SHINE

Singapore Hybrid-integrated Next-generation μ-Electronics Centre

6th Technical Workshop

24 to 25 June 2025

Hosted by:

NUS National University of Singapore | College of Design and Engineering

NUS National University of Singapore

NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

NRF SINGAPORE

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DSO NATIONAL LABORATORIES

Agency for Science, Technology and Research SINGAPORE

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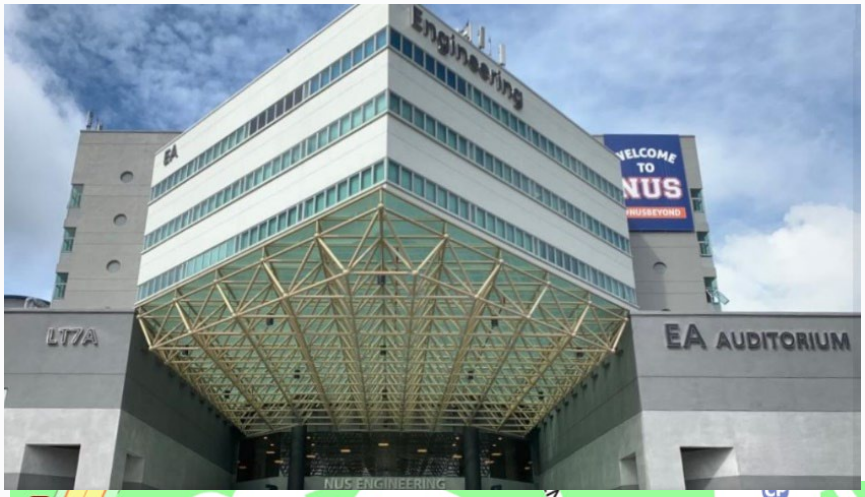
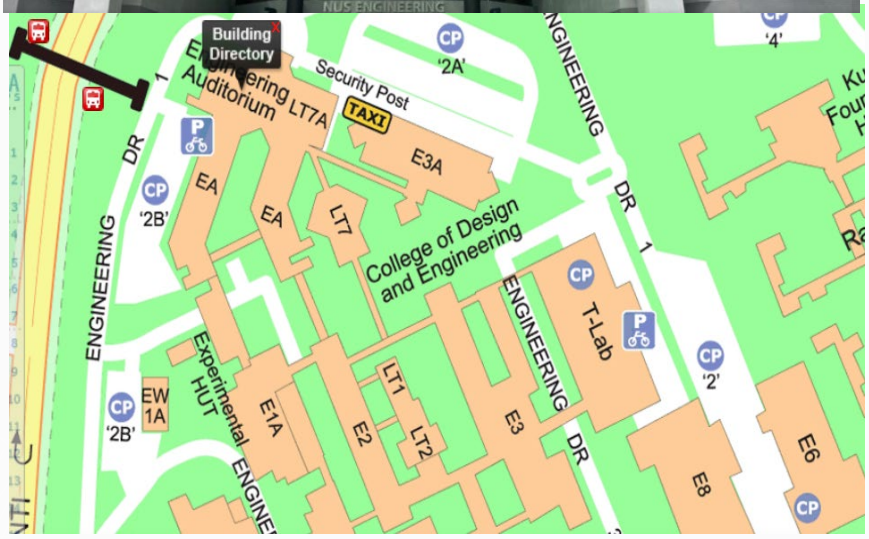
General Information

VENUE: National University of Singapore, College of Design and Engineering, 9 Engineering Drive 1, S(117575)

- ❑ IEEE FLEPS 2025 Industry Open Plenary - Block EA, LT 7A
- ❑ SHINE Seminar - Block EA, Auditorium
- ❑ SHINE Technical Workshop* - Block EA, Auditorium

  ** For SHINE Consortium Members only*





Driver is advised to enter via Engineering Drive 1 and park at Car Park 2A/2B

The Agenda

Day 1 : 24 June 2025
8:00 AM - 8:30 AM: Registration

Morning Seminar - Invited Talks#

#Open to public

Start Time	End Time	Presentation Topic	Presenter
8:30 AM	8:45 AM	SHINE's Role in Advancing Singapore's Semiconductor Landscape	Prof. Lim Yeow Kheng SHINE Centre, Programme Director National University of Singapore
8:45 AM	9:15 AM	Unleashing Power of Advanced Packaging with Smart Manufacturing	Mr. Chris Sim Director of Package Development Engineering (PDE) Micron Technology
9:15 AM	9:45 AM	Robust, Easy to Integrate Z-Axis Interconnect for Flexible Hybrid Electronics	Mdm. Madhu Stemmermann CEO SunRay Scientific Inc, USA
9:45 AM	10:15 PM	Automotive FPC Display Interfaces – Modelling & Validation	Mr. Dontireddy, Kalivaraprasad Reddy Senior Expert Continental Automotive Singapore
10:15 AM - 10:35 AM: Networking & Break			
10:35 PM	11:35 AM	Nanoscale Silver for Flexible & Transparent Electronics: from Development to Commercialization	Dr. Ajay Virkar Vice President of Advanced Circuits and Packaging DuPont, USA
11:35 AM	12:05 PM	The Latest Technology Breakthroughs for Flexible Printed OLED TV Display Technology	Dr. James Lee Deputy Chief Engineer TCL Corporate Research
12:05 PM	12:35 PM	Advancing Manufacturing in Flexible Hybrid Electronics through Innovation & Design	Dr. Sudheer Kumar COO, National Centre for Flexible Electronics, Indian Institute of Technology Kanpur
12:35 PM	1:05 PM	The Challenge of Current stretchable PCB & the Fabrication Approach	Mr. Shimizu Ryota Chief of R&D Department Satosen Corporation, Japan
1:05 PM - 2:00 PM: Lunch			

… to be continued

The Agenda

Day 1 : 24 Jun 2025
1:30 PM -2:00 PM: Registration(for SHINE afternoon open plenary# and Workshop*)

#Open to public

Start Time	End Time	Presentation Topic	Presenter
2:00PM	2:05PM	Welcome Address	Prof. Chen Xiaodong Deputy Director, SHINE Centre Distinguished University Professor, Nanyang Technological University
2:05PM	2:35PM	RF-Millimeter Wave GaN-on-Si for Future 5G/6G Communications	Prof. NG Geok Ing Centre Director of the National GaN Technology Centre (NGTC) Nanyang Technological University
2:35PM	3:05 PM	Next-generation Photonics Heterogeneous Integration towards Multi-Material System	Dr. Luo Xianshu Vice President, Advanced Photonics at National Semiconductor Translation and Innovation Centre (NSTIC)
3:05 PM	3:35 PM	Interconnect Technologies for Multi-Chiplet Heterogeneous Integration	Mr. Vempati Srinivasa Rao Director and Head, Heterogeneous Integration Department A*Star IME
3:35 PM - 3:50 PM: Networking & Break			
**** For consortium members only***			
3:50 PM	4:20 PM	SHINE Chiplet Ecosystem Across the Entire System Lifecycle and Silicon Case Studies	Prof. Massimo Alioto SHINE Thrust-1 Co-Investigator National University of Singapore
4:20 PM	4:50 PM	Conformal Bioelectronics for Human Machine Interface	Prof. Chen Xiaodong SHINE Thrust-2 Co-Investigator Nanyang Technological University
4:50 PM	5:20 PM	Development of Thermal Energy Conversion & Photo Responsive Composite for Soft Electronics	Dr. Hyunwoo Bark SHINE Thrust-2 Senior Research Fellow Nanyang Technological University
End of Programme (Day 1)			

The Agenda

Day 2 : 25 Jun 2025*
8:30 AM -8:45 AM: Registration
For Consortium Members only

Start Time	End Time	Presentation Topic	Presenter
8:45 AM	9:15AM	3D IC Partitioning Algorithm Comparison	Prof. Alberto Sangiovanni-Vincentelli SHINE Thrust-1 Research Collaborator University of California, Berkeley, USA
9:15 AM	9:45 AM	Advancing the Next-Generation of Electronic Failure Analysis	Dr. Lucas Lum Yu Xiang SHINE Thrust-4 Research Fellow National University of Singapore
9:45 AM	10:15 AM	Non-Hermitian Thermophotonic Funneling	Mr. Yang ShuiHua SHINE Thrust-4 PhD Student National University of Singapore
10:15 AM - 10:30 AM: Networking & Break			
10:30 AM	11:00 AM	Integration Towards Flexible Active Phased Arrays	Dr. Jiang Yi Zhou SHINE Thrust-3A Research Fellow National University of Singapore
11:00 AM	11:30 AM	Miniature Transceiver for Multi-band Data Communication	Mr. Soh Chee Heong Principal Engineer (RF Team) DSO National Laboratories
11:30 AM	12:00 PM	Flexible & Conformable Phased Arrays: Techniques & Technologies	Prof. Koenraad Mouthaan SHINE Thrust-3B Co-Investigator National University of Singapore
12:00 PM	12:05 PM	Closing Address	Prof. Lim Yeow Kheng SHINE Centre, Programme Director National University of Singapore
End of Programme (Day 2)			

Opening Address

SHINE's Role in Advancing Singapore's Semiconductor Landscape

Prof. Lim Yeow Kheng

SHINE Centre, Programme Director

National University of Singapore

Abstract:

By working across NUS, NTU, A*STAR-IME, DSO National Labs, and SIMTech, the Singapore Hybrid-Integrated Next-Generation μ-Electronics (SHINE) Centre, hosted at the NUS College of Design and Engineering, seeds a National Heterogeneous Integration pilot line locally that is capable of unique "Mix-&-Match" hybrid electronic technologies. At the intersection of materials science, electronics, and photonics, the Centre brings together researchers across disciplines to develop advanced microelectronics, including flexible electronics, with an emphasis on real-world impact. As a platform for academic-industry collaboration, SHINE enables partners across the semiconductor value chain to co-develop and translate emerging technologies into practical applications. By advancing heterogeneous integration capabilities and hybrid-integrated technologies, SHINE plays a pivotal role in propelling Singapore's semiconductor industry forward, driving innovation, and solidifying the country's position as a key player in the global microelectronics landscape.

Biography:

Prof. Lim Yeow Kheng is the Programme Director of the SHINE Centre and the Master of Science in Semiconductor Technology and Operations (STO) programme at the National University of Singapore (NUS). He also serves as Assistant Dean (Research and Technology) and Professor in the Department of Electrical and Computer Engineering at the College of Design and Engineering. With over 20 years of industry experience in semiconductor technology and OSAT manufacturing, Prof. Lim has held leadership roles at GlobalFoundries and JCET Group. His research interests span advanced wafer-level packaging, heterogeneous integration, nanomaterials, flexible electronics, and AI/ML applications. He is a Senior Member of IEEE, holds multiple patents, and is active in numerous local and international technical committees and conferences in microelectronics and packaging technologies.

IEEE FLEPS Industry Plenary Talk 1

Unleashing Power of Advanced Packaging with Smart Manufacturing

Mr. Chris Sim

Director of Package Development Engineering (PDE)

Micron Technology

Abstract:

This keynote explores how the semiconductor industry is advancing toward the next frontier of innovation through cutting-edge smart manufacturing capabilities that are reshaping advanced packaging. As packaging complexity increases, the industry is embracing a new paradigm that combines system-level codesign, predictive modeling, advanced process controls, and digital twin technologies.

Attendees will gain insight into how these capabilities are transforming manufacturing into a more intelligent, adaptive, and efficient ecosystem. We will examine how predictive simulations and digital twins are enabling virtual qualification, enhancing quality and consistency, and driving predictive maintenance. The session will also highlight how smart manufacturing is becoming a cornerstone of Industry 4.0, unlocking new levels of agility and performance in semiconductor production.

Biography:

Mr Chris Sim serves as the Director of Package Development Engineering (PDE) at Micron Technology, where he spearheads strategic initiatives across HBM, NAND, and DRAM technologies. In this role, he leads advanced packaging, technology development, package integration, industrial engineering, digital twin implementation, and key equipment teams—accelerating innovation and the deployment of next-generation silicon technodes.

Chris joined Micron in 2015 as a product engineer focused on SSD and module solutions. Since then, he has earned recognition for his deep technical expertise and cross-functional leadership, playing a pivotal role in advancing Micron's memory and storage innovations.

He holds a Bachelor's degree in Electronics Engineering with a specialization in Bio-instrumentation from Multimedia University, Malaysia (2010), and an MBA from Singapore Management University (2021), equipping him with a strong blend of technical insight and business strategy.

IEEE FLEPS Industry Plenary Talk 2

Robust, Easy to integrate Z-Axis Interconnect for Flexible Hybrid Electronics

Madam Madhu Stemmermann

CEO

SunRay Scientific Inc.

Abstract:

Flexible Hybrid Electronics are comprised of soft and rigid electronic components. Robust and reliable electrical interconnections are necessary to ensure the proper functionality of the devices with rigid semiconductors, communications, and sensor components on flexible circuits. ZTACH® ACE, magnetically aligned Anisotropic Conductive Epoxy (ACE) takes advantage of magnetically induced self-assembly of ferro-magnetic particles that self-align into Z-axis "wires" in an epoxy polymer matrix optimized for Flexible Hybrid Electronic (FHE) applications. ZTACH® ACE provides a high-reliability electrical and mechanical interconnection without requiring precise patterning, high heat, or pressure. This magnetically aligned conductive epoxy cures at low temperatures (80C-160C) and supports fine-pitch (100 microns) reliably while maintaining low contact resistance and strong mechanical bond strength. Additionally, ZTACH® ACE acts as its own underfill and edge encapsulant, eliminating the need for a separate underfill step. Importantly, ZTACH® ACE integrates seamlessly into traditional Surface Mount Technology (SMT) lines, enabling efficient, high-volume production.

SunRay will present several case studies of this novel adhesive technology using various demonstration vehicles, showcasing results of rigorous electrical and mechanical testing. Example applications to be discussed include flipped bare die attachment on flexible circuits, replacing wire-bonding, and dam and fill assembly on rigid boards. ZTACH® ACE bonding enables lower profile component attachment on flexible substrates for smart labels, allowing the addition of security features or integrated sensing, while decreasing costs and meeting performance requirements. Further case studies include the use of ZTACH® ACE in typical wearable electronic applications on host substrates like textiles and TPU, without the addition of underfill and/or encapsulation. This magnetically aligned adhesive is compatible with existing SMT lines, making adoption for manufacturing a low cost, easily adaptable technology. An Ultraviolet (UV) curable version under development is garnering interest in roll-to-roll flexible assemblies.

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The goal of this talk will be to demonstrate the possibilities of transitioning rigid products to FHE systems using a novel magnetically aligned ACE with existing SMT infrastructure. Easier, lower cost manufacturing of robust, flexible, wearable FHEs can be integrated into a wider range of cost effective, reliable end use applications.

Biography:

Mdm Madhu Stemmermann, CEO and Co-Founder, SunRay Scientific Inc., has 25 years of experience in executive leadership roles across manufacturing, supply chain, sales and product management spanning various industries such as electronics packaging, conductive adhesives, medical devices, LED lighting and engineered plastics. She was the youngest and first female Plant Manager appointed at Philips Lighting. She has led and executed various company transformations and acquisitions. Mdm Madhu received her degree in Chemical Engineering from Purdue University, West Lafayette, IN.

IEEE FLEPS Industry Plenary Talk 3

Automotive FPC Display Interfaces – Modelling and Validation

Mr. Dontireddy Kalivaraprasad Reddy

Senior Expert

Continental Automotive Singapore

Abstract:

Continental Automotive develops pioneering technologies and services for sustainable and connected mobility of people and their goods. It offers safe, efficient, intelligent, and affordable solutions for vehicles, machines, traffic, and transportation. Our pioneering technologies for visual, tactile, and auditory interaction with the vehicle determine the mobility of the future.

In this presentation, we will give an overview about automotive display interfaces design and challenges associated with those interfaces. These interfaces use FPC/FFC cables along with FPC display boards. Flexible PCBs can be folded or shaped to fit into compact or irregular spaces, making them ideal for modern vehicles. To have the flexibility, they need to have thin cores and special ground structures that can create significant SI (Signal Integrity) and EMC (Electro Magnetic Compatibility) issues. Simulations helps here to model these flex PCB's up front and resolve the issues regarding the SI and EMC early and helps in achieving superior quality and cost-efficient design.

Biography:

Mr. Dontireddy, Kalivaraprasad Reddy started his carrier in 2010 after finishing his master's degree in Microwave Engineering from IIT BHU. He joined Bosch as EMC engineer and later moved to Stuttgart, Germany, where he worked on automotive electronics with a focus on EMC.

Subsequently, he Joined Visteon and then Cummins as a Technical Specialist in High Speed and EMC simulations domain. He played a key role in developing simulation methods and processes to achieve signal integrity (SI) and EMC compliance.

In 2017, he relocated to Singapore to work at Continental Automotive where he currently serves as a Senior Expert in high-speed design and EMC simulation. He has extensive experience in designing memory interfaces like LPDDR4 along with display interfaces like LVDS and eDP etc. Additionally, he has developed methodologies for in-house FPC designs with special ground structures to meet SI and EMC requirements. His research interests include exploring alternative techniques for achieving EMC compliance and leveraging AI in high-speed design.

IEEE FLEPS Industry Plenary Talk 4

Nanoscale Silver for Flexible and Transparent Electronics: from Development to Commercialization

Dr. Ajay Virkar

Vice President of Advanced Circuits and Packaging

Dupont, USA

Abstract:

In this presentation, we introduce DuPont's Activegrid™—a highly flexible, stretchable, and formable silver nanowire-based transparent conductor (TC) that matches or surpasses the optoelectronic performance of conventional brittle sputtered TCs, such as indium tin oxide (ITO).Activegrid inks can be deposited from solution using a variety of high-speed, low-takt-time manufacturing methods, and they require significantly lower processing temperatures—down to just 25°C -compared to other transparent conductors. Technology has already been commercialized in several of the world's first mass-produced flexible consumer electronic devices, where it primarily serves as the TC in capacitive touch sensors.

Beyond consumer electronics, Activegrid has been prototyped, qualified, and integrated into a wide range of emerging applications, including smart windows, EMI shielding, photovoltaics, next-generation displays, and biomedical devices. A new generation of Activegrid is now being commercialized specifically for automotive applications, with a focus on transparent heating for LiDAR and camera sensors—delivering substantial performance, design, and processing advantages over incumbent technologies. We will also highlight recent developments in highly concentrated silver nanowire inks and dispersions, which exhibit exceptional electrical and rheological properties. These advanced materials open new opportunities for the design and manufacturing of next-generation flexible and printed electronics.

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Biography:

Dr Ajay Virkar is Vice President Advanced Circuits and Packaging at DuPont, focusing on business and technology development initiatives. Prior to this role, he was the Co-founder, CTO, and a Board Member of C3Nano—an advanced materials company acquired by DuPont in August 2024. At C3Nano, Dr Ajay played a pivotal role in securing multiple rounds of strategic and venture funding, commercializing new technologies used in some of the world's first flexible consumer electronic devices. He led the development of intellectual property, technology innovation, and managed key partnerships across the global consumer electronics supply chain.

Dr Ajay is a co-inventor on over 100 issued patents and has co-authored 13 peer-reviewed journal articles. In addition to supporting multiple hardware and materials startups, he advised the U.S. Department of Energy (DOE)'s Perovskite Solar Initiative. Beyond his technical work, Dr Ajay served as an associate producer for Infinite Potential, a documentary about physicist David Bohm. He earned his BS from the University of Illinois and his PhD from Stanford University where his thesis was awarded the Spinger Prize.

IEEE FLEPS Industry Plenary Talk 5

The Latest Technology Breakthroughs for Flexible Printed OLED TV Display Technology

Dr. James Lee

Deputy Chief Engineer

TCL Corporate Research

Abstract:

The flexible printed OLED TV display technology will be able to create new application market, such as rollable/foldable TV, in the future. It's TV Mobiles. The flexible printed OLED TV Mobiles, combined with touch/camera technology, ubiquitous connectivity through 5G/6G technology, and with the integration of Iot/healthcare sensors on the flexible printed OLED TV Mobiles panel, and with the help of AI, Big Data and iCloud, will change our daily life into a smart way of thinking, living, and working. TCL believes that this kind of TV Mobiles will be a "Disruptive Game Changer" in the display industry in near the future.

Since the TCL (TCL CSOT, Guangdong Juhua Printed Display Technology Co. Ltd. & TCL Corporate Research) has successfully demonstrated the 31" FHD flexible printed OLED TV, there are a lot of technology breakthroughs for improving the panel performance and cost reduction. The co-planar top gate Oxide TFT device architecture, printing OLED top emission device architecture with new OLED materials, MURA free ink jet printing technology with unique bank design, advanced encapsulation technology with new inorganic material for panel performance improvement are developed. Especially innovative mechanical release technology without using laser lift off technology is developed for cost reduction and production yield up in flexible printed OLED TV MP line. Based on these technology breakthroughs, 31" 4K flexible printed OLED TV with high resolution(142ppi) are fabricated. The performance of 31" flexible printed OLED TV is, 4K high resolution (3840x2160, 142ppi), luminance: FW 150nits, excellent C/R; > 1M:1, color gamut: DCI-P3: >99%, wide viewing angle ($\triangle u'v' < 0.02$): ≥ +/- 45°, A/R: 47.75%, and curvature radius: 20mm. The panel performance of 31" 4K high resolution flexible printed OLED TV and the latest technology breakthroughs are discussed in detail.

Biography:

Dr. James Lee's over 30 years working experience comes from global leading display companies after receiving Ph.D. degree at Tohoku university in Japan, such as Apple in USA (Principal Technologist), LG Display (Research Fellow), Samsung Electronics (Principal Engineer) and CDT in UK (Director) holding fundamental IPs of Polymer OLED material/device architecture/process and is an expert in OLED display manufacturing technology & product development for TV & mobile application. Currently Dr. Lee, Deputy Chief Engineer at TCL Corporate Research since June 2015, is responsible for developing the printing OLED/QLED (Quantum Dots) display technology and innovative flexible display technology development.

IEEE FLEPS Industry Plenary Talk 6

Advancing Manufacturing in Flexible Hybrid Electronics through Innovation & Design

Dr. Sudheer Kumar

Chief Operating Officer

National Centre for Flexible Electronics,

Indian Institute of Technology Kanpur

Abstract:

Flexible Hybrid Electronics represents the forefront of technology, combining the flexibility of printed electronics with the performance of traditional semiconductor components to create lightweight, bendable, and adaptable electronic systems with enhanced functionality. As the flexible hybrid electronics market needs shift to additive printing, reduced paste metal content, and lower processing temperatures, it is required to develop direct write technologies to meet these technical targets. Ability to influence the electronic structure and material properties such particle morphology, aspect ratio, conductivity, adhesion and residual organic content is critical for robust functioning of the end-product. The talk will delve into the developments and advancements in flexible hybrid electronics, with a specific focus on emerging applications in advanced packaging and healthcare applications.

Biography:

Dr. Sudheer Kumar is presently working as COO, National Centre for Flexible Electronics, IIT Kanpur. He has over 24 years of experience in working academics and industries mainly in Solar Energy, Displays, Semiconductor and Electronics Industries spanning across globally. He has earlier served many key top positions in various industrial organizations and some of them are - Flisom AG, Switzerland, Tata Industries Ltd, Moserbaer Solar Ltd. and SAMTEL Color Ltd. His main contributions belong to the areas of project conceptualization, Operations, Supply Chain Management, Business development / management, Evaluation of many companies, Technology Transfers, value engineering and startup projects with chronicle success of driving benchmarks, setting-up growth and expansion for reputed organizations. His main areas of interests / specialization are – Organic Semiconductor, Flexible Electronics, Flexible Solar, Smart Packaging, Displays, Large Fab Engineering and Operations.

IEEE FLEPS Industry Plenary Talk 7

The Challenge of Current Stretchable PCB & the Fabrication Approach

Mr. Shimizu Ryota

Chief of R&D Department

Satosen Corporation, Japan

Abstract:

For this talk, Mr. Shimizu will discuss the stretchable Printed Circuit Board (PCB) that incorporates the use of liquid metal to enhance flexibility, a fabrication approach with potential for high-volume production, and social implementation.
At Satosen, Mr. Shimizu and his team fabricated PCBs with liquid metal channels in an elastomer, achieving high durability and reliable electrical conductivity. The study showcases the fabrication process, electrical performance under strain, and mechanical robustness. The results show the potential of the above-mentioned approach for use in wearable electronics and flexible sensors. Key findings include long-term performance. This work represents a step forward in the advancement of highly deformable electronic devices.

Biography:

Born in Kobe, Japan, in 1985, Mr Shimizu Ryota embarked on a career path that seamlessly blends international business acumen with cutting-edge technological innovation. His journey began at Satosen, where he excelled as an international sales representative, building valuable relationships and navigating the complexities of global commerce. This experience provided him with a strong foundation in understanding diverse customer needs and market dynamics.

Driven by a passion for innovation, Mr Shimizu transitioned to Satosen's Research and Development department. Here, he focused on the development of next-generation printed circuit boards (PCBs), with a particular emphasis on stretchable PCBs. This groundbreaking technology holds immense potential for various applications, from wearable electronics to flexible sensors.

Mr Shimizu's work in R&D involved close collaboration with a diverse range of customers, guiding projects from initial conception to mass production. This experience honed his ability to translate technical concepts into practical solutions, bridging the gap between research and real-world applications. He also dedicated himself to researching stretchable PCBs that utilize liquid metal, a field that is at the very forefront of electronic flexibility.

Mr Shimizu's career is defined by a commitment to pushing the boundaries of technology and fostering collaboration. His dedication to developing and implementing innovative solutions, particularly in the realm of stretchable PCBs, positions him as a key contributor to the advancement of flexible electronics.

SHINE Open Seminar Talk 1

RF-Millimeter Wave GaN-on-Si for Future 5G/6G Communications

Prof. Ng Geok Ing

Centre Director of the National GaN Technology Centre (NGTC)

Nanyang Technological University

Abstract:

Due to the growth of ubiquitous wireless connectivity in the 5G/6G era increases, there is a strong desire for high performance and cost-effective technology which could complement existing CMOS-based RF front end modules. This demand has spurred strong interests in both academic R&D and major semiconductor companies in RF GaN-on-Si technology in recent years. As a result, excellent progress in GaN-on-Si devices has been made with performance closing to the more matured GaN-on-SiC counterparts.

In this talk, the recent reported RF GaN-on-Si HEMTs results from academic research in RF GaN-on-Si HEMTs embarked by various institutions, including Nanyang Technological University (NTU) and industry will be presented. Topics include low-voltage (<5V) power and noise performance at RF-millimeter wave frequencies, and D-band power amplification at 123 GHz etc. These results demonstrate the high potential of RG GaN-on-Si technology for future low-cost and high-performance 5G/6G communication applications.

Thanks to the solid foundation laid by R&D, RF GaN-on-Si technology stands at the dawn of commercialization. This talk will also highlight how research institutes play an indispensable role in the lab to fab of RF GaN-on-Si, citing the case study of National GaN Technology Centre (NGTC), Singapore, which was launched in 2023 with an initial USD 85M investment. In addition to state-of-the-art industry-oriented R&D, this Centre will offer rapid prototyping service of high performance 8” GaN-on-Si CMOS-compatible process and 6” GaN-on-SiC process (qualified MMIC processes with PDKs). This talk will conclude with key opportunities and challenges in bringing RF GaN-on-Si technology from lab to fab.

Biography:

Prof. Ng Geok Ing is a professor at the School of Electrical and Electronic Engineering, Nanyang Technological University (NTU), Singapore, and currently serves as the Centre Director of the National GaN Technology Centre (NGTC). He received his Ph.D. in Electrical Engineering from the University of Michigan, Ann Arbor. His research focuses on Gallium Nitride (GaN) High-Electron-Mobility Transistors (HEMTs) for Monolithic Microwave Integrated Circuit (MMIC) applications. Prof. Ng has published over 350 journal and conference papers, delivered numerous invited talks, and holds two granted and five filed patents. He serves on the IEEE Electron Device Society Board of Governors, is an Editor of the IEEE Journal of the Electron Devices Society (JEDS), and a member of the Editorial Board for *Electronics*. He is a two-time recipient of Singapore’s Defense Technology Prize, recognizing his contributions to MMIC R&D and GaN technology for defense applications.

SHINE Open Seminar Talk 2

Next-generation Photonics Heterogeneous Integration towards Multi-Material System

Dr. Luo Xianshu

Vice President, Advanced Photonics

National Semiconductor Translation and Innovation Centre (NSTIC)

Abstract:

As an enabling technology, silicon photonics has been explored for various application. For instance, silicon photonics based optical transceiver which features the advantages of high-speed and low-cost have been introduced in the market over the past decade with the aggregated data rate increase from 10 Gbps till nowadays 800 Gbps. Giving the data center IP traffic being doubling every two and half years, the transceiver data rate follows the similar trend. As of today, silicon photonics transceiver with 400 Gbps data rate has already been deployed while transceiver with 800 Gbps data rate already started the sampling. However, giving the intrinsic material limitation, the conventional silicon photonic technology may see the technical bottleneck, such as the limitation of silicon photonic modulator with the trade-off among optical loss, modulation efficiency, modulation speed, etc. Thus, in order to further push the technology forward, we envision for the next generation photonic technology, multiple materials integrated system is required with enhanced device performance and optical functionalities. In this talk, we will discuss how we may pursue next-generation photonics technology through photonics heterogenous integration by integrating various photonic materials into silicon platform, such as III/V, Lithium Niobate, etc. We will review the state-of-the-art demonstration and also discuss our development along this direction.

Biography:

Dr. Xianshu Luo received his Ph. D. degree in Electrical and Computer Engineering from The Hong Kong University of Science and Technology (HKUST), Hong Kong, in 2010. He joined Institute of Microelectronics (IME), A*STAR, Singapore, as a Research Scientist in 2010, where he engaged in research on silicon photonic integrated circuits (Si-PIC), heterogeneous integration of optoelectronic integrated circuits (H-OEIC). In 2017, he joined Advanced Micro Foundry Pte. Ltd., as a Co-Founder and Research Manager, and later Research Director, working on the device performance advancement, and silicon photonics for advanced applications. He returned IME, A*STAR as Principal Scientist in 2023, and jointly appointed as VP, Advanced Photonics at National Semiconductor Translation and Innovation Centre (NSTIC) in 2024. He is leading the development of next-generation advanced photonics via photonic heterogenous integration (PHI) in IME an NSTIC.

Dr. Luo is the Fellow of Optica Society, Fellow of A*STAR, Senior Member of IEEE/IEEE Photonic Society, and Member of Project Management Institute. He is now serving as the Associate Editor for Optica Photonics Research. He served as the Associate Editor of IEEE Photonics Technology Letters and the Guest Editor for IEEE Journal of Selected Topics in Quantum Electronics focus issue in “Hybrid Integration for Silicon Photonics”. He has been serving as the steering committee member of IEEE Silicon Photonics Conference since 2019. He has also been serving as the Technical Committee Chair / Co-Chair / Member for various international conferences.

Interconnect Technologies for Multi-Chiplet Heterogeneous Integration

Mr. Vempati Srinivasa Rao

Director and Head of Heterogeneous Integration Department

*A*Star IME*

Abstract:

Generative AI and HPC demands higher compute power which is driving integration of chiplets at package level to realize the advanced compute systems with Trillion transistors. System-in-package scaling enables the long-term roadmap for continued power, performance, form-factor and cost optimization of HPC-systems. A system-in-package (SiP) typically integrates multiple heterogeneous chiplets namely, xPU, Memory, and I/O chiplets, and, hundreds to thousands of such SiPs are interconnected in servers and racks across a hyper-scale data centre to reach exaflops to zettaflops of compute performance targets to meet the growing needs of generative AI over the coming decade. Advanced packaging platform technologies are critical to realise these complex multi-chiplet heterogeneous integrated system-in-packages which forms the basic building block for HPC systems of today and future. The success of chiplets integration in advanced packages depends heavily on the density and speed/bandwidth of their interconnections to connect each other in compact energy-efficient manner within the SiP. In this presentation, we will discuss the key advanced packaging technologies and interconnect scaling developments at IME to enable the industry to perform pathfinding, design, fabrication, assembly and prototyping of multi-chiplet heterogeneous integrated SiP for AI and HPC. We will also present how IME drives collaborative R&D across the entire semiconductor ecosystem to accelerate the development and translation of advanced packaging technologies.

Biography:

Mr. Vempati Srinivasa Rao is Director and Head of Heterogeneous Integration Department at Institute of Microelectronics (IME), Singapore. He has over 20 years of R&D experience in microelectronics packaging, assembly, reliability, and failure analysis. He leads development of advanced wafer level packaging platform technologies and process/integration capabilities such as fine pitch multi-layer RDL, TSV interposer, W2W and C2W Hybrid Bonding required for heterogeneous chiplet integration. He has authored or co-authored more than 80 journal and conference publications in electronic packaging area. His research interest includes chiplet integration using Fan-out wafer level packaging, 2.5D packaging, 3D chip stacking. He received a Masters Degree in Mechanical Engineering with Material Science Specialization from the National University of Singapore, and Bachelor Degree in Metallurgical Engineering from the National Institute of Technology, Warangal, India.

Technical Workshop

SHINE Chiplet Ecosystem Across the Entire System Lifecycle and Silicon Case Studies

Prof. Massimo Alioto

Thrust 1 Co-investigator

National University of Singapore

Abstract:

In the broad area of heterogeneous integration, creating an ecosystem that fosters economy of scale and innovation requires a robust level of simultaneous cooperation and simultaneous competition ("co-competition"). Such synergy mandates the availability of shared core technologies and methodologies spanning from chiplet design to heterogeneous system design and system testing, while allowing semiconductor players to compete at each level of the lifecycle (and value chain). Among the innovation pillars in the SHINE program, such common design-to-testing framework has been built from the ground up to lower the barrier to entry for new players in the space both at the chiplet and the system integration level of the value chain.

In this talk, an overview of the circuit and architectural innovations enabled by the SHINE program will be illustrated along with the fundamental principles that enable the creation of a (SHINE) technology ecosystem. Novel ultra-low power chiplet architectures based on the SHINE Open Standard 1.0 (SHINEOS1.0) are exemplified through several silicon demonstrations with unprecedented (low) levels of power and minimally-complex integration/testing.

Biography:

Prof Massimo Alioto is Provost's Chair Professor at the ECE Department of the National University of Singapore, where he leads the Green IC group, the Integrated Circuits and Embedded Systems area, and the FD-fAbrICS center on intelligent and connected systems. He previously held positions at the University of Siena, Intel Labs (CRL, 2013), University of Michigan–Ann Arbor (2011–2012), University of California–Berkeley (2009–2011), and EPFL–Lausanne.

He has (co-)authored 400 publications and four books with Springer (two more forthcoming). His main research interests are ultra-low power and self-powered systems, green computing, circuits for machine intelligence, hardware security, and emerging technologies.

Prof. Alioto was Editor-in-Chief of IEEE Transactions on VLSI Systems, Deputy Editor-in-Chief of IEEE Journal on Emerging and Selected Topics in Circuits and Systems, Chair of the Distinguished Lecturer Program, and Distinguished Lecturer for the SSC and CAS Societies. He chaired the "VLSI Systems and Applications" Technical Committee (2010–2012), and has served as Guest Editor for major journals, Technical Program Chair for IEEE conferences, and TPC member for ISSCC and ASSCC. His group's work has received various best paper awards (e.g., ISSCC) and was highlighted in the TSMC annual report. Prof. Alioto is an IEEE Fellow.

SHINE Technical Workshop

Conformal Bioelectronics for Human Machine Interface

Prof. Chen Xiaodong

Thrust-2, Co-Investigator

Nanyang Technological University

Abstract:

The emerging human machine interface is creating new opportunities for developing advanced sensing technologies with unparalleled sensitivity and specificity. This talk will explore key questions in the materials chemistry underlying bio-integrated electronics, focusing on achieving a deeper and clearer understanding of their fundamental principles. Emphasis will be placed on conformal bioelectronic interfaces, which allow seamless integration of electronics into biological systems, enabling sense digitalization while maintaining functionality under deformation. Additionally, I will discuss the recent development of a biphasic, nano-dispersed (BIND) interface that reliably connects soft, rigid, and encapsulation modules without requiring adhesive pastes. This innovative interface has been applied to create stretchable devices for in vivo neuromodulation and on-skin electromyography, significantly enhancing signal quality and electrode performance. The modular integration facilitated by the BIND interface simplifies and accelerates the development of both on-skin and implantable stretchable devices. Finally, the talk will address ongoing challenges that must be overcome to fully harness the transformative potential of conformal bioelectronics in human–machine interfaces.

Biography:

Professor Xiaodong Chen is a Distinguished University Professor at Nanyang Technological University (NTU), Singapore, where he holds a professorship in Materials Science and Engineering and courtesy appointments in both Chemistry and Medicine. His research interests span mechanomaterials science and engineering, data-driven materials chemistry discovery, flexible electronics technology, sense digitalization, and carbon-negative technology. Prof. Chen's outstanding scientific contributions have been recognized with numerous awards, including the Singapore President's Science Award, Singapore National Research Foundation (NRF) Investigatorship and NRF Fellowship, the Friedrich Wilhelm Bessel Research Award, Dan Maydan Prize in Nanoscience and Nanotechnology, Winner of Falling Walls, and Kabiller Young Investigator. He is an elected member of the Singapore National Academy of Science, the Academy of Engineering Singapore, the German National Academy of Sciences Leopoldina, and the Royal Society (UK), and an elected fellow of the Royal Society of Chemistry, the Chinese Chemical Society, and American Institute for Medical and Biological Engineering (AIMBE). Prof. Chen also serves on the editorial advisory boards of numerous esteemed international journals, including *Advanced Materials*, *Matter*, *Chemical Reviews*, *CCS Chemistry*, *Small,* and *Nanoscale Horizons*. Currently, he is the Editor-in-Chief of *ACS Nano*, a flagship journal in nanoscience and nanotechnology.

SHINE Technical Workshop

Development of Thermal Energy Conversion & Photo Responsive Composite for Soft Electronics

Dr Hyunwoo Bark

Thrust-2, Senior Research Fellow

Nanyang Technological University

Abstract:

Here, we introduce 3D printable inks for thermal management and energy harvesting. We will first discuss photo-curable composite ink. Based on 2D MXene/paraffin wax-SiO2 (core-shell) particle/photo-curable PDMS, a flexible substrate for antenna application was fabricated via a digital light processing (DLP) 3D printing process.

Owing to the 2D MXene and core-shell particle fillers in the PDMS matrix, effective heat dissipation was practical. Simultaneously, good dielectric properties were obtained (dielectric constant: ~3.4, tangent loss: ~0.004). An antenna device with printed composite was fabricated, and the temperature-dependent RF performance was characterized. In addition, to demonstrate the flexibility of the composite, the RF performance was also characterized under mechanical stress.

Secondly, polymer ion gel/thermogalvanic redox couples composite inks were prepared for thermal energy conversion. Due to the thermogalvanic redox reaction, a high potential can be obtained. Notably, deformable and flexible energy harvesting devices can be fabricated.

Biography:

Dr Hyunwoo Bark received his Ph.D. from the School of Advanced Materials Engineering at the Kookmin University (Seoul, Republic of Korea) in 2018.

Since joining Prof. Pooi See Lee's group in 2019, he is a senior research fellow at the School of Materials Science and Engineering, Nanyang Technological University. (Singapore) His research focuses on organic/inorganic composites for thermal management, thermal energy conversion, soft, and 3D printable electronics.

SHINE Technical Workshop

3D-IC Partioning Algorithm Comparison

Prof. Alberto Sangiovanni – Vincentelli

Thrust-1, Research Collaborator

University of California, Berkeley, USA

Abstract:

Prof Alberto will present compare several algorithmic approaches—both traditional and machine learning-based-to optimize the partitioning of computational graphs across multiple chiplets. The objective was to minimize inter-chiplet communication and power usage while adhering to constraints such as latency, area, and bandwidth. Multiple strategies including simulated annealing, quadratic programming, and reinforcement learning. were implemented and evaluated. These approaches were tested with real-world netlists (flattened chip topology) to assess scalability, performance, and robustness. Notably, reinforcement learning showed promise in quickly providing partitioning results that matched simulated annealing.

Biography:

Prof Alberto Sangiovanni Vincentelli (Fellow) is the Edgar L. and Harold H. Buttner Chair of EECS at UCB. He is an author or coauthor of over 1000 papers, 17 books and 3 patents in design tools and methodologies, large scale systems, embedded systems, hybrid systems and AI. He was a co-founder of Cadence and Synopsys, the two leading companies in Electronic Design Automation. He is an IEEE and ACM Fellow and a member of the National Academy of Engineering. He was a consultant or member of the Advisory Boards of several companies such as BMW, Mercedes, Magneti Marelli, Intel, ST microelectronics, HP, General Motors, United Technologies, Lutron, Lendlease and Elettronica. Currently, he is a member of the following boards of directors: Cadence, KPIT Technologies, eGap, Exein, Cy4Gate. He is Chairman of the Board of Quantum Motion, Innatera, Phoelex, e4Life and Phononic Vibes. He was member of the Scientific Council of the Italian National Science Foundation (CNR) from 2001 to 2015. From February 2010 to December 2020, he had been a member of the Executive Committee of the Italian Institute of Technology, where he is now a member of the Technical Scientific Committee. In September 2023, he has been appointed President of the Chips.it, the 250MEuro Foundation of the Italian Government to foster integrated circuit design. He is the Chairperson of the Strategy Board and of the International advisory Board of the Milano Innovation District (MIND) He is the recipient of several academic honors, research awards including the IEEE/RSE Wolfson James Clerk Maxwell Medal *"for groundbreaking contributions that have had an exceptional impact on the development of electronics and electrical engineering or related fields"* and the BBVA Frontiers of Knowledge Award in the Information and Communication Technologies category: *"for transforming chip design from a handcrafted process to the automated industry that power today's electronic devices"*. Alberto obtained an electrical engineering and computer science degree ("Dottore in Ingegneria") summa cum laude from the Politecnico di Milano, Italy in 1971 and holds four Honorary Doctorates from University of Aalborg, KTH, AGH and University of Rome, Tor Vergata.

SHINE Technical Workshop

Advancing the Next-Generation
of Electronic Failure Analysis

Dr. Lucas Lum Yu Xiang
Thrust-4, Research Fellow
National University of Singapore

Abstract:

As semiconductor devices scale in complexity with the rise of 3D-IC architectures, traditional failure analysis (FA) techniques face growing limitations in resolution, depth, and efficiency. This presentation introduces a two-tiered FA approach that combines Electromagnetic Frequency Domain Analysis (EM-FDA) with Magnetic Field Imaging (MFI). EM-FDA generates a spatial heatmap by analysing return loss across power pins, guiding targeted fault localization and significantly reducing scan time. The second stage employs a non-iterative MFI algorithm using Ramanujan sums and Mahalanobis distance for rapid 3D defect localization, achieving up to 57% improvement in Z-resolution and 33% faster computation. Together, these techniques can offer a scalable, non-destructive solution for diagnosing power plane defects in 3D-IC devices, and mark a step forward in predictive, ML-integrated FA workflows.

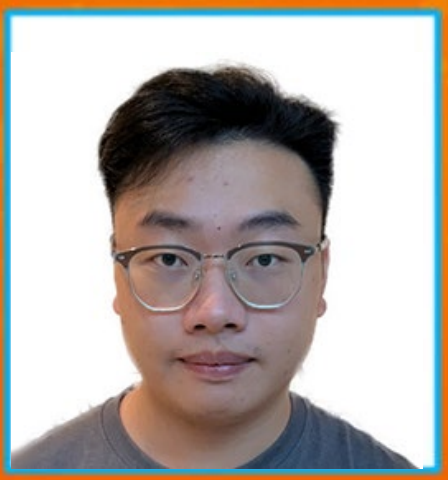
Biography:

Dr Lucas Lum is currently engaged in advanced research in electronic failure analysis, specializing in electromagnetic characterization and novel defect detection methods for semiconductor packaging technologies. With a strong background in electromagnetic isolation and interference mitigation, he has contributed significantly to the field through various publications.

His recent work focuses on innovative approaches for fault localization in advanced 3D-IC and heterogeneous integration, incorporating electromagnetic frequency domain analysis, magnetic-field imaging (MFI), and machine learning techniques for precise defect classification and reliability diagnostics.

Dr Lucas remains dedicated to translating theoretical insights into practical solutions, enhancing reliability and performance in next-generation electronic systems.

SHINE Technical Workshop



Non-Hermitian Thermophotonic Funneling

Mr Yang Shui Hua

Thrust 4, PhD Student

National University of Singapore

Abstract:

Thermal management in nanoscale devices has long posed significant challenges due to the limited thermal conductivity of natural materials and the inherent slowness of heat conduction. In this context, near-field thermal radiation offers a promising alternative. Unlike propagating waves in the far-field, evanescent waves provide additional channels for photon-based heat flow, enabling super-Planckian radiative heat flux. Here, we introduce nonreciprocal surface waves into deep-subwavelength dimerized lattices to demonstrate an efficient thermophotonic funnel. The system comprises an array of silicon carbide (SiC) nanoparticles coupled with a graphene substrate. Driven by the drift-biased graphene and long-range inter-particle interactions, radiative energy is strongly localized at one end of the lattice, achieving up to a 278-fold enhancement in radiative intensity. The topological fingerprints of this funneling effect are characterized by point-gap topology and complex-eigen-spectrum braiding. Our findings bridges nonreciprocal thermophotonics with non-Hermitian physics, offering new insights for nanoscale energy and information manipulation.

Biography:

Mr Yang Shui Hua is a Ph.D. student at National University of Singapore, supervised by Prof. Qiu Chengwei from the Department of Electrical and Computer Engineering. He received his M.E. and B.E. degree in Engineering Thermophysics from Harbin Institute of Technology. His research focuses on non-Hermitian systems and singular transport in thermodynamics. He has published seven peer-reviewed journal papers such as Nat. Photon., Nature Communications, PNAS, Rep. Prog. Phys., Physical Review B, et al.

Integration Towards Active Phased Array

Dr. Jiang Yi Zhou
Thrust-3, Research Fellow
National University of Singapore

Abstract:

To address beam distortion caused by deformation in phased array antennas, it is crucial to understand the relative displacements between antenna elements. Existing technologies rely on bulky transceivers or additional RF circuits, which are impractical in flexible antenna systems. As a consequence, proper integration with bending sensors is essential. However, resistive strain sensors are facing the issue of high temperature coefficient, limiting their application scenarios. On this workshop we will share our approach of successfully integrating the first capacitive bending sensor into a flexible antenna system to compensate for the distortion.

Biography:

Dr. Yizhou Jiang is a Research fellow in Singapore Hybrid-Integrated Next-Generation μ-Electronics Centre. He received his Ph.D. in 2023 from the School of Information Science and Technology, Fudan University, China. His research interests include co-design, hybrid integration, and optimization of solid-state circuits with flexible electronics and emerging devices. He joined National University of Singapore in 2023.

Miniature Transceiver for Multi-band Data Communication

Mr. Soh Chee Hong

Principal Engineer (RF Team)

DSO National Laboratories

Abstract:

Heterogeneous Integration (HI) is a fascinating and rapidly evolving field in electronics packaging. By integrating diverse semiconductor technologies on a through-silicon via (TSV) interposer, HI enables significant miniaturization and enhanced performance. This presentation will share the transceiver architecture, circuit analysis, packaging concept and the performance of RF-HI-chips for a multi-band transceiver.

Biography:

Mr Soh Chee Heong is a PMTS from the RF program in DSO National Laboratories. He received his B.Eng. degree from the Nanyang Technological University, and MSc (EE) from the National University of Singapore.

He specialises in the research and development of compact RF transceiver design, RF system-in-package integration and advanced assembly processes. He collaborates with multidisciplinary teams to drive the development of innovative System-in-Package solutions, ensuring enhanced performance, thermal management and cost efficiency.

Flexible & Conformable Phased Arrays: Techniques & Technologies

Prof. Koen Mouthaan
Thrust-3 Co-investigator
National University of Singapore

Abstract:

The research and development of innovative, flexible and conformable antennas for application in phased arrays for communication and remote sensing systems is one of the key objectives of the SHINE program. In this presentation, several flexible and conformable phased arrays at L-band and X-band are discussed. Typical challenges and possible solution techniques are presented. Integration of active components, such as power amplifiers, will be presented as well.

Biography:

Prof Koen Mouthaan received the M.Sc. and Ph.D. degrees in Electrical Engineering from Delft University of Technology in the Netherlands. He worked at TNO Defense, Safety and Security in the Netherlands, and at SkyGate, a company that designed phased-array antennas for consumer applications.

Between 2003 and 2015 he was Assistant Professor and Tenured Associate Professor in the Department of Electrical and Computer Engineering at the National University of Singapore. He rejoined the same department in 2016. His research interests include microwave and millimeter-wave circuits and systems, phased array antennas, digital beamforming, and design and innovation. He also holds an MBA from Nanyang Technological University, a Master of Science in Organizational Leadership from Johns Hopkins University, and a Master in Space Engineering from the Technical University of Berlin.

Notes

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