MEDIA RELEASE
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Trailblazing scientific talent receive Singapore’s highest research and innovation accolades

Singapore – Two teams and an individual have been awarded this year’s President’s Science and Technology Awards¹ (PSTA), the highest honours bestowed upon research scientists and engineers in Singapore whose work have resulted in significant scientific, technological or economic benefits for the country.

The PSTA 2019 consists of the following awards:
- President’s Science Award (PSA) - Two recipients
- President’s Technology Award (PTA) - One recipient

The winners received their awards from President Halimah Yacob during a ceremony at the Istana on 17 October 2019.

They were picked by a distinguished panel of representatives from industry, academia and research.

This year, there were two PSA recipients: Professor Toh Kim Chuan, Department of Mathematics and Institute of Operations Research and Analytics, National University of Singapore (NUS); and a team from the Singapore Eye Research Institute (SERI) consisting of Associate Professor Audrey Chia, Professor Saw Seang Mei, Professor Roger Beuerman, and Adjunct Professor Donald Tan.

The PTA was awarded to a team consisting of Dr Poh Hee Joo, A*STAR’s Institute of High Performance Computing (IHPC), Dr Koh Wee Shing, IHPC, Mr Fachmin Folianto,

¹ The PSTA represents the highest honours conferred upon outstanding research scientists and engineers in Singapore for their excellent achievements in science and technology. Originally established in 1987 as the National Science and Technology Awards, the awards were elevated to the Presidential level in 2009.
A*STAR’s Institute for Infocomm Research (I²R), and Mr Tan Sze Tiong, Housing & Development Board (HDB).

President’s Science Award (PSA) recipients

Pioneering the field of computational optimisation
Professor Toh Kim Chuan has done ground-breaking work in the field of computational optimisation, and is a world-leading figure in algorithms for semi-definite programming (SDP). He has been internationally recognised for his fundamental contributions to the theory, practice and application of this key area of research.

His work has enabled important advances in applications ranging from sensor network localisation to 3D chromosome organisation, as well as in machine-learning and data science. His algorithms could also be applied to the prediction of consumer behaviours of interest to businesses. Critical optimisation problems that were previously regarded as too difficult to solve in practice are now routinely dealt with by SDP solvers that Prof Toh made major contributions to.

Leading clinical research and combating myopia in Singapore and beyond
The team from SERI – comprising Assoc Prof Audrey Chia, Prof Saw Seang Mei, Prof Roger Beuerman, and Adjunct Prof Donald Tan – is recognised for their pioneering work in the field of myopia research that has contributed to a decrease in the prevalence and severity of myopia in children over the last three decades.

The team carried out translational research and clinical trials that established the role of low-dose atropine in controlling myopia in young children; as well as epidemiological studies that have led to practical recommendations for better eye health. Both strategies have contributed to decreasing the severity of myopia in children.

The SERI team was the first to identify low-dose atropine eyedrops as a viable treatment option that is both safe and effective for long-term use in children. This work has triggered many other interventional trials globally. This led SERI to develop its own eye drops to reduce the development and progression of myopia and this is now available in many countries. The team also developed the FitSight watch that encourages children to spend more time outdoors, as studies have shown that this is effective in reducing the occurrence of myopia. The team’s work has impacted education, clinical care, optometry guidelines, clinical interventions and preventive measures, leading them to be recognised as an international leader in myopia research.
President’s Technology Award (PTA) recipient

Taking urban planning to the next level with a state-of-the-art modelling tool
An Integrated Environmental Modeller (IEM), developed by a team consisting of Dr Poh Hee Joo (IHPC, A*STAR), Dr Koh Wee Shing (IHPC, A*STAR), Mr Fachmin Folianto (IPR, A*STAR), and Mr Tan Sze Tiong (HDB) looks set to play an important role in urban planning for greater environmental sustainability.

The IEM is an advanced modelling tool which uses high-resolution 3D city models to simulate the interaction of environmental factors such as solar irradiance, wind flow, air temperatures and noise levels, as well as their combined effects on an urban setting. Other modellers currently available in the market typically only assess one to two environmental factors.

With the IEM, urban planners can visualise environmental factors “virtually” to optimise the design of urban spaces. This platform is based on the latest high performance computing technologies from A*STAR’s IHPC, in collaboration with HDB.

The IEM was adopted in the urban design plan for Tengah town. HDB’s planners, architects and engineers will be able to use the IEM as one of the smart planning tools to analyse key wind channels and the solar heat gained by different urban features, such as concrete, vegetation, or water bodies. This will help them to design open spaces, as well as optimise the building layouts and orientation to enhance the intensity of wind flow and promote natural ventilation within the town.

Young Scientist Awards (YSA)

Organised by the Singapore National Academy of Science and supported by A*STAR, the Young Scientist Awards (YSA) recognise the accomplishments of researchers under 35, and who have shown the potential to scale greater heights. The awards highlight the importance of investments in the country’s scientific talent pool.

This year, two outstanding young individuals were recognised with the YSA.

They are:

- **Dr Lim Ci Wen, Charles**, NUS; for his research in quantum cryptography that contributes to Singapore’s world-class strengths in quantum cybersecurity;
- **Dr Shao Huilin**, NUS; for her work in developing innovative diagnostic technologies to empower patient care.
They received their awards from Mr Chan Chun Sing, Minister for Trade and Industry, at the same event.

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Enclosed:

ANNEX A – List of PSTA winners
ANNEX B – Citations of PSTA winners
ANNEX C – List of YSA winners and information sheet on YSA
ANNEX D – Citations of YSA winners
ANNEX E – Fact sheet on PSTA selection committees

About the Agency for Science, Technology and Research (A*STAR)

The Agency for Science, Technology and Research (A*STAR) is Singapore's lead public sector agency that spearheads economic oriented research to advance scientific discovery and develop innovative technology. Through open innovation, we collaborate with our partners in both the public and private sectors to benefit society.

As a Science and Technology Organisation, A*STAR bridges the gap between academia and industry. Our research creates economic growth and jobs for Singapore, and enhances lives by contributing to societal benefits such as improving outcomes in healthcare, urban living, and sustainability.

We play a key role in nurturing and developing a diversity of talent and leaders in our Agency and Research Institutes, the wider research community and industry. A*STAR’s R&D activities span biomedical sciences and physical sciences and engineering, with research entities primarily located in Biopolis and Fusionopolis.

A*STAR is the secretariat for the annual President's Science and Technology Awards.

For more information on A*STAR, please visit www.a-star.edu.sg.
ANNEX A

LIST OF PSTA WINNERS

I. President’s Science Award (PSA)

(i) Professor Toh Kim Chuan
Department of Mathematics and Institute of Operations Research and Analytics, National University of Singapore

(ii) Team consisting of:
Associate Professor Audrey Chia
Co-Head, Myopia Research, Singapore Eye Research Institute
Co-Director, Myopia Centre @ Bedok, Singapore National Eye Centre
Vice-Chair, Ophthalmology & Visual Sciences Academic Clinical Programme (ACP), Duke-NUS Medical School
Head, Paediatric and Strabismus Service, Singapore National Eye Centre & KK Women’s and Children’s Hospital

Professor Saw Seang Mei
Co-Head, Myopia Research, Singapore Eye Research Institute
Professor, Saw Swee Hock School of Public Health, National University of Singapore
Joint Professor, Duke-NUS Medical School

Professor Roger Beuerman
Senior Scientific Advisor, Singapore Eye Research Institute
Professor, SRP in Neuroscience and Behavioural Disorders,
Professor, Ophthalmology & Visual Sciences ACP,
Duke-NUS Medical School

Adjunct Professor Donald Tan
Adjunct Professor, Ophthalmology & Visual Sciences ACP, Duke-NUS Medical School
Senior Scientific Advisor, Singapore Eye Research Institute
Visiting Senior Consultant, Singapore National Eye Centre Senior Partner, Eye & Retina Surgeons, Camden Medical Centre
II. President’s Technology Award (PTA)

Team consisting of:
Dr Poh Hee Joo
Senior Scientist
Institute of High Performance Computing, A*STAR

Dr Koh Wee Shing
Senior Scientist
Institute of High Performance Computing, A*STAR

Mr Fachmin Folianto
Senior Research Engineer
Institute for Infocomm Research, A*STAR

Mr Tan Sze Tiong
Director
Centre of Excellence for Environmental Sustainability Research
Housing & Development Board
ANNEX B

CITATIONS OF PSTA WINNERS

PRESIDENT'S SCIENCE AWARD 2019

Professor Toh Kim Chuan
Department of Mathematics and Institute of Operations Research and Analytics, National University of Singapore

“For his fundamental contributions to the theory, algorithms, and applications of convex optimisation, especially the development of algorithms and software for semi-definite and conic programming”

Professor Toh Kim Chuan is internationally recognised for his work on computational optimisation, and is a world-leading figure in algorithms for conic and semi-definite programming (SDP). Prof Toh is currently the Leo Tan Professor in Science at the National University of Singapore (NUS). He obtained his Bachelor of Science (Honours) and Master of Science degrees in Mathematics from NUS, and his PhD in Applied Mathematics from Cornell University.

Since the nineties, SDP has been a major development in optimisation, with experts likening it to the revolutionary development of linear programming in the 1950s. Prof Toh has made major contributions to SDP that now routinely solves critical optimisation problems that were previously regarded as too difficult to be dealt with in practice.

He has contributed significantly to the advancement and development of practical algorithms for solving SDP problems, which in turn has contributed to the explosive growth in the adaptation and application of SDP models in various scientific and engineering domains.

The SDPT3 software he co-developed is currently one of the most versatile and efficient solvers available for solving general medium-scale SDP problems. The software is now used as the computational engine in high-level optimisation modelling languages such as CVX and YALMIP, which are widely used interfaces for feeding SDP application problems to SDP solvers.

He has also pushed computational boundaries by developing highly efficient specialised algorithms for extremely-large scale structured SDP and conic programming problems.
arising from applications such as sensor network localisation, matrix completion, molecular conformation, 3D chromosome organisation, polynomial optimisation, as well as machine learning and data science. In addition, he has also co-developed the award-winning solver SDPNAL+ for solving large-scale nondegenerate SDP problems. This solver is currently the only available tool for handling large-scale general SDP problems, especially for the extremely challenging class of doubly non-negative SDP problems.

Over his 23-year academic career, Prof Toh has published more than 100 papers in major international journals. His work has been cited more than 9,000 times, and the significance and impact of his research have been recognised locally and internationally.

In the course of his outstanding career, Prof Toh has garnered an impressive list of accolades. He received the Farkas Prize awarded by the INFORMS Optimization Society in 2017 for his fundamental contributions to the theory, practice, and application of convex optimisation, as well as the triennial Beale Orchard-Hays Prize awarded by the Mathematical Optimization Society in 2018 for Excellence in Computational Mathematical Programming. He was elected as a Fellow of the Society for Industrial and Applied Mathematics in 2018 for his contributions on the development of algorithms and software for semi-definite programming and conic programming.

Professor Toh holds editorial appointments in major optimisation journals, including the SIAM Journal of Optimization, Mathematical Programming, Mathematical Programming Computation, and ACM Transactions on Mathematical Software. He has also given talks at major conferences such as the SIAM Annual Meeting, and International Symposium on Mathematical Programming.

For his fundamental contributions to the theory, algorithms and applications of convex optimisation, especially the development of algorithms and software for semi-definite and conic programming, Prof Toh is awarded the 2019 President’s Science Award.
PRESIDENT’S SCIENCE AWARD 2019

Team comprising:

Associate Professor Audrey Chia
Co-Head, Myopia Research, Singapore Eye Research Institute
Co-Director, Myopia Centre @ Bedok, Singapore National Eye Centre
Vice-Chair, Ophthalmology & Visual Sciences Academic Clinical Programme (ACP), Duke-NUS Medical School
Head, Paediatric and Strabismus Service, Singapore National Eye Centre & KK Women’s and Children’s Hospital

Professor Saw Seang Mei
Co-Head, Myopia Research, Singapore Eye Research Institute
Professor, Saw Swee Hock School of Public Health, National University of Singapore
Joint Professor, Duke-NUS Medical School

Professor Roger Beuerman
Senior Scientific Advisor, Singapore Eye Research Institute
Professor, SRP in Neuroscience and Behavioural Disorders,
Professor, Emerging Infectious Diseases,
Professor, Ophthalmology & Visual Sciences ACP,
Duke-NUS Medical School

Adjunct Professor Donald Tan
Adjunct Professor, Ophthalmology & Visual Sciences ACP, Duke-NUS Medical School
Senior Scientific Advisor, Singapore Eye Research Institute
Visiting Senior Consultant, Singapore National Eye Centre
Senior Partner, Eye & Retina Surgeons, Camden Medical Centre

“For their dedicated research spanning over three decades in the field of myopia, which resulted in public health strategies and interventional myopia control therapies to help decrease the rates of myopia/high myopia, and myopia-related blindness in Singapore”

There is rapidly growing interest around the world in myopia and strategies for its prevention. Among young adults in urban East Asian cities, such as Singapore, the prevalence of myopia has risen to more than 80 per cent, and high myopia by more than 15 per cent. Myopia rates are also increasing in the West. By 2050, it is estimated that half the world’s population will be myopic.
The team from the Singapore Eye Research Institute (SERI) has worked through the Ministry of Health’s National Myopia Prevention Programme since 2001 to initiate public health messages that encourage more outdoor activity and better eye habits amongst children in kindergartens and schools. The team is also working on wearables and phone apps to help children and parents better manage outdoor activities and use of mobile devices.

As co-leaders of the Consortium for Refractive Error and Myopia consortium which has pooled together genetic information of more than 50,000 adults, the team has contributed to the identification of new gene clusters associated with myopia. They plan to leverage this research capability to identify genetic markers that will help predict response to intervention and novel therapeutic options.

In terms of interventional clinical studies, the team has conducted a range of trials involving glasses, contact lens, and pharmacological agents. In particular, the Atropine Treatment of Myopia (ATOM) studies, are instrumental in demonstrating the efficacy of atropine eye drops. They are also the first to identify low-dose atropine as a viable treatment option that is both safe and effective for long-term use in children. This work has triggered many other interventional trials globally. The team has now embarked on its third ATOM study to see if myopia onset can be prevented in pre-myopic children who are at risk of developing high myopia.

Moving forward, there are ongoing major, large-scale industry collaborative programmes on myopia therapeutics with global companies, such as Santen and Johnson & Johnson Vision Care. These aim to work on new therapeutic agents, delivery systems, and the management of preventing myopic complications and blindness over the next decade. Together with local and international collaborators, the team hopes to develop better clinical guidelines to manage myopia in childhood, as well as identify and prevent myopic complications and blindness in adulthood.

For their dedicated research spanning over three decades in the field of myopia, which resulted in public health strategies and interventional myopia control therapies which help decrease the rates of myopia/high myopia, and myopia-related blindness in Singapore, Associate Professor Chia and team are awarded the 2019 President’s Science Award.
PRESIDENT’S TECHNOLOGY AWARD 2019

Team comprising:

Dr Poh Hee Joo
Senior Scientist, Institute of High Performance Computing, A*STAR

Dr Koh Wee Shing
Senior Scientist, Institute of High Performance Computing, A*STAR

Mr Fachmin Folianto
Senior Research Engineer, Institute for Infocomm Research, A*STAR

Mr Tan Sze Tiong
Director, Centre of Excellence for Environmental Sustainability Research, Housing & Development Board

“For their development of the Integrated Environmental Modeller, an advanced modelling tool that is capable of integrating combined wind-solar-noise environmental factors, their interrelationship, and their total impact on an urban setting”

Dr Poh and team are recognised for their ground-breaking development of the Integrated Environmental Modeller (IEM). The IEM is an advanced modelling tool that allows users to project the interrelationships and combined impact of solar, wind, temperature, noise and other environmental factors on an urban setting. Other modellers currently available in the market typically only assess each environmental factor in isolation.

The IEM was developed using both in-house and open-sourced multi-physics environmental modelling code that captures the correlation of environmental factors. It is an integrated and scalable tool to couple the physics of all key environmental factors and their complex interactions into a single simulation platform, using the latest high performance computing technology.

With the IEM, users are able to visualise environmental features such as solar irradiance, air flow, air temperature and noise levels on a virtual “Digital Twin” platform which allows for efficient refinement of urban design plans. This allows development plans to be tested
computationally before actual implementation and hence reduces the risks inherent in physical testing of the plans. It also provides quantitative and scientific assessments that enable planners to optimise for one environmental factor over another, supporting better decision-making.

The IEM, which is computationally scalable, has also pushed the technological boundaries in high performance supercomputing. It has created the first-ever 3D air-flow simulation at a 10-metre horizontal resolution that depicts all the buildings in Singapore. The simulation was completed over five days with 6,000 processors at the National Supercomputing Centre (NSCC) Singapore.

The IEM was one of the smart planning tools that was applied in the planning of Tengah Town. Using the IEM, HDB's planners, architects and engineers were able to analyse key wind channels, and the solar heat gain by different urban features such as concrete, vegetation, and water bodies within Tengah. This helped them to design open spaces, as well as optimise the building layouts and orientation to enhance the intensity of wind flow and promote natural ventilation within the town. HDB will continue to leverage such planning tools to complement HDB's town planning efforts and provide residents with a new generation of public housing, located in green, sustainable and smart towns.

For their development of the Integrated Environmental Modeller, an advanced modelling tool that is capable of integrating combined wind-solar-noise environmental factors, their interrelationships, and their total impact on an urban setting, Dr Poh and team are awarded the 2019 President's Technology Award.
ANNEX C

LIST OF YSA WINNERS AND INFORMATION SHEET ON YSA

The Young Scientist Awards (YSA) are organised by the Singapore National Academy of Science and supported by A*STAR. The YSA recognise the accomplishments of researchers under 35, and who have shown the potential to scale greater heights. The awards also highlight the importance of investments in the country’s scientific talent pool.

List of YSA Winners 2019

Physical, information & Engineering Sciences category

(i) Dr Lim Ci Wen, Charles
Assistant Professor
Department of Electrical and Computer Engineering, National University of Singapore
Centre for Quantum Technologies, National University of Singapore

(ii) Dr Shao Huilin
Assistant Professor, Department of Biomedical Engineering, National University of Singapore
Principal Investigator, Institute for Health Innovation & Technology (iHealthtech), National University of Singapore
Joint Investigator, Institute of Molecular and Cell Biology, A*STAR

Young Scientist Awards Selection Committee

The judging committee for the Young Scientist Awards is chaired by Associate Professor Lim Tit Meng, Chief Executive Officer, Singapore Science Centre.
ANNEX D

CITATIONS OF YSA WINNERS

Singapore National Academy of Science Young Scientist Awards 2019

Physical, information & Engineering Sciences category

Dr Lim Ci Wen, Charles
Assistant Professor, Department of Electrical and Computer Engineering and Centre for Quantum Technologies, NUS

“For his research on quantum cryptography that paved the way to practical quantum-safe networks”

Dr Lim’s research focus is in quantum information science, centering on quantum communications and cryptography. He began his career in the development of finite-key security proofs for quantum key distribution\(^2\) (QKD) systems. Together with his colleagues, he successfully developed finite-key security proof techniques for a wide range of QKD protocols. More recently, Dr Lim and his international collaborators have demonstrated the world’s fastest QKD system, generating up to 23 Mbit/s secret key rate, thus enabling ultra-high-speed quantum secure communication for the first time.

Dr Lim joined the department of electrical and computer engineering of NUS in 2017. There, he started to include experimental quantum communications and cryptography research into his research. Since then, he has secured competitive research grants. These include the prestigious National Research Foundation (NRF) Fellowship in 2019, an NRF Quantum Engineering Programme grant in 2019, and an overseas research grant from the Asian Office of Aerospace R&D in 2018. With these resources, he aims to develop the necessary know-how and quantum chip-based technology that will enable a truly scalable and fast quantum-safe network in Singapore, where different nodes are connected by quantum-secured mobile devices.

He has produced more than 30 peer-reviewed articles. His work has been featured in prestigious publications such as Nature Photonics, Nature Communications, and Physical Review X. He is also an active member of the quantum technology industry, where he is currently an editor for an on-going ISO quantum cryptography standardisation effort.

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\(^2\) Quantum key distribution is a secure communication method which utilises a cryptographic protocol involving components of quantum mechanics
providing leadership and technical expertise to the international IT security techniques committee.
Dr Shao’s research focuses on developing transformative technologies to empower non-invasive disease detection and treatment monitoring. In comparison to invasive tissue biopsies, circulating biomarkers\(^3\) can be safely and repeatedly obtained from bodily fluids (e.g. blood). Despite the clinical potential of many novel circulating biomarkers, their clinical application remains challenging, due to a lack of compatible biosensors. Dr Shao’s research is motivated by these unmet biomedical needs and accomplished through a highly interdisciplinary approach. Her work spans the field of molecular biology, nanomaterials science, and device engineering.

Dr Shao has pioneered multiple platform technologies for non-invasive molecular diagnostics, including the world’s smallest nuclear magnetic resonance system for molecular detection, nanoplasmonic sensor for label-free analysis of cancer exosomes, and novel microfluidics for serial monitoring of tumour drug resistance. More recently, she has led the development of molecular switches for direct and visual detection of infectious diseases. These switches, made of hybrid enzyme-DNA nanostructures, are rapidly turned on by pathogen nucleic acids to produce a colour readout that can be detected by the naked eye.

She has also led the development of an amplified plasmonic detector that can accurately measure brain changes in Alzheimer’s disease, even at a very early stage, through a fast and cost-effective blood test. Her latest research on nanostructured DNA barcodes not only improves cancer detection accuracy, but also provides early indication of disease aggressiveness, making biopsies less invasive and more informative. These technologies have been successfully validated in clinical trials and have far-reaching impacts on basic and clinical studies. They will continue to expand the clinical reach of previously under-appreciated biomarkers, and introduce new opportunities for non-invasive disease detection and monitoring of personalised treatment.

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\(^3\) Biomarkers are cellular, biochemical or molecular alteration in cells, tissues or fluids that can be measured and evaluated to indicate normal biological processes, pathogenic processes, or pharmacological responses to a therapeutic intervention.
Dr Shao's work has been published in internationally acclaimed journals such as Nature Biotechnology, Nature Medicine, Nature Biomedical Engineering, and Nature Communications. She has received multiple awards and fellowships, including the NUS Early Career Research Award, L’Oréal-UNESCO For Women in Science National Fellowship. She is also a National Science Scholar.
ANNEX E

FACT SHEET ON PSTA SELECTION COMMITTEES

Judging Process

Nominations for the awards start from January every year, and end with judging and endorsement of the awards in August. The nominations undergo a rigorous process of selection before being shortlisted for judging.

Award Selection Committees

The award selection panels comprised key representatives from the industry, academia, defence and research institutes. The main selection committee was chaired by Professor Tan Chorh Chuan, Executive Director, Ministry of Health (MOH) Office for Healthcare Transformation, and Chief Scientist, MOH.

Professor Lee Eng Hin, Professor, Department of Orthopaedic Surgery, Yong Loo Lin School of Medicine, National University of Singapore, chaired the selection committee for the President’s Science Award.

Ms Shirley Wong, Managing Partner, TNF Ventures Pte Ltd, chaired the selection committee for the President’s Technology Award.