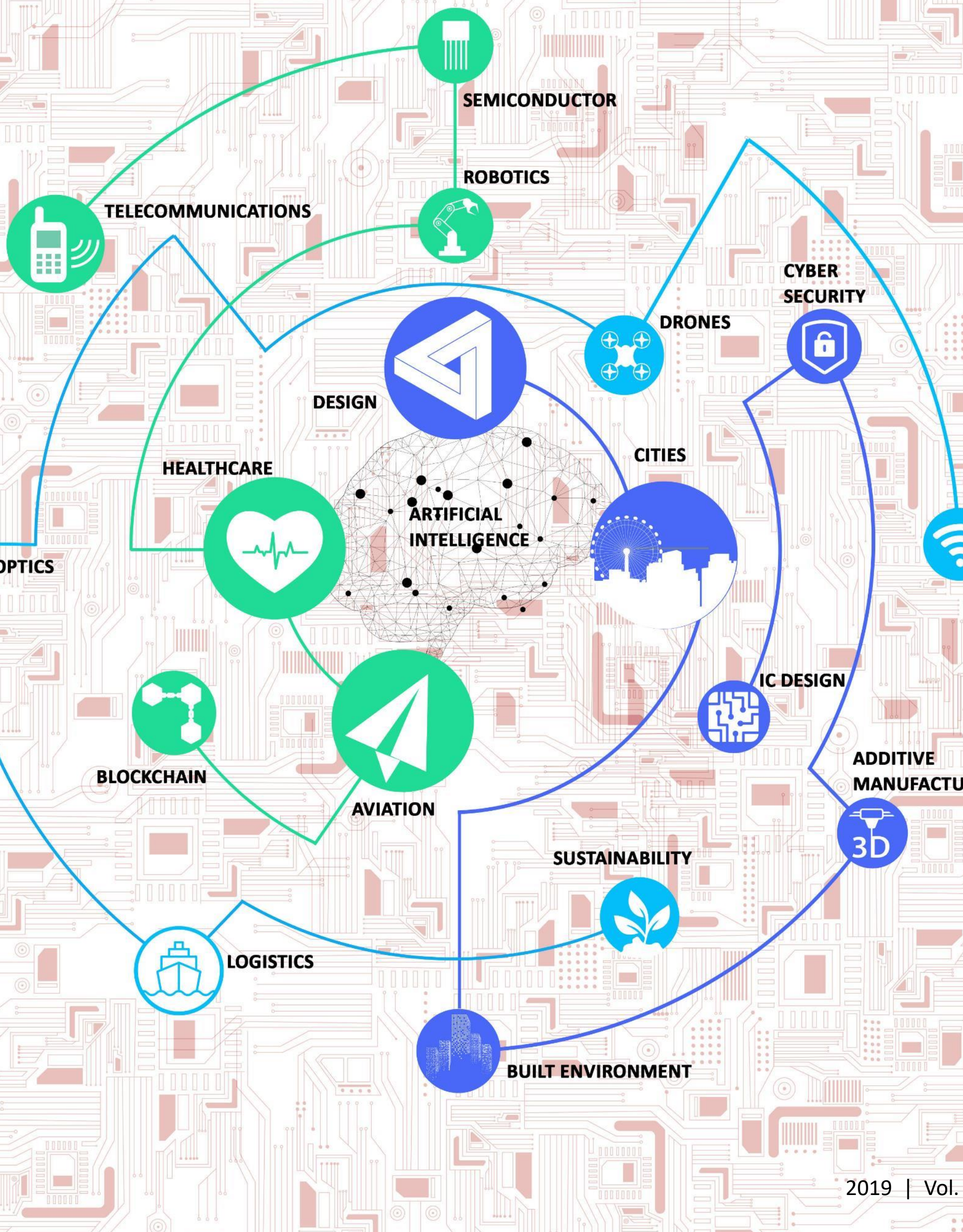
# ASPIRE

SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN

An SUTD Publication: Impactful Research Endeavors




2019 | Vol. 2

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## **T**alent :: **O**pportunities :: **P**artnerships

### Research Highlights



## Research Publication



## Research Talent

# IMD Smart City Index 2019


Professor Chan Heng Chee, Chairman of LKYCIC, SUTD and Ng Chee Khern, Chairman of GovTech on a panel at the launch discussing smart cities.

The International Institute for Management Development (IMD) World Competitiveness Center's Smart City Observatory, in partnership with Singapore University of Technology and Design (SUTD), are proud to present the first edition of the **IMD Smart City Index 2019**, which ranks 102 cities worldwide. The only global index of its kind, the **IMD Smart City Index 2019** uniquely focuses on how citizens perceive the scope and impact of efforts to make their cities 'smart', balancing "economic and technological aspects" with "humane dimensions".

More information can be found here

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# SUTD in Nature Index's Young Universities Supplement

SUTD was featured in the Nature Index's Young Universities supplement, which was published on the 24 Oct 2019 issue of Nature. This is the 1st time that SUTD has made it to the Young Universities issue based on the increase in the 'Fractional Count' over the years. With this inaugural entry into this elite group of young universities.

The Nature Index's Young Universities Supplement profiles best-in-class young institutions who have made a name for themselves with outstanding performance in innovative research. It highlights the projects, personalities, practices and policies which have contributed to their success to date and examines strategies for facing the future of hyper-competition for scarce research resources.

**70**

Among Top 175 young universities* ranked by their fractional count in 2018 (FC 2018)

**25**

Top 25 rising young universities* ranked by change in fractional count from 2015 to 2018

More information can be found here

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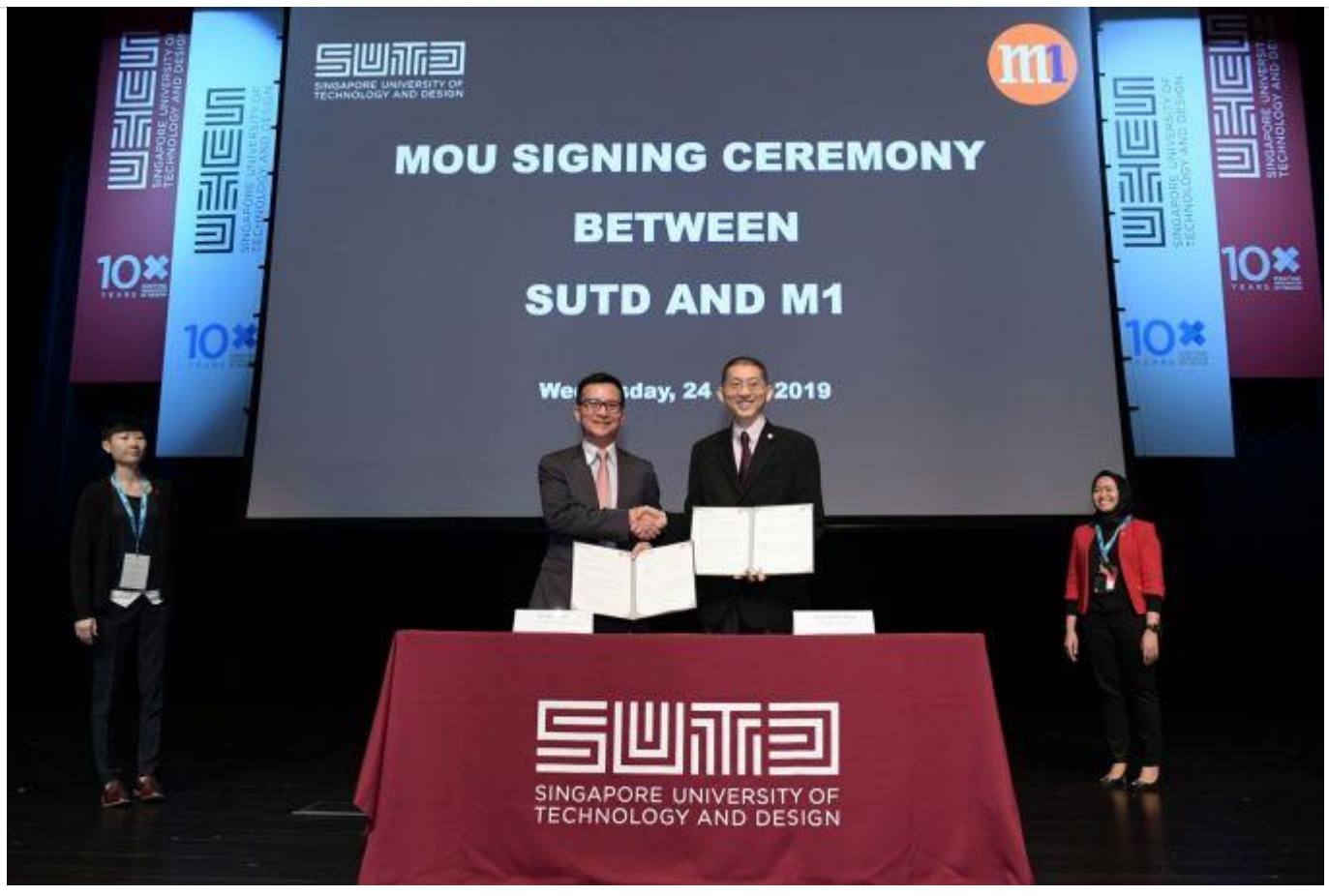
# M1 and SUTD Unveil Joint Research to Advance 5G Robotics Technology and Innovation




Professor Yeo Kiat Seng (second from left), SUTD associate provost for research and international relations, and Denis Seek, chief technical officer at M1, signed the Memorandum of Understanding for the research partnership, during SUTD's annual Fostering Industrial Research Success Together (FIRST) Industry Workshop.

Photo Credit: SUTD and M1

M1 Limited (M1) and Singapore University of Technology and Design (SUTD) today signed a memorandum of understanding (MOU) to embark on a joint research partnership around remote operation of tactile robots using 5G technology, further supporting Singapore's Smart Nation transformation journey. The MOU was signed at SUTD's annual Fostering Industrial Research Success Together (FIRST) Industry Workshop, where stakeholders from industry, academia and the Government convened to foster collaborative research success and deepen industry-academia ties.

This partnership between M1 and SUTD will see a deep dive into the development of 5G technologies for advanced robotics systems. Through their collective expertise, M1 and SUTD will accelerate innovation in the development of 5G robotics.

M1 will provide and deploy the supporting 5G network, building M1's technical competency in 5G system deployment and explore potential use cases of 5G. An indoor network testbed of 5G small cells will be set up in SUTD for researchers and students to test out and gain a deeper understanding of the potential of 5G technologies. Key areas of focus and application will include tactile security, delivery and mascot robots, real-time remote sensing, real-time remote operation of robots and e-scooters, as well as Virtual Reality (VR) and Augmented Reality (AR) content delivery with 360$^{o}$ video streaming. The aim of testbed is to translate innovative research into practical solutions for government and enterprises, as well as to cultivate a talent pipeline to drive Singapore's Smart Nation goals.

"We are pleased to collaborate with M1 to be the first to testbed an indoor 5G system in Singapore. Such an industry-academia collaboration is mutually beneficial as SUTD's students, faculty and researchers will not only have access to the latest 5G technology, and enhance their relevant knowledge and skills, but also lead to new innovations and solutions in SUTD's 5G-enhanced autonomous mobility and robotics platforms," said Professor Yeo Kiat Seng, SUTD Associate Provost for Research and International Relations.

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More information can be found here

# Gigabit Wireless Wideband for 5G Applications

Professor Yeo Kiat Seng, Engineering Product Development Pillar

Wireless transmission with more than one Gigabit-per-second (Gbps) data rate is becoming essential due to increased connectivity between different devices [1]. In order to cope with exponential increase of wireless devices and data rates to provide, the network infrastructure is becoming more complex and denser. As a result, the network infrastructure will be endowed with an unprecedented degree of intelligence, integrating with the environment and offering multiple access, fast, secure, and reliable communications as shown in Figure 1 [2]. Objects like lamp posts, road signs, buildings, vehicles, drones, robots, trains and watercrafts will be equipped with intelligent devices able to store data, detect electromagnetic signals and perform computations.

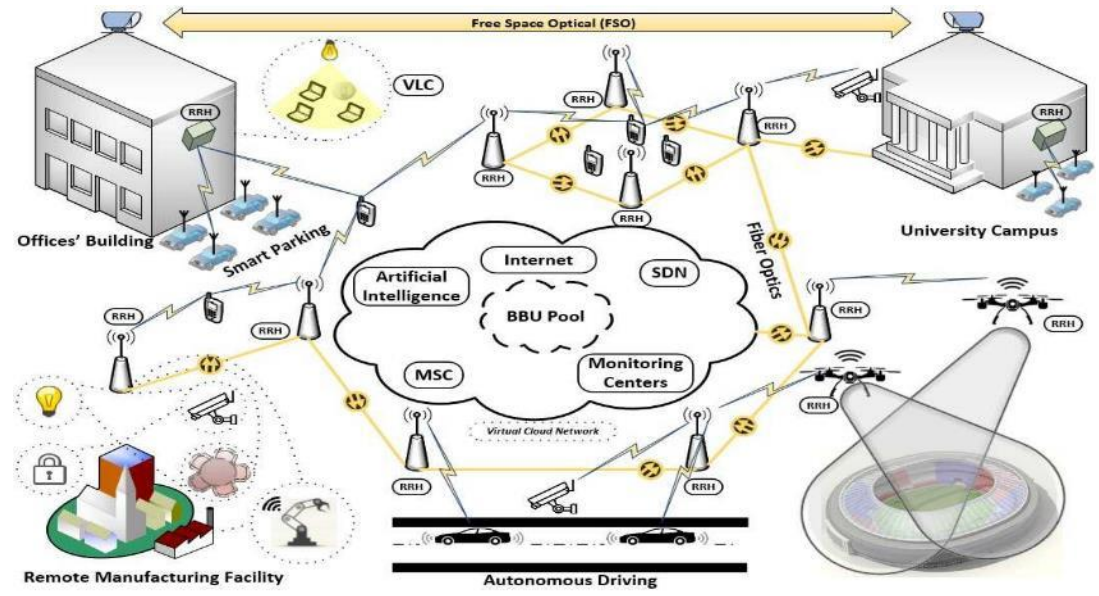



Figure 1. A new method for massive multiple access in 5/6G [2].

Although individual user experience is improved, the system capacity remains basically unchanged. It is also harder to achieve high data rate applications below a 6-GHz band due to spectrum scarcity. Therefore, the millimeter-wave (MMW) band has drawn increasing interest over recent years for enabling such a high speed wireless transmission because of the enormous raw bandwidth that is available like 5G technology [3].

Combining cutting-edge network technology and MMW integrated circuit design, 5G technology offers connections that are multitudes faster than current connections with low latency (1ms or less) and high speed (> 1Gbps) for massive Internet of Things (IoT), tactile internet, drones and robotics. It will transform the way we live, play, work and travel while delivering more performance, efficiency and comfort. New products, systems, services, business models and entire industries will be born as 5G technology provides a huge leap forward in speed, capacity and connectivity.

At the Singapore University of Technology and Design (SUTD), a group of researchers have successfully developed a MMW transceiver System-on-Chip (SoC) for 5G technology. The microchip consists of a transmitter, a receiver, a frequency synthesizer and some digital reconfiguration control blocks. It incorporates both time division half duplex and full-duplex multiplexing mode which is reconfigurable by digital control. The chipset can be interfaced as single-ended 50-Ω matched at RF front-end and differential quadrature 100-Ω matched baseband interface to support long distance gigabit data rate wireless communication.

**System Architecture**

The MMW transceiver SoC consists of the transmitter and receiver chain which are both using sub-harmonic mixer (SHM) frequency translation architecture as shown in Figure 2.

Both the up-conversion and the down-conversion SHMs are provided with the differential quadrature local oscillator signal generated from a common phase lock loop sub-system and a differential quadrature hybrid coupler. Most of the building blocks are biased using the internal compact bandgap reference that provides a stable current source. The baseband processor is interfaced with the microchip using the receiver and transmitter digitally controlled variable gain amplifiers (VGA).

[1] Kaixue Ma and Kiat Seng Yeo, "*Low-Power Wireless Communication Circuits and Systems: 60GHz and Beyond*", Pan Stanford Publishing, ISBN 9789814745963 - CAT# N11848, 2018.

[2] Yasser Al-Eryani and Ekram Hossain, "Delta-OMA (D-OMA): A New Method for Massive Multiple Access in 6G", Computer Science, ArXiv, January 2019.

[3] Kiat Seng Yeo, Chirn Chye Boon, Xiang Yi and Fanyi Meng, "*CMOS Millimeter-Wave Integrated Circuits for Next Generation Wireless Communication Systems",* World Scientific Publishing (Singapore), International Edition, 2019.

Contact Professor Yeo Kiat Seng at kiatseng_yeo@sutd.edu.sg

## Research Highlights

The RF front-end from the antenna are interfaced to the receiver at the low noise amplifier (LNA) input and the power amplifier (PA) output. Figure 3a presents the overall system layout comprises three sub-systems with each having a pre-defined functionality namely a receiver (RX), a transmitter (TX), and a phase locked loop (PLL). The microchip is integrated on a printed circuit board (PCB) with built-in antenna as shown in Figure 3b that can support four non-overlapping channels, each 2.16-GHz bandwidth. Figure 3c shows the evaluation board for full system performance measurement, verification and validation.

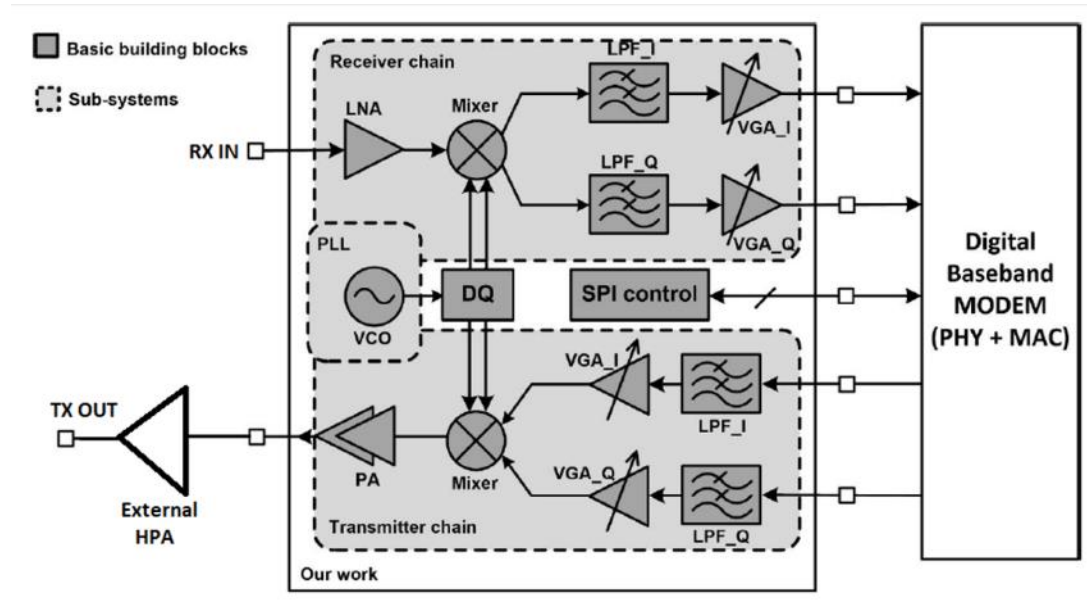



Figure 2. MMW transceiver SoC with sub-systems and building blocks.
Picture Credit: Yeo Kiat Seng, SUTD

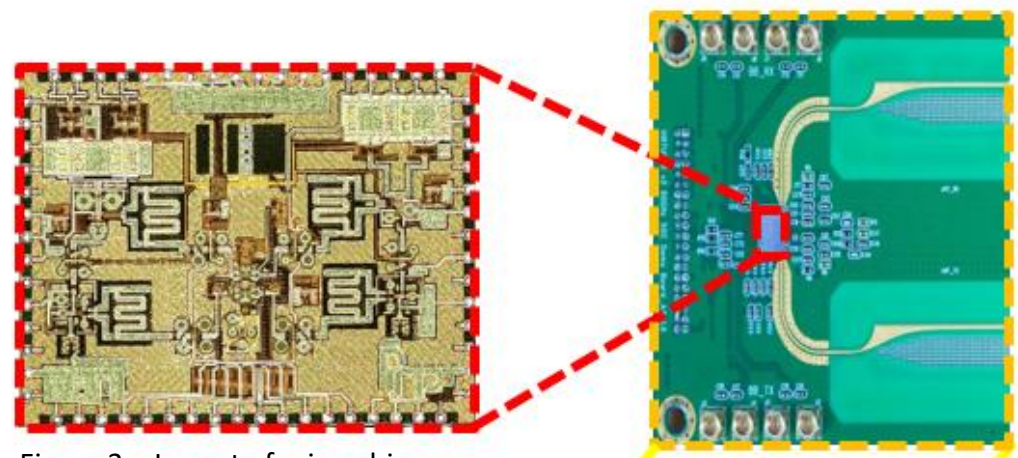


Figure 3a. Layout of microchip

Figure 3b. Microchip with antenna and PCB

Figure 3c. Evaluation board

### Potential Applications

The microchip can be used in several industry sectors such as manufacturing, automotive and healthcare. It can also fill the gap in the long distance fiber networks and the short distance Ethernet networks. A description of the various applications is given below.

***Building-to-building communication***

The building-to-building application, as shown in Figure 4, is one of the main targets for this microchip. Basically, it provides a low-cost high-speed communication link between two separate buildings without any building renovation and cable laying works. In addition, the application can create highly stable and secure point-to-point standalone physical link outside of the existing network.

***Broadband infrastructure***

The broadband connection to a separate district needs special fiber planning which may cost much more than normal fiber laying in city area. The broadband server provider may consider using this microchip to extent the broadband link coverage. This solution can also help to upgrade existing system bandwidth for higher data rate requirements.

***Wireless surveillance system***

This microchip can provide wireless broadband connection up to 1,000m. For example, it can cover wireless camera network in larger area with difficult terrain that has no existing communication network. Also, the secure interconnection is suitable for wireless surveillance system. The wider bandwidth can support high definition, high speed and complex camera network implementations.

Figure 4. Building-to-building application.

Contact Professor Yeo Kiat Seng at kiatseng_yeo@sutd.edu.sg

# Cleaning Robots to be Available Island-wide by March 2020

Assistant Professor Mohan Rajesh Elara, Engineering
Product Development Pillar

Founded in February 2018, Singapore headquartered LionsBot International is poised to become the global brand leader in advanced, fully-autonomous, team-based cleaning robotics.

Lionsbot was cofounded by our SUTD faculty Assistant Professor Mohan Rajesh Elara together with Dylan and Michelle Ng from SuperSteam. Within LionsBot's floor-cleaning robots, there are four different families and 16 unique models. These models include different capacity sizes, cleaning mechanisms and variants for indoor and outdoor.

In July 2019, the company announced the launch of the local production of 300 autonomous cleaning robots for deployment in Singapore. Currently, the company has deployed its Leobot class of robots at Jewel, National Gallery, Resort World Sentosa, Esplanade and many other prominent sites in Singapore.

LionsBot robots can coordinate and clean a given area simultaneously as a team. They use up to 70 per cent less water compared with their commercial counterparts.

The company currently has a team of over 35 engineers who produce these robots in Singapore, from developing a cloud platform for live mapping data to 3D prototyping. It plans to produce four robots on average each day. Lionsbot's steep success in product development and commercialisation is powered by a big force of over 15 full-time engineers who are graduates from SUTD's very own Engineering Product Development (EPD) and Information Systems Technology and Design (ISTD) pillars.

LionsBot is a frontrunner in offering cleaning robots on a subscription model, where companies can utilise the bots without having to invest in ownership and maintenance. To provide training for cleaners on how to use the robots, the company has set up the LionsBot Training Academy to oversee a comprehensive training programme.

LionsBot's Leobot Class of Cleaning Robots.

Leobot deployed at Jewel.

Leobot deployed at National Gallery.

Contact Assistant Professor Mohan Rajesh Elara at rajeshelara@sutd.edu.sg

# The Sprint Towards 5G

Article by: Jessica Sasayiah, Research Communications

With the fifth generation (5G) of wireless communications expected to be rolled out in Singapore in 2020, everyone is buzzing with anticipation to experience the larger bandwidth, wider coverage and lightning speed that 5G promises to offer. Associate Professor Tony Quek, Acting Head of Pillar for Information Systems Technology and Design in SUTD and a leader in the field of wireless networks, explains how 5G will be playing a key role in Singapore's digital transformation and ultimately change the way we live.

Known to be around 10 times faster than 4G networks, 5G will be able to support smart cities, smart mobility, cloud gaming and robots like never before. With its extremely low latency, or 'lag' as it is more commonly known, 5G networks are able to ensure more accurate and timely real-time communication that is needed to support devices and take them to the next level.

"Take robots as an example. While we already have robots that can clean autonomously and identify obstacles in its path using embedded sensors, they are not able to distinguish if a certain obstacle is an inanimate object that can be approached closer for a thorough clean, or a small child, in which case it should maintain a safe distance. However, with a more powerful, faster network connection, it can support the additional sensors required to enable the robot to be 'smarter' which the current network is just unable to support," explained Associate Professor Tony Quek, making reference to the cleaning robots operated by LionsBot International. The company was co-developed by SUTD's Assistant Professor Mohan Rajesh Elara, a known expert in the robotics and AI field.

In more critical use cases, smart mobility such as self-driving cars or remote surgical procedures performed by robots simply cannot afford a lag in real-time communication as that might mean dire consequences for users and patients. The ultra-fast speeds that 5G networks are touted to have, are seeking to advance such future technologies and make them more readily available.

**SUTD at the forefront of Innovation**

To explore the potential use cases of 5G, SUTD has partnered with M1, one of the major telecommunications service providers, to set up an indoor network testbed of 5G small cells. The testbed will be placed at SUTD and is the first indoor 5G system to be deployed in Singapore. Real-time remote operation of robots, augmented-reality content and e-scooters are some of the testbed's areas of focus. This will help translate research innovations into industry solutions while providing SUTD's students, faculty and staff invaluable access to the latest 5G technology.

Small cell networks, compared to conventional base stations which transmit networks over a wider span of geographical area, are able to be deployed indoors in locations such as trains, offices or residential homes. This allows for the network to be closer to users, resulting in a lower-power network and seamless coverage for quicker, reliable connectivity. Tony, whose research domain focuses on small cell networks, will be leading the testbed research in SUTD.

He has also co-authored two books, 'Small Cell Networks' and 'Cloud Radio Access Networks', published by Cambridge University Press in 2013 and 2016 respectively. His books have provided insights to academia and industry experts into the area of small cell solutions as well as opportunities for deep diving into technical refinements to boost efficiency and network performance.

Contact Associate Professor Tony Quek at tonyquek@sutd.edu.sg, and Jessica Sasayiah at jessica_sasayiah@sutd.edu.sg

"This testbed for a small cell network will enable us to leverage our strengths to preempt any challenges that may come about during the deployment of 5G technology, figure out how to manage those challenges and eventually model them. It will also be an excellent platform for our faculty and students to experiment with new design and engineering ideas and push the boundaries of 5G," pointed out Tony.

## Powering On to 6G Networks

With the testing and deployment of 5G technology well underway, researchers and industry experts are already laying the groundwork to start thinking about 6G networks. At the 'Sprint 5G | Forward 6G Wireless Communication Summit' which was organised by Rohde & Schwarz and hosted by SUTD on 14 October 2019, Tony participated in the panel discussion on the 'Outlook of Industry and Business Transformation Catalysed by 5G and 6G'. He discussed the strategy of developing sustained long-term research in artificial intelligence (AI) driven by ultra-high speed networks and shared how AI was not intended to replace humans, but rather leverage human intelligence and expertise to perform complex tasks.

"6G will open up a whole new world of possibilities for us. In the case of the cleaning robots, they can become more interactive and tactile. They will be able to interact with humans and other robots in real-time to know if a certain area needs more cleaning, or to step in to help other robots with their tasks if their "colleagues" are unable to do so automatically," explained Tony.


*(From left to right) Panelists Dr. Lua Eng Keong, Dr. Taro Eichler, Prof. Matti Latva-aho and moderator, Prof. Tony Quek discussing the Outlook of Industry and Business Transformation Catalyzed by 5G and 6G at the Sprint 5G | Forward 6G Wireless Communication Summit at SUTD on 14 October 2019.*

"But it doesn't just stop there. 6G will also potentially allow us to have a more immersive, four dimensional experience enhanced with digital scent technology when watching a movie, playing a game or travelling virtually. Self-driving cars are also able to make more complex decisions on the fly when dealing with unexpected route changes with little or no human intervention. The possibilities are endless and are truly exciting," he said.

**About Tony Quek**

Tony Q.S. Quek received the Bachelor of Engineering and Master of Engineering degrees in Electrical and Electronics Engineering from Tokyo Institute of Technology. At MIT, he earned the Ph.D. in Electrical Engineering and Computer Science. Currently, he is a tenured Associate Professor with the Singapore University of Technology and Design (SUTD). He also serves as the Acting Head of ISTD Pillar and the Deputy Director of SUTD-ZJU IDEA. His research topics include wireless communications and networking, security, big data processing, network intelligence, and Internet of Things.

Associate Professor Quek has been actively involved in organising and chairing sessions and has served as a TPC member in numerous international conferences. He is currently an elected member of the IEEE Signal Processing Society SPCOM Technical Committee. He was an Executive Editorial Committee Member of the IEEE Transactions on Wireless Communications, an Editor of the IEEE Transactions on Communications, and an Editor of the IEEE Wireless Communications Letters.

He received the 2008 Philip Yeo Prize for Outstanding Achievement in Research, the IEEE Globecom 2010 Best Paper Award, the 2012 IEEE William R. Bennett Prize, the 2016 IEEE Signal Processing Society Young Author Best Paper Award, 2017 CTTC Early Achievement Award, 2017 IEEE ComSoc AP Outstanding Paper Award, and 2016 to 2019 Clarivate Analytics Highly Cited Researcher. He is a Distinguished Lecturer of the IEEE Communications Society and a Fellow of IEEE.

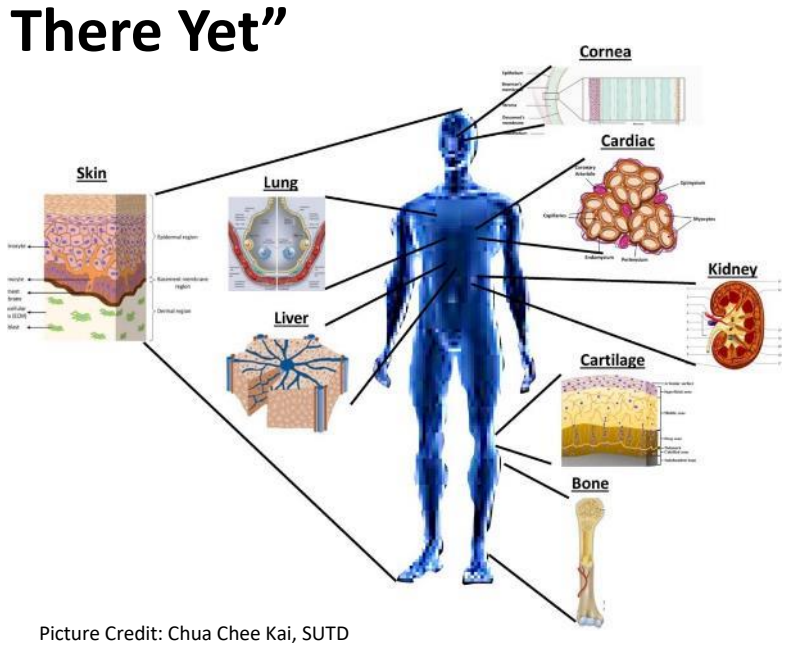
## SUTD Explains Video Series

Watch our faculty members and researchers lead discussions on everyday topics and explain how their multi-disciplinary research impacts us. Click on this link


Contact Associate Professor Tony Quek at tonyquek@sutd.edu.sg, and Jessica Sasayiah at jessica_sasayiah@sutd.edu.sg

# Research Publication

## Progress in Polymer Science: "Print Me An Organ! Why We Are Not There Yet"




Picture Credit: Chua Chee Kai, SUTD

A SUTD team led by Professor Chua Chee Kai looks at an in-depth analysis of recent improvements in the bioprinting techniques, progress in bio-ink development, implementation of new bioprinting and tissue maturation strategies. Bioprinting offers a highly-automated and advanced manufacturing platform that facilitates the deposition of bio-inks (living cells, biomaterials and growth factors) in a scalable and reproducible manner, a process that is lacking in conventional tissue engineering approaches. The SUTD research team strongly believe that with the advances in polymer sciences, it will be an impending reality for on-demand bioprinting of patient-specific tissues/organs.

More information can be found here

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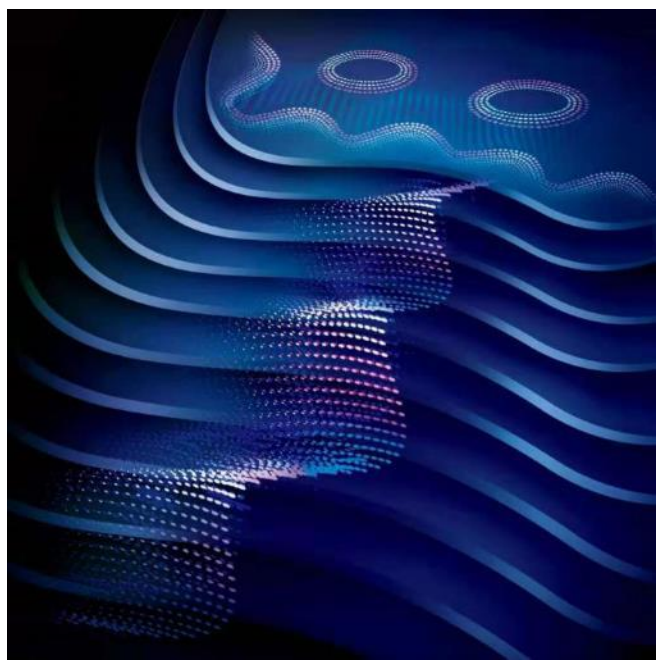
## Nature (2019) Publication: Three-dimensional Quantum Hall Effect and Metal–insulator Transition in $ZrTe_5$



Picture Credit: Wang Guoyan and He Cong

The three-dimensional quantum Hall effect was predicted more than 30 years ago, but has not been observed until now by SUTD together with international researchers. SUTD's experimental collaborator, the Southern University of Science and Technology (SUSTech) in China, has been working on a unique material known as ZrTe5 since 2014. This material is able to satisfy the required conditions and exhibit the signatures of 3D QHE. Assistant Professor Yang Shengyuan is the co-author in this publication.

More information can be found here

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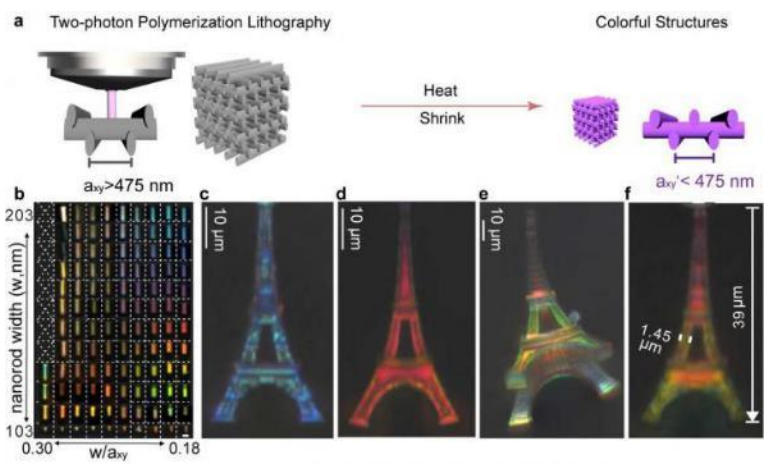
## Nature Communications Publication: Structural Colour Printing of 3D Microscale Objects by Shrinking Photonic Crystals




Picture Credit: Joel Yang, SUTD

The research team led by Associate Professor Joel Yang (EPD Pillar) has printed probably the smallest colourful 3D model of the Eiffel Tower. Impressively, no pigments or inks were used. Instead, the 3D-printed model of the Eiffel Tower, is colorful due to the fine arrangement of nanostructures in a transparent polymer that form photonic crystals. Measuring as small as half the width of a human hair at ~40 micrometers, this work demonstrates the ability to print arbitrary and complex 3D colour objects at the microscale. It brings us a step closer to what certain butterflies have been able to achieve, i.e. to generate vibrant colors that don't fade.

More information can be found here

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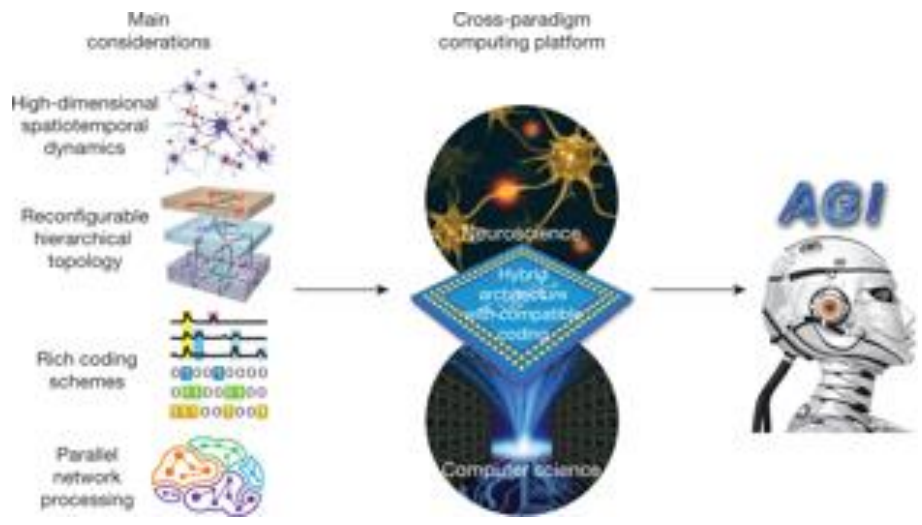
# Research Publication

## Nature (2019) Publication: Towards Artificial General Intelligence with Hybrid Tianjic Chip Architecture




Picture Credit: Zhao Rong, SUTD

Research led by Associate Professor Zhao Rong (EPD Pillar) has been published in Nature. Her research presented the world's first cross-paradigm chip that has the computer-science-oriented and neuroscience-oriented computing paradigm, and demonstrated a self-driving bicycle using this chip. It's proven in supporting multiple coding schemes and adaptive capabilities in a complicated environment could move the world a step closer to achieving artificial general intelligence.

More information can be found here

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## ICBC 2019 Best Paper Award: SUTD Researchers Enhance Security in Proof of Stake Blockchain Protocols


SUTD researchers, Stefanos Leonardos, Daniel Petrus Reijsbergen and Assistant Professor Georgios Piliouras (ESD pillar), devised a new algorithm for added security in Proof of Stake Blockchain protocols and won the Best Paper Award at the 2019 IEEE International Conference on Blockchain and Cryptocurrency (ICBC 2019). ICBC 2019 is the first premier technical conference on Blockchain and Cryptocurrency, sponsored by IEEE Communications Society (ComSoc).

More information can be found here

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## ASCE 2019 Best Research-Oriented Paper Award: ASCE Journal of Water Resources Planning and Management


A paper, "Deep-Learning Approach to the Detection and Localisation of Cyber-Physical Attacks on Water Distribution Systems," co-authored by Dr Riccardo Taormina and Asst Prof Stefano Galelli (iTrust) was selected by the Editor of the Journal of Water Resources Planning and Management to receive the 2019 Best Research-Oriented Paper Award. The award was presented to them at the World Environmental & Water Resources Congress in Pittsburgh, Pennsylvania on 21 May 19.

More information can be found here

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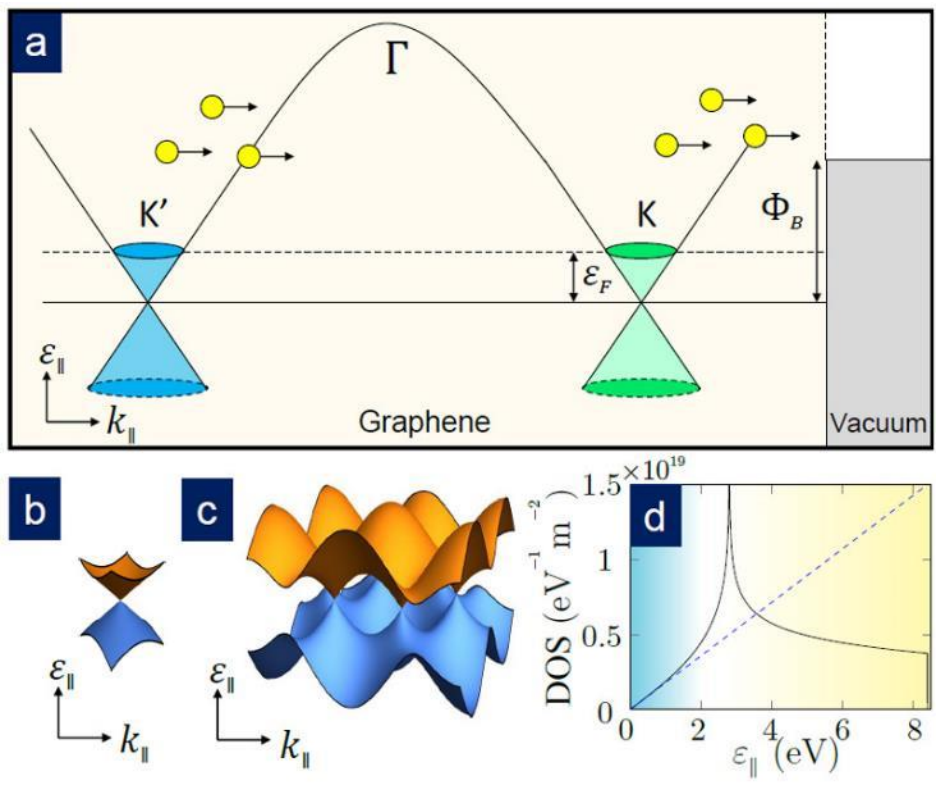
# Research Publication

## Physical Review Applied: SUTD Physicists Unlock the Mystery of Thermionic Emission in Graphene




SUTD researchers discover a new theory that paves the way for the design of better graphene electronics and energy converters. They have discovered a general theory that describes the thermionic emission from graphene. By carefully studying the electronic properties of graphene, they have constructed a generalized theoretical framework that can be used to accurately capture the thermionic emission physics in graphene and is suitable for the modeling of a wide range of graphene-based devices.

More information can be found here

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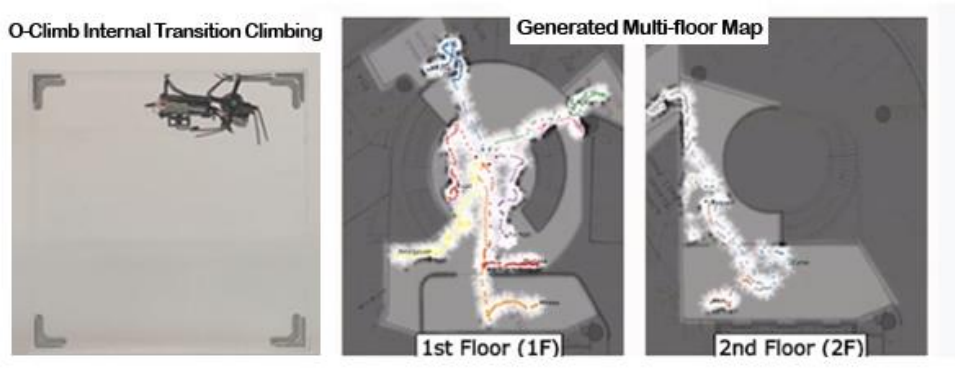
## IEEE MRS 2019: SUTD's Research on a Multi-Robot System Wins Outstanding Paper Award




***ORION is a first-of-its-kind multi-robot system made up of a wheeled ground unit, miniature and wall-climbing robots to form a scalable swarming system similar to ant colonies.***

Researchers from SUTD have developed a strong, flexible and scalable multi-robot system (MRS) that can be used in intelligence, surveillance and reconnaissance (ISR) operations. The interdisciplinary research team received the Outstanding Paper Award for their ground-breaking research at the 2nd International Symposium on Multi-Robot and Multi-Agent Systems 2019 (IEEE MRS 2019) held at Rutgers University in New Jersey, United States.

More information can be found here

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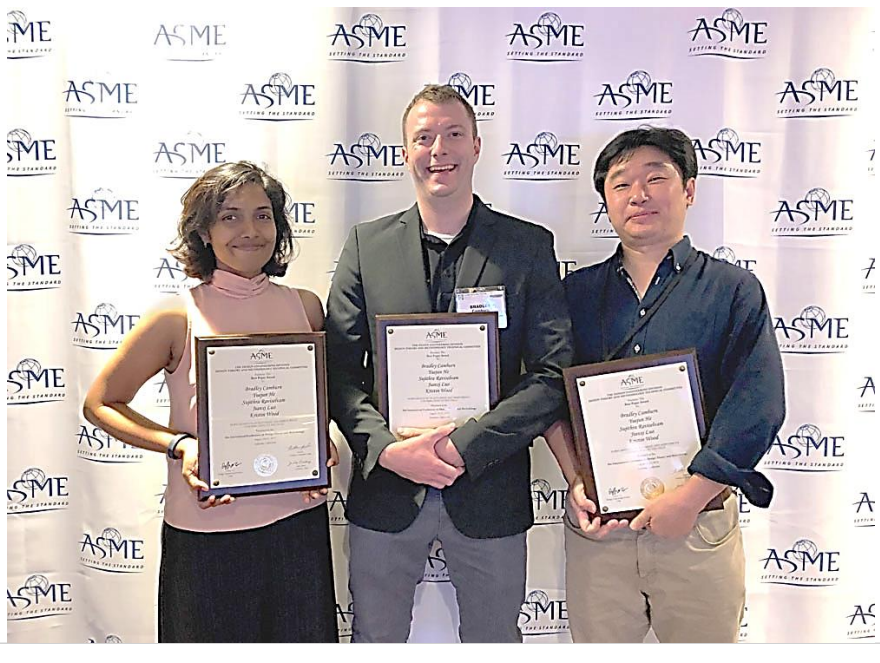
## ASME: Design Theory and Methodology Best Paper Award 2019



SUTD team won the ASME Design Theory and Methodology (DTM) Best Paper Award 2019. The paper, 'Evaluating Crowdsourced Design Concepts with Machine Learning', was presented at the 31st International Conference on Design Theory and Methodology, held from 18 to 21 August 2019, at Anaheim, California. "The paper arises from a series of SUTD research to push the frontier of Artificial Intelligence for Conceptual Design."

More information can be found here

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# Our Research Talent

## Top 20 Experts in the World on Electronic Transistor Front End Reliability

Associate Provost Professor Pey Kin Leong (Undergraduate Studies and SUTD Academy) has been recognized by the International Integrated Reliability workshop (IIRW 2018) and the IEEE Electron Device Society (EDS) as one the top 20 experts in the world on electronic transistor Front End reliability

Professor Pey's recognition demonstrates not just the technical depth and rigour of SUTD's research efforts, but also the University's commitment to seeking innovative and ground-breaking solutions to industry-relevant challenges

## The Chicago Athenaeum / The European Centre of Architecture Art Design and Urban Studies International Architecture Award

Professor Thomas Schroepfer (ASD Pillar) has been awarded the prestigious International Architecture Award 2019 for his work 'The Future of Us Pavilion' by The Chicago Athenaeum Museum of Architecture and Design, The European Centre for Architecture Art Design and Urban Studies and Metropolitan Arts Press. The Award recognizes excellence in architecture and urban design globally.

The Future of Us Pavilion was built in to house the capstone event of the SG50 celebrations in 2015, with the Ministry of National Development working with SUTD on the project.

## The Optical Society (OSA) Fellow

Associate Professor Joel Yang (EPD Pillar) has been elected Fellow of The Optical Society (OSA) on 16 September 2019 at the OSA meeting in Washington, DC, USA.

As an OSA Fellow, Joel joins a distinguished group of members who have served the Society and the optics and photonics community with distinction.

# Our Research Talent

## NRF Fellowship for AI (2019)

Assistant Professor Ioannis Panageas (ISTD Pillar) has received NRF Fellowship for Artificial Intelligence in 2019. The title of his proposal is "Rigorous AI using Game Theory and Statistics".

Before joining SUTD Ioannis was a MIT Postdoctoral Fellow working with Costis Daskalakis. He obtained his PhD in Algorithms, Combinatiorics, and Optimization (ACO) at Georgia Tech. His research interest is in theory of computation and its interface with applied probability and statistics, optimization, dynamical systems, machine learning and their applications to game theory, evolution and dynamics on networks.

## Top 30 at the 2019 Super AI Leader (SAIL) Award


Associate Professor Ngai-man (Man) Cheung (ISTD Pillar), with his research project “KroniKare: Transform Chronic Wound Care using AI”, was shortlisted as one of the top 30 finalists at the 2019 Super AI Leader (SAIL) Award.

The award results were announced as part of the 2019 World Artificial Intelligence Conference (WAIC), held in Shanghai from 29 August 2019 to 31 August 2019.

There were nearly 700 projects that participated in the SAIL Award this year, including AI teams from Tencent, Baidu, Amazon, IBM, Shanghai Jiao Tong University, and more. The Award recognizes outstanding and breakthrough projects in AI from all over the world.

## Winning the National Blockchain Challenge 2019


Researchers Aung Maw (iTrust) and Siddhant Shrivastava (iTrust) participated in the National Blockchain Challenge 2019 that took place from 14 to 16 June 2019 at the Lifelong Learning Institute, Singapore. The event was sponsored by SkillsFuture SG, Our Singapore Fund, Lifelong Learning Institute, Amazon Web Services, and supported by top blockchain companies. 67 people participated in the Challenge and six teams reached the finals.

Siddhant and Aung delivered a technical pitch and a business pitch for their Blockchain solution, which they called “Blockbusters.” Blockbusters uses the principles of decentralization, immutability, and data replication to solve the problem of data tampering in Critical Infrastructures arising from cyber attacks. In the event that data is manipulated, Aung and Siddhant demonstrated Blockbuster could also recover lost data which is useful for forensics in cyber attacks such as the one on SingHealth in 2018.

The judges, comprising a panel of representatives from Business Angel Network (BANSEA), Kleros, IOST and GovTech, awarded iTrust the overall first prize and the vertical prize in the Cybersecurity category.

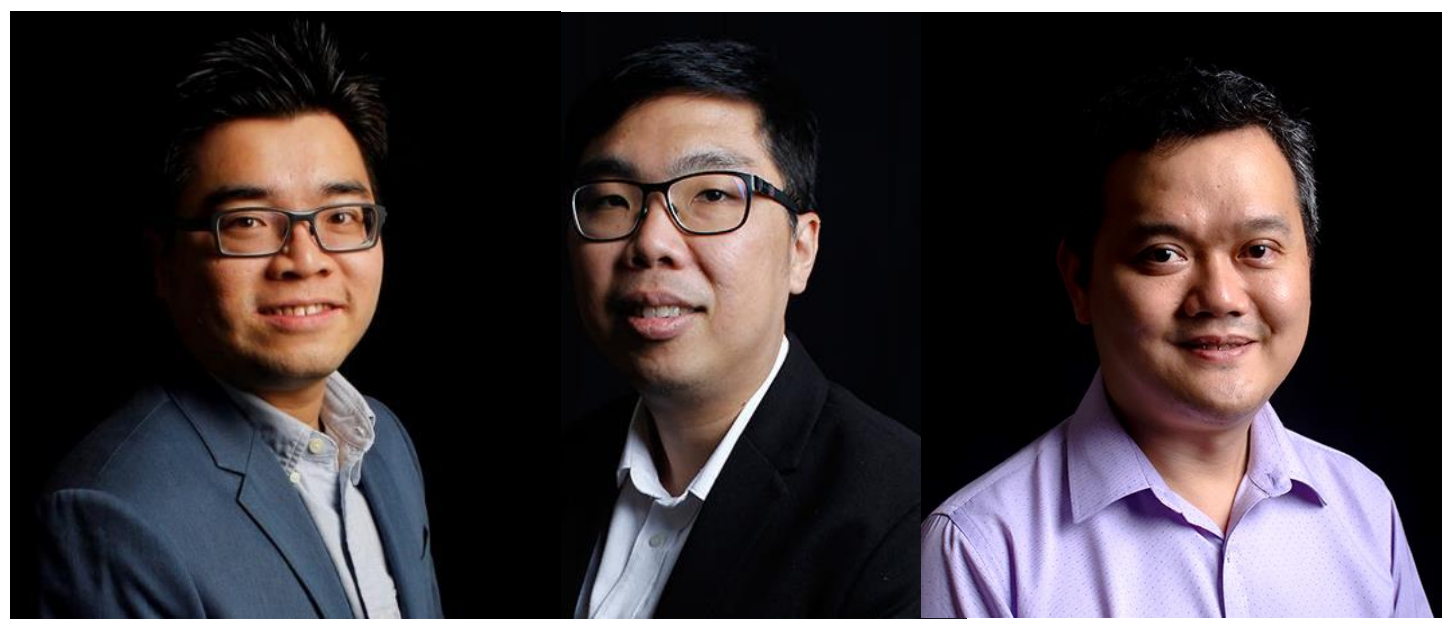
# Our Research Talent

## 2019 Global Watch List for "30 Women in Robotics"

Assistant Professor Meghjani (ISTD Pillar) has been featured in the list for “30 women in robotic by Robohub.org, a non-profit online communication platform that brings together experts in robotics research, start-ups, business, and education from across the globe.

From Mexican immigrant to MIT, from Girl Power in Latin America to robotics entrepreneurs in Africa and India, the 2019 annual “women in robotics you need to know about” featured 30 inspiring #womeninrobotics.

## National Robotics Programme – Robotics Enabling Capabilities and Technologies (RECT)



Associate Professor Foong Shaohui (Left)(EPD Pillar) and his Co-PI : Associate Professor Soh Gim Song (Middle)(EPD Pillar) and Assistant Professor Tan U-Xuan (Right)(EPD Pillar) have been awarded $2.7M funding under the National Robotics Programme (NRP) Robotics Enabling Capabilities and Technologies (RECT) Funding Initiative to develop Intelligent Ground-Aerial Robots for Closed Quarters Interactive Operations.

## Enabling Safe and Sustainable Deployment of Mobile Robotic Systems For Healthcare in Singapore

Assistant Professor Mohan Elara (EPD Pillar) and his Co-PI from Changi General Hospital have been awarded $3.8M funding under the National Robotics Programme (NRP) Grant to develop WASP: A Highly Versatile Robot Platform for Healthcare Settings.

Mohan has also secured $4.1M funding under the National Robotics Programme – Robotics Enabling Capabilities and Technologies (RECT) to develop Long Term Autonomy in Self-reconfigurable Maintenance Robots (ERMINE II).

# Our Research Talent

## Design Business Chamber Singapore (DBCS) announces 12 SG Mark winners from SUTD

Launched in 2013 by Design Business Chamber Singapore (DBCS) in partnership with the Japan Institute of Design Promotion, the SG Mark is a benchmark for good design quality impacting local and global communities. The SG Mark gives recognition to products and services that address human needs and experience, contributing significant value to improving quality of life. More information can be found here.

SINGAPORE GOOD DESIGN

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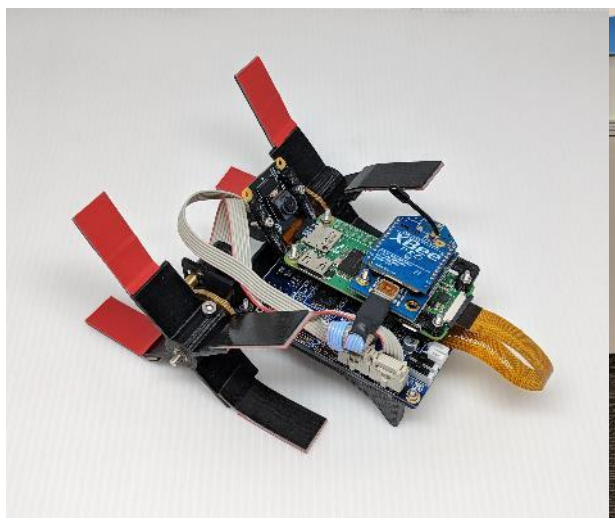
More information can be found here.

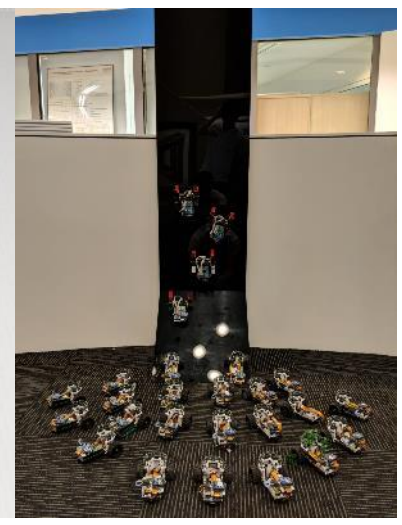
## SG Mark Special Mention: *Honk!*



Left: Assistant Professor Lyle Fearnley (HASS)
Centre: Mr Poon King Wang, Senior Director (Strategic Planning) & Director (LKYCIC)
Right: Dr Andy Zheng, Adjunct Fellow (LKYCIC)

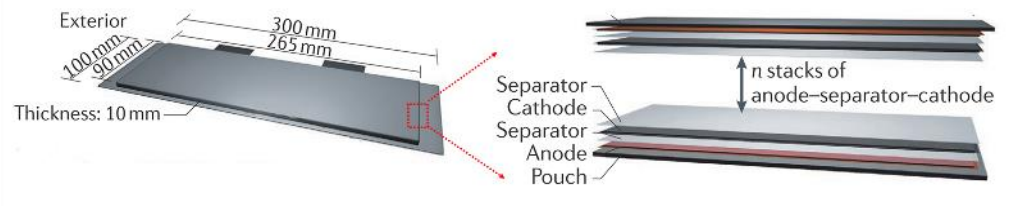
## *ORION*





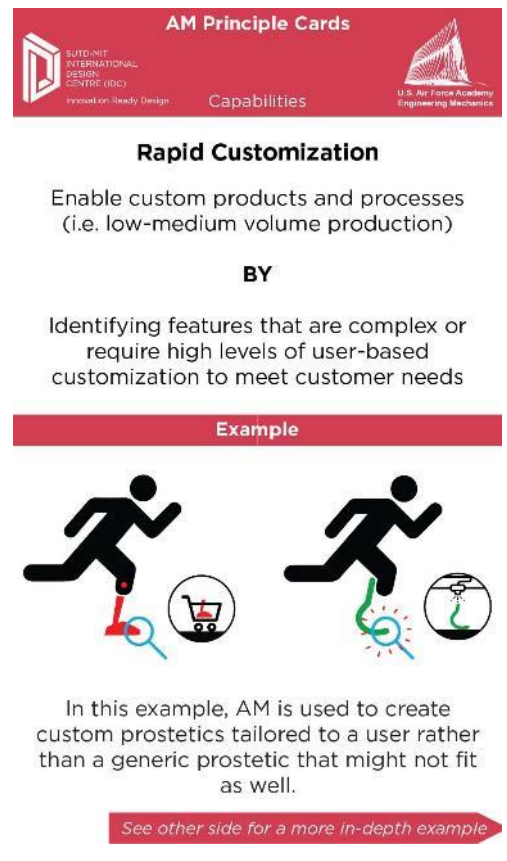
Left: Associate Professor Roland Bouffanais (EPD Pillar)
Right: Associate Professor Soh Gim Song (EPD Pillar)

## *New Generation of Lithium Sulfur Battery Based on Nanostructured Open-Hollow Sulfur@MnO2 Cathode*

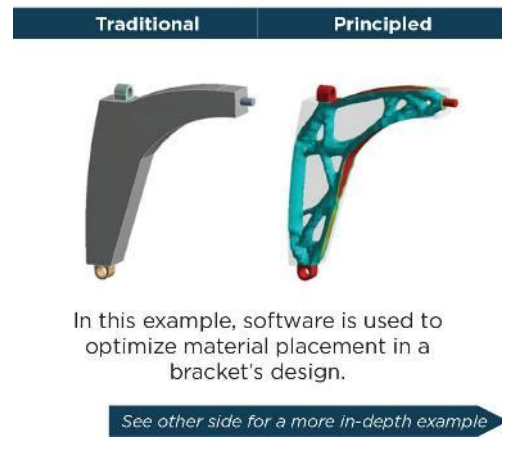



Associate Professor Yang Hui Ying (EPD Pillar)

## *Design Inspiration Cards for 3D Printing*








Blake Perez (SUTD Alumni)

# Our Research Talent

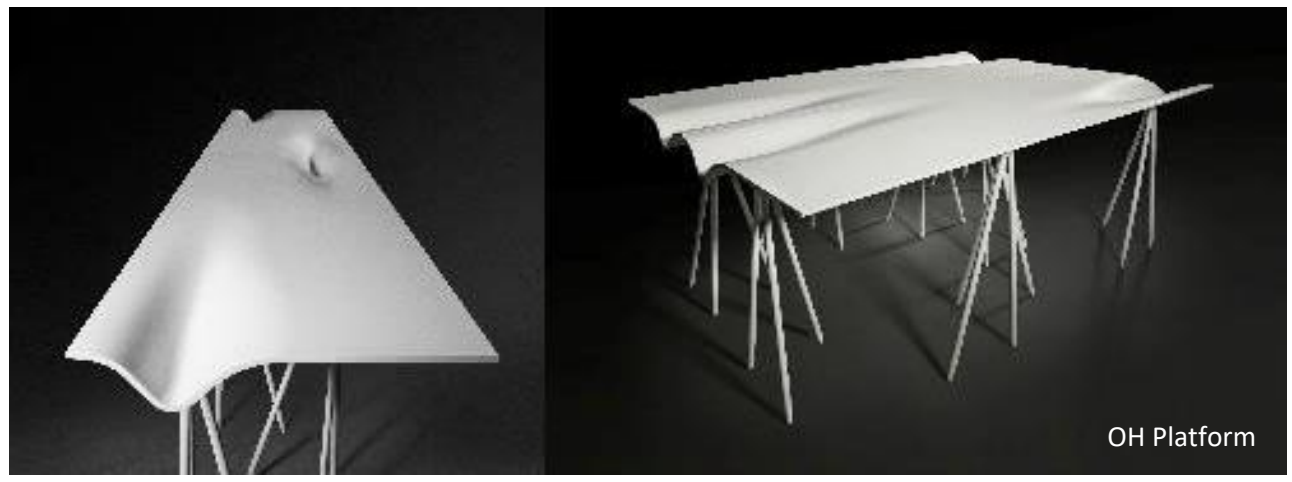
## *CRoW: Compact Rotating Wing & SAW: Samara Autorotating Wings*

CRoW: Compact Rotating Wing

SAW: Samara Autorotating Wing

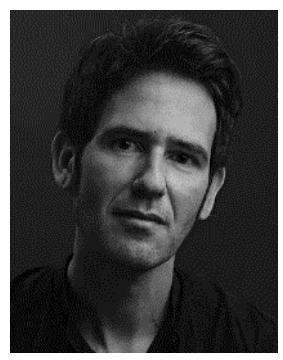
Left: Associate Professor Foong Shaohui (EPD Pillar)
Right: Associate Professor Soh Gim Song (EPD Pillar)

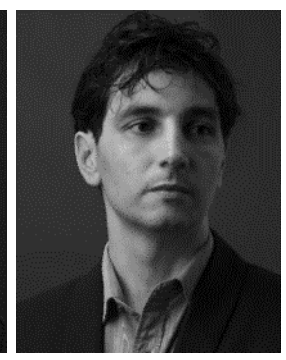
## *OH Platform & AirTable*



OH Platform

AirTable





Left: Assistant Professor Carlos Bañón (ASD Pillar)
Right: Assistant Professor Felix Raspall (ASD Pillar)

## *Mantis: A Modular Window Facade Cleaning Robot*

Assistant Professor Mohan Rajesh Elara (EPD Pillar)

More information can be found here.

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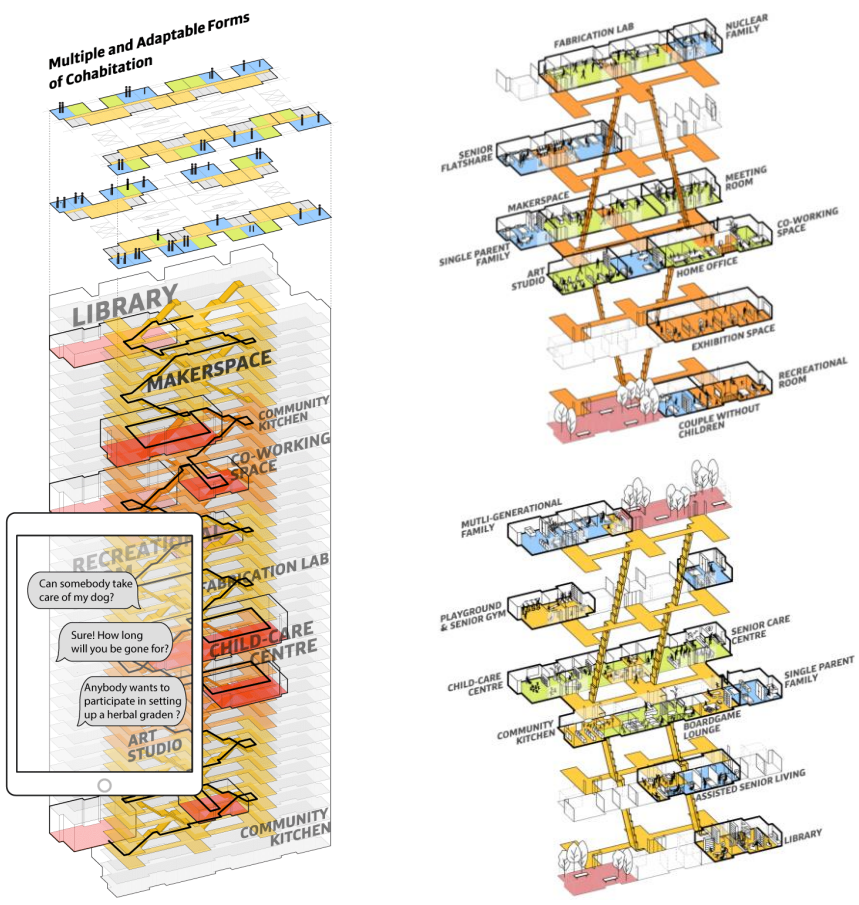
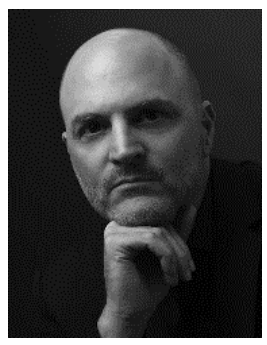
# Our Research Talent

## *Generic Dwelling Templates for Future Urban Habitation*



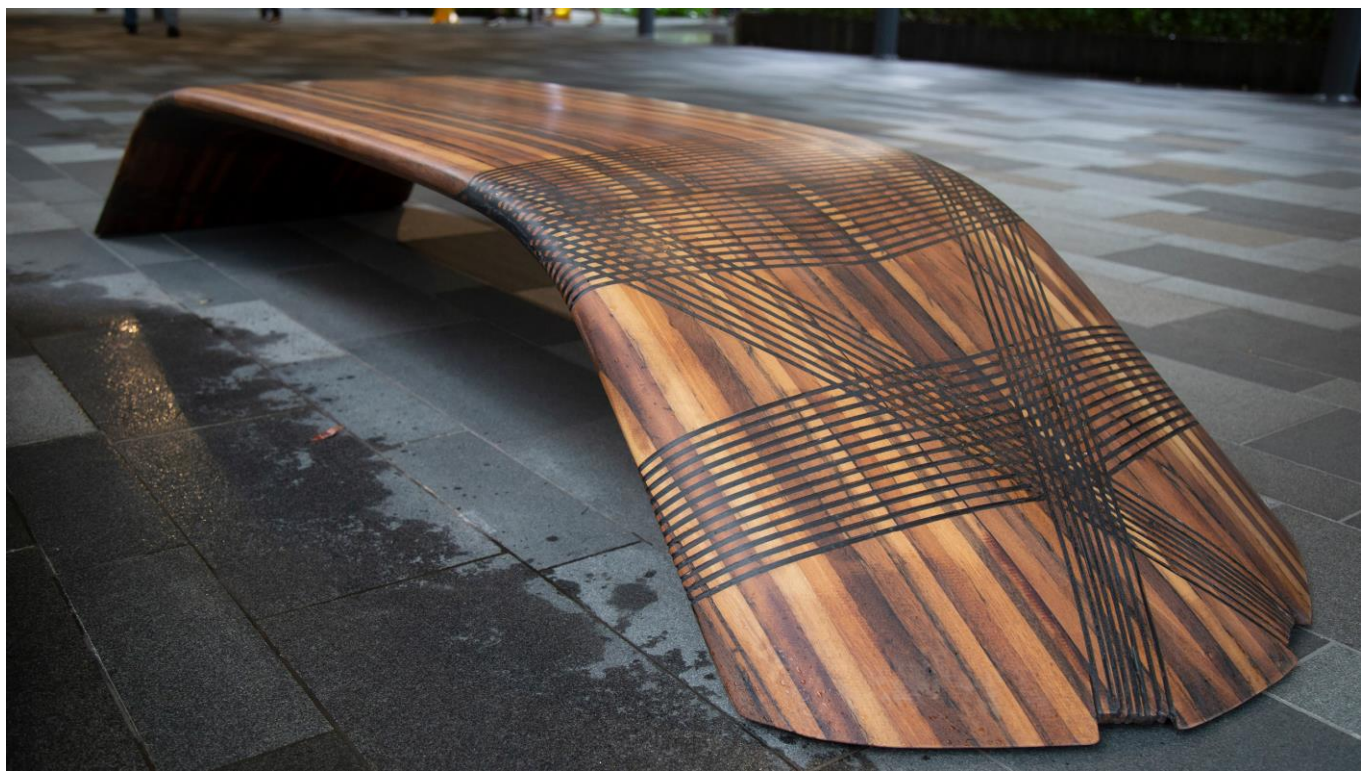



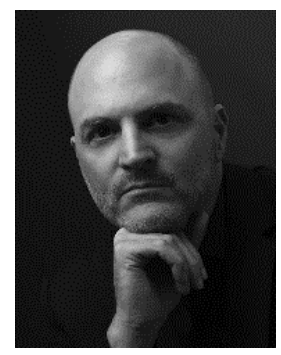
Left: Assistant Professor Oliver Heckmann (ASD Pillar)
Right: Assistant Professor Michael Budig (ASD Pillar)

## *Natural Composite Pillar*

Left: Associate Professor Stylianos Dritsas (ASD Pillar)
Right: Assistant Professor Javier G. Fernandez (EPD Pillar)

## *Tiny Thread | Massive Blocks*





Left: Assistant Professor Michael Budig (ASD Pillar)
Right: Assistant Professor Kenneth Tracy (ASD Pillar)

More information can be found here.

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