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Four researchers here receive the Young Scientist Award

Their works push boundaries in fields from eye health to sustainable manufacturing

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Correspondent

Four researchers were presented with the Young Scientist Award by Deputy Prime Minister and National Research Foundation chairman Heng Swee Keat on Sept 27.

The award is administered by the Singapore National Academy of Science and supported by the NRF. The nominees are aged 40 and younger.

The Straits Times talks to these trailblazers.

NEW FRONTIERS IN EYE RESEARCH

As a retinal surgeon, Associate Professor Daniel Ting needs to handle very fine eye structures that contain millions of neural connections.

"(These) require extreme precision and meticulous handling to avoid irreversible damage and visual loss during eye surgery," said the senior consultant ophthalmologist from the surgical retina department of the Singapore National Eye Centre.

Dr Ting, 40, has turned to artificial intelligence (AI) to better plan out surgical procedures such as implanting an intraocular lens, which replaces the eye's natural lens, usually as treatment for cataracts.

His research into AI in ophthalmology and healthcare focuses on the development of safe, ethical and responsible AI applications.

"In ophthalmology and global eye health, we developed several AI screening technologies for diabetic retinopathy, glaucoma suspect, age-related macular degeneration, and childhood and adulthood myopia to help countries where there are shortages of eye specialists to screen for potentially eye-blinding conditions," Dr Ting said.

An example of such tech developed by Dr Ting and his team is a deep learning AI software system that can detect threatening eye conditions accurately and efficiently.

It has been used in more than 500,000 screenings worldwide.

"This award strengthens my commitment to leverage cutting-edge AI technologies to find more cures, create more cutting-edge health innovations by creating new intellectual properties, start-ups, and scaling Singapore's home-grown AI innovations globally," Dr Ting said.

NEW INSIGHTS INTO RNA CHANGES

A computational biologist specialising in ribonucleic acid (RNA) research, Dr Jonathan Goke, 40, developed methods that accurately predict chemical changes in RNA molecules from genomic data.

RNA is the central messenger molecule that interprets the genetic information stored in DNA.

Dr Goke, a senior principal scientist at the Laboratory of Computational Transcriptomics of the Genome Institute of Singapore, said RNA has chemical molecules that may change its function.

While these RNA modifications are widespread, they are very difficult to identify.

So he developed computational methods for RNA sequencing that paved the way for new insights into RNA biology and the role RNA plays in human diseases.

His work has, for the first time, enabled the identification of RNA changes at single-base, single-molecule resolution.

His contributions to identifying modified RNA from raw sequencing data have made RNA modification profiling accessible to a much broader scientific community. His computational methods have been downloaded over 200,000 times and independently benchmarked as among the best in the field.

"This award is a big motivation

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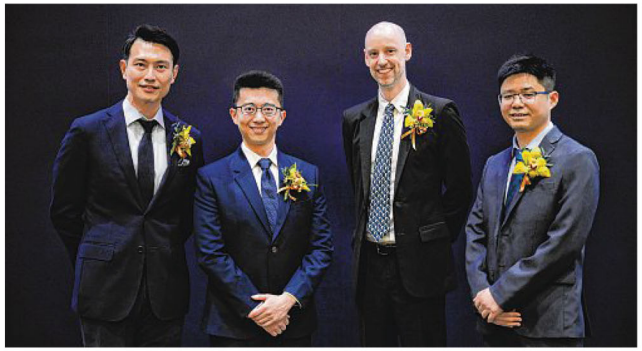

(From left) Dr Daniel Ting, Dr Li Qianxiao, Dr Jonathan Goke and Dr Lu Jiong were presented with the Young Scientist Award by Deputy Prime Minister Heng Swee Keat on Sept 27. ST PHOTO: MARK CHEONG

for me to further innovate computational methods to better understand RNA. I hope it will also inspire a new generation to use data science to transform our understanding of biology and human health," he said.

FRAMEWORKS TO UNDERSTAND AI

His PhD adviser from Princeton University, Professor E. Weinan, once told him that applied mathematics research must always be connected to the broader scientific community, and Dr Li Qianxiao has held on to this principle ever since.

"(It) has driven my research and reminded me that I must constantly learn from and talk with scientists from other fields to formulate good research questions," said the assistant professor from the Department of Mathematics at the NUS Science Faculty.

Dr Li, 37, has made significant contributions to the mathematical foundations of deep learning, a crucial technology that underpins the success and scaleability of modern AI systems.

His work provided rigorous mathematical frameworks necessary for understanding and improving deep learning methodologies, and laying the groundwork for future innovations in the field.

"Deep learning models use layers of 'artificial neurons' expressed as simple mathematical functions or operations, that process information in a way inspired by how the human brain works. These models are trained on large amounts of data to perform certain tasks that only humans used to be able to do in the past," Dr Li explained.

With his team, Dr Li pioneered the understanding of how expressiveness – the ability to learn arbitrary relationships – arises in deep neural networks, and the work turned up intricate connections between this modern technology and classical mathematics.

"My work tries to understand how these 'artificial neurons' can express very complex relationships between things, and how best to improve the efficiency of training them. This is important as the scale of modern applications becomes larger," he said.

Mathematics to Dr Li is less about numbers and more about logic and concepts.

"Mathematics bridges our understanding across different domains, (and helps us) find commonalities and often creative ways to understand and solve problems."

GREENER MANUFACTURING

Sustainability informs chemist Lu Jiong's research.

The fine chemicals and pharmaceutical sectors are major sources of air pollution, with some studies showing that the carbon footprint of the pharmaceutical industry surpasses that of the automotive industry. So Dr Lu, 39, and his team of researchers developed a new class of catalysts that promotes greener and more sustainable manufacturing processes.

Dr Lu's catalysts achieved significantly higher yields and greater efficiency, as well as a reduction in environmental impact and production cost, compared with conventional options.

"This innovation creates dynamic, atomically precise catalytic centres, while ensuring high activity and recoverability, thereby promoting greener and more sustainable manufacturing processes for fine chemicals and pharmaceuticals," the associate professor from the Department of Chemistry at the NUS Faculty of Science said.

The team put a catalyst they developed through nine consecutive cycles of chemical reactions, and discovered that it remained stable, which meant the amount of waste and risk of contamination are significantly reduced.

Analysing the environmental benefits of using this novel catalyst, they found that it achieves a carbon footprint 10 times lower than using conventional catalysts.

"Our catalysts could signify the dawn of a new era, where they play a pivotal role in achieving greener and more environmentally friendly chemical and pharmaceutical manufacturing," Dr Lu said.

A few examples of industries that rely upon fine chemicals include pharmaceuticals, agrochemicals, electronics, automotive, cosmetics and construction.

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