration will also involve customisation of solutions to meet specific requirements, training in coating preparation and application as well as technology transfer.

*For enquiries, please contact **Mr Goh Chee Chien** at gohcc@SIMTech.a-star.edu.sg*

Last Mile Logistics

A planning and tracking solution to improve the management of drivers/vehicles to effectively meet customer-imposed pickup and delivery requirements amidst resource contraints.

*For enquiries, please contact **Mr Gary Kwok** at gary_kwok@SIMTech.a-star.edu.sg*

Real-time Dashboard

A real-time dashboard that is customised to suit the company needs and to connect to multiple sources for congregation and analysis of real-time data.

*For enquiries, please contact **Mr Gary Kwok** at gary_kwok@SIMTech.a-star.edu.sg*

EVENTS

MPTC Annual Conference 2019

9 October 2019 | 8.30am-5.00pm | Four Seasons Hotel Singapore, Level 2, Ballroom

Empower your organisation to achieve its potential and realise the digital advantages. Join us at the MPTC Annual Conference 2019 as the event sheds light on the Digital Transformation journeys of companies. With the theme, **Digital Ecosystems: Accelerating Growth through Deep Partnerships,** speakers share on success stories, digital talents, best practices and information from enterprises faced with digital transformation challenges. See you at the MPTC Annual Conference 2019, the most customer-centric event for SMEs and Industry.

*For enquiries, please contact **Ms Connie Ng** at yyng@SIMTech.a-star.edu.sg*

Scan for more events

COURSES

WSQ OMNI Programme

8 July 2019 | 8.30am - 12.30pm | Fusionopolis 2

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

2 September 2019 | 6.30pm - 9.30pm |
Institution of Engineers Singapore

PE WSQ Graduate Diploma in Advanced Welding Technologies

Module 1: Evaluate Advanced Metal Welding Processes

3 September 2019 | 6.30pm - 9.30pm | Fusionopolis 2

WSQ OMNI Programme

9 September 2019 | 8.30am - 12.30pm | Fusionopolis 2

PE WSQ Programme in Integrated Carbon Footprint Assessment Methodology (i-CARE)

9 September 2019 | 9.00am - 6.30pm | Fusionopolis 2

PE WSQ Understand the Microfluidics Manufacturing Processes

16 September 2019 | 6.30pm - 9.30pm | Fusionopolis 2

Master Class in Mastering Sales and Operations Planning (S&OP) Process to Align Strategies for Operational Excellence

16 - 17 September 2019 | 8.30am - 5.30pm | Fusionopolis 2

PE WSQ Apply Advanced Coating Technologies for Wear and Corrosion Protection

24 September 2019 | 6.30pm - 9.30pm | Fusionopolis 2

PE WSQ Inventory Management

7 October 2019 | 6.30pm - 9.30pm | Fusionopolis 2

WSQ OMNI Programme

23 October 2019 | 8.30am - 12.30pm | Fusionopolis 2

PE WSQ Graduate Diploma in Advanced Welding Technologies

Module 2: Design Arc Welding

24 October 2019 | 6.30pm - 9.30pm | Fusionopolis 2

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

For general enquiries, please contact
Tel: 6590 3193 or
email: KTO-enquiry@SIMTech.a-star.edu.sg

Scan for more courses

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 450 researchers, we are committed to serving the manufacturing industry to develop the human, intellectual, and industrial capital in Singapore.

A*STAR SIMTech for Industry