Department of Mechanical Engineering
香港城市大學
City University of Hong Kong

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MNE Newsletter

In this issue, we introduce two of our faculty members, Prof. Alice HU and Prof. Peng YIN. We also highlight impactful publications by our faculty, report the recent achievements of our robotics team, and share an inspirational speech by a student representative graduating from MNE.

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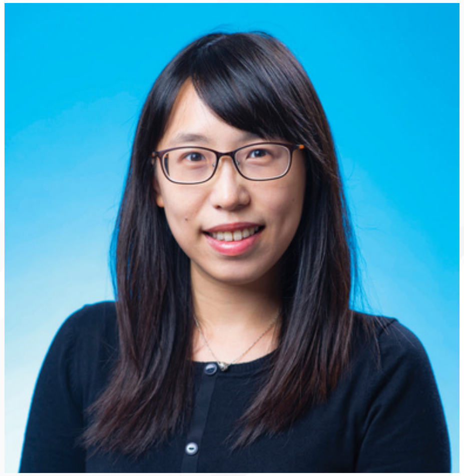
People Stories

Prof. Alice HU

Associate Professor



Research Interests

- Quantum Computing
- Algorithms
- Ab initio Methods

Having earned a PhD from Purdue University in 2014, an MS in 2011 from the same institution, and a B.S. from National Taiwan University in 2009, Prof. HU brings a wealth of knowledge and experience to the academic community. Their research interests and accomplishments stand as a testament to their dedication and passion for advancing computational efficiency and accuracy through rigorous scientific inquiry.

With a commitment to excellence in research and education, Prof. HU serves as an invaluable resource and mentor to students and colleagues alike, fostering a dynamic learning environment that inspires intellectual curiosity and innovation.

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People Stories

Prof. Peng YIN

Assistant Professor

Research Interests

- Field Robotics
- SLAM
- Planning
- Multi-Agent System
- Reinforcement Learning
- Embodied AI

Prof. YIN is an accomplished researcher and Assistant Professor at CityU, with a distinguished background in robotics and autonomous systems. He earned his PhD from the Shenyang Institute of Automation, Chinese Academy of Sciences, and has held notable positions including Project Scientist at the Robotics Institute of Carnegie Mellon University and Senior Advisor to NASA's Mars Landing Project. Prof. YIN has published extensively in top-tier conferences and journals, including IROS, ICRA, RSS, RAL, IEEE T-RO, IEEE TIE, and IEEE TITS. Notably, he has first-authored three papers in the prestigious IEEE Transactions on Robotics (IEEE T-RO).

Prof. YIN and his team, GairLab, are dedicated to integrating cutting-edge localisation, mapping, and exploration methodologies to provide a collective intelligence framework for multi-agent systems operating on a large scale and over extended periods.

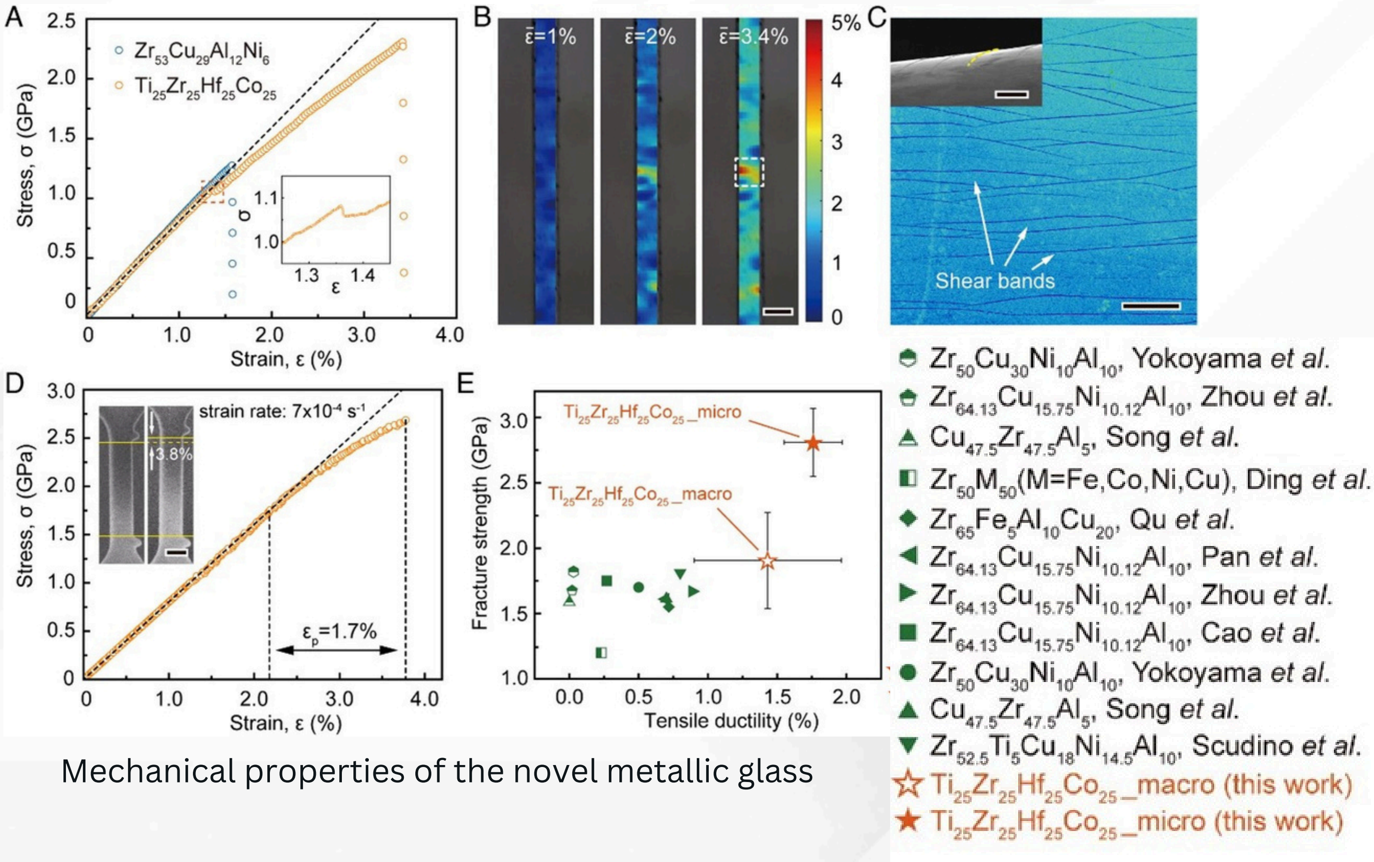
2.1 PNAS: Intrinsic tensile ductility in strain hardening multi-principal element metallic glass

The problem

Metallic glasses (MGs) are an important material whose applications span across different industries, from consumer products, automotive manufacturing, micro-electro-mechanical systems to aerospace engineering, due to their desirable properties. In addition to their high strength, MGs exhibit superior anticorrosion properties and can be utilised for the fabrication of superhydrophobic surfaces. These characteristics make MGs highly promising for applications in blood-contact devices within the field of biomedical engineering. However, MGs are brittle due to their inability to strain harden, limiting their applications.

The solution

The research group led by Prof. YANG Yong developed a multiprincipal element MG (MPEMG), which exhibits a gigapascal yield strength, significant strain hardening that almost doubles its yield strength, and 2% uniform tensile ductility at room temperature. These remarkable properties stem from the heterogeneous amorphous structure of their MPEMG, which is composed of atoms with significant size mismatch but similar atomic fractions.



Mechanical properties of the novel metallic glass

2.1 PNAS: Intrinsic tensile ductility in strain hardening multi-principal element metallic glass

The significance

The intrinsic ductility they have found offers fascinating insights from a purely scientific perspective. Unlike previous works, the strain hardening observed in their MPEMG originates from shear-induced elemental segregation and subsequent ordering. This unique mechanism allows them to surpass the 1% limit of tensile ductility encountered in previous rejuvenation methods. In traditional MGs, shear-induced dilation typically results in disordering, leading to strain softening and brittle fracture. However, Prof. YANG's research demonstrates that shear-induced dilation can also be achieved via ordering in MPEMGs. This phenomenon facilitates strain hardening and tensile ductility, offering a promising pathway for designing strong and ductile MGs and other densely packed glasses, like high-entropy ceramic glasses.

PNAS RESEARCH ARTICLE | APPLIED PHYSICAL SCIENCES

Intrinsic tensile ductility in strain hardening multiprincipal element metallic glass

Zhibo Zhang[a,1], Shan Zhang[a,b,1], Qing Wang[c], Anliang Lu[a], Zhaoqi Chen[a], Ziyin Yang[a], Junhua Luan[d], Rui Su[b,e], Pengfei Guan[b,2], and Yong Yang[a,d,2]

Edited by David Weitz, Harvard University, Cambridge, MA; received January 5, 2024; accepted March 26, 2024

April 25, 2024 | 121 (18) e2400200121 | https://doi.org/10.1073/pnas.2400200121

2.2 Science Advances: From salt water to bioceramics: Mimic nature through pressure-controlled hydration and crystallization

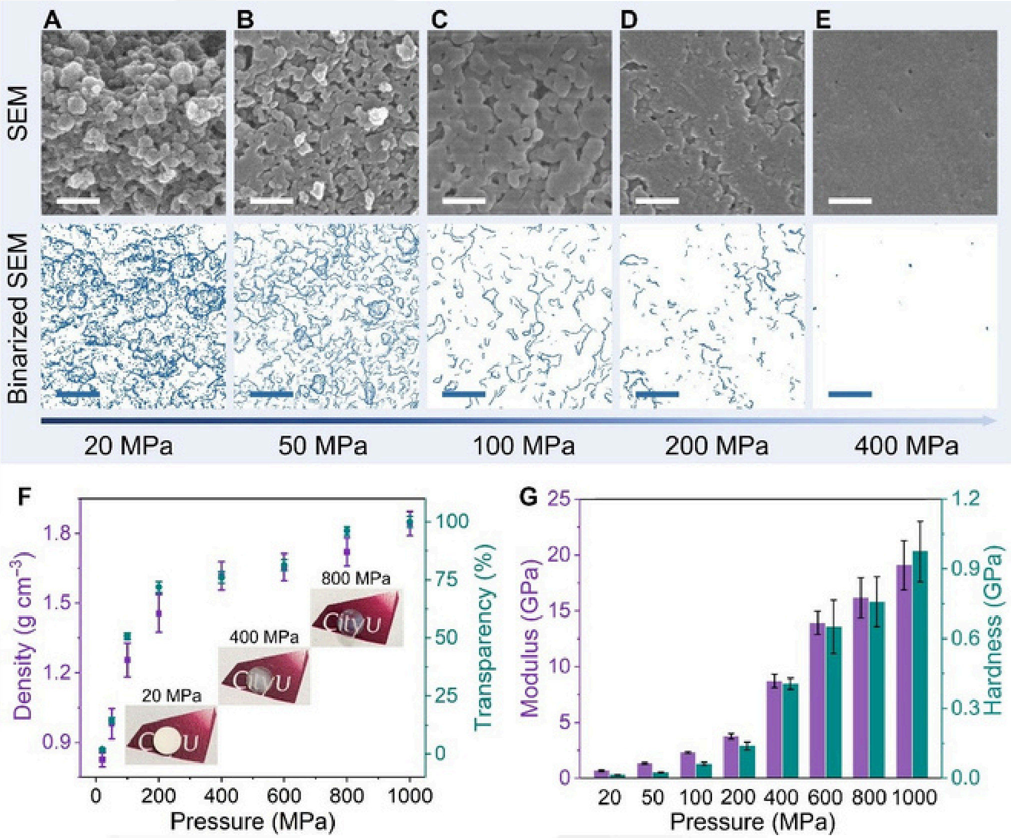
The problem

Modern synthetic technology generally invokes high temperatures to control the hydration level of ceramics, but even the state-of-the-art technology can still only control the overall hydration content. Magically, natural organisms can produce bioceramics with tailorable hydration profiles and crystallization traits solely from amorphous precursors under physiological conditions. So the puzzle is: How does life modulate the hydration profile (the water content and the relative proportion of various water species) for controlling amorphous minerals and for biomineralisation in its aqueous matrices?

The finding

To mimic the biomineralisation tactic, here, the research team led by Prof. LI Yangyang and Prof. LU Jian achieved pressure-controlled hydration and crystallisation in fabricated ceramics, solely from the amorphous precursors of purely inorganic gels (PIGs) synthesised from biocompatible aqueous solutions with most common ions in organisms (Ca^{2+}, Mg^{2+}, CO_3^{2-}, and PO_4^{3-}), Transparent ceramic tablets are directly produced by compressing the PIGs under mild pressure, while the pressure regulates the hydration characteristics and the subsequent crystallisation behaviors of the synthesised ceramics. Among the various hydration species, the moderately bound and ordered water appears to be key in regulating the crystallisation rate.

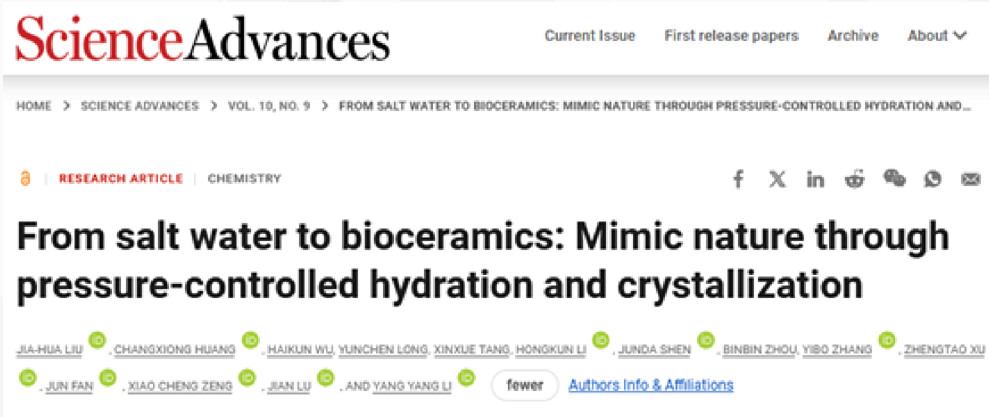
2.2 Science Advances: From salt water to bioceramics: Mimic nature through pressure-controlled hydration and crystallization



Transparent ceramic tablets are produced by high compressed pressure

The impact

This study opens an avenue for producing amorphous ceramic materials with customizable hydration levels and enables control over their crystallisation behaviours, all under fully biocompatible conditions.


ScienceAdvances

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RESEARCH ARTICLE | CHEMISTRY

From salt water to bioceramics: Mimic nature through pressure-controlled hydration and crystallization

JIA-HUA LIU, CHANGXIONG HUANG, HAIKUN WU, YUNCHEN LONG, XINXUE TANG, HONGKUN LI, JUNDA SHEN, BINBIN ZHOU, YIBO ZHANG, ZHENGTAO XU, JUN FAN, XIAO CHENG ZENG, JIAN LU, AND YANG YANG LI

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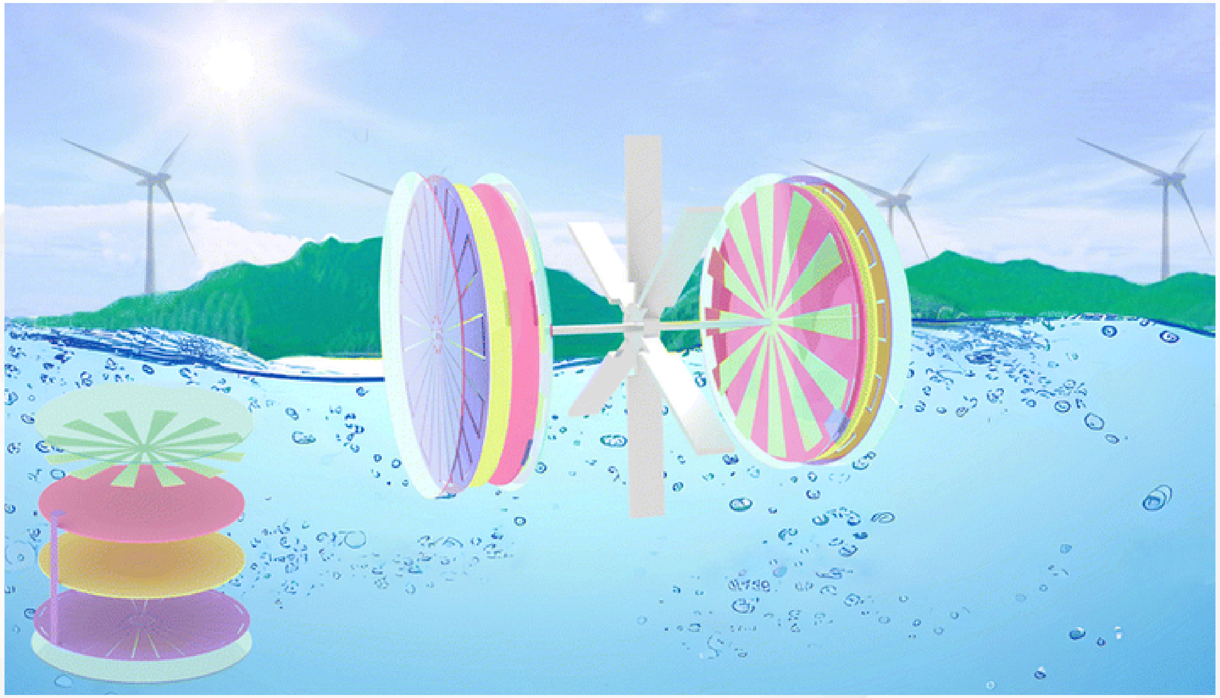
2.3 Energy & Environmental Science: From garish to practical: synergetic effect of short-circuiting and charge-trapping for high-entropy energy harvesting

The problem

To achieve carbon neutrality, clean and sustainable energy forms are highly demanded. Through coupling of contact electrification and electrostatic induction, triboelectric energy harvesters form the foundation for a new era of sustainable energy. However, there are several primary issues to be addressed: (1) improving the output through maximising the triboelectrification charge and preventing charge dissipation; (2) maximising the charge transfer quantity between the electrodes; and (3) developing an effective energy storage strategy, etc.

The solution

The research team led by Prof. Walid A. DAOUD and collaborators from the Chinese Academy of Sciences addressed these obstacles by introducing short-circuiting (SC) through intermittent contact between the electrode and triboelectrification layer, and further integrated it with charge-trapping (CT) for boosting the electrostatic charge and preventing charge dissipation. Through synergy of SC and CT, the volumetric power density reached a record-high value of 384 W $m^{-3}Hz^{-1}$. Furthermore, the underlying mechanism was studied at the atomic level and through theoretical calculations.



Schematic illustration of the high-entropy energy harvester

2.3 Energy & Environmental Science: From garish to practical: synergetic effect of short-circuiting and charge-trapping for high-entropy energy harvesting

The impact

Compared with existing improvement tactics, SC is a new finding that offers unparalleled simplicity, effectiveness, and universal applicability, which allows for prospective application in sensing, tribocatalysis, and high-entropy energy harvesting. The design of combining CT and SC yielded a low costs, simple fabrication, and superior electrical output, overcoming the challenges toward practical deployment and making it a promising candidate for large-scale adoption.

Issue 15, 2024

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From the journal:
Energy & Environmental Science

From garish to practical: synergetic effects of short-circuiting and charge-trapping for high-entropy energy harvesting†

Check for updates

Jihong Shi,‡[a] Xiangyang Zhang,‡[a] Weilu Li,[a] Xiangkun Bo,[a] Jasim M. Almardi,[a] Zehua Peng,[a] Wen Jung Li,[a] Zhong Lin Wang*[bc] and Walid A. Daoud*[ad]

3 CityU Underwater Robotics Team achieved 3rd place in the 2024 MATE ROV (Remotely Operated Vehicle) Competition Explorer Class

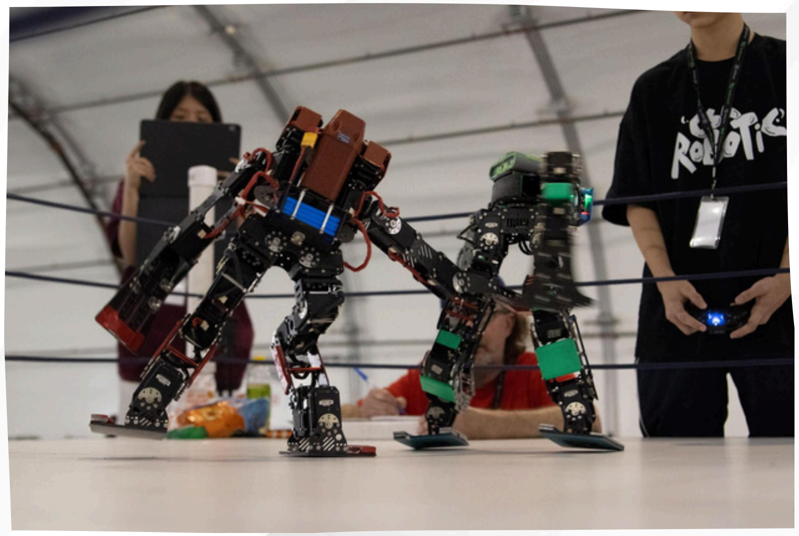
CityU Underwater Robotics Team is a student-run team with occasional assistance from instructors. The team's objective is to design and build robots for international competition, engage public participation and interest in the industry through outreach and STEM workshops and ultimately extend the application of robots into real life. The team took part in two main competitions this year, the Singapore AUV Challenge (SAUVC) and MATE ROV (Remotely Operated Vehicle) Competition.

Two MNE students (Cai Zichen and Ng Chi Oi) who belong to the Underwater Robotics Team achieved third place in the 2024 MATE ROV Competition Explorer Class held in the United States. The MATE ROV Competition is a prestigious international event that challenges student teams to design, build, and operate underwater robots to complete simulated real-world missions. Competing against the top teams worldwide, the team demonstrated exceptional engineering skills, innovative thinking, and strong teamwork. In addition to the MATE ROV competition, the team was also awarded the Engineering Quality Award in the SAUVC 2024.

These achievements mark the biggest haul of awards for the team in recent years, and we are thrilled to see if the team can reach even greater heights in the future.

4.1 MNE Graduate Ray FOK won several international robotics contests

Mr. Ray FOK (gold medal recipient)



Robot designed by Ray (left) is competing with another robot designed by an international competitor

In the realm of robotics, there are those whose passion burns brightly from an early age, propelling them on a trajectory of discovery and innovation.

Ray, an alumnus of MNE, epitomises this unwavering dedication to the field of robotics that has defined his journey from a young enthusiast to a respected researcher and mentor.

Ray's love affair with robots began in the halls of his primary school, where his fascination with technology and automation first took root. From tinkering with simple circuits to designing complex robotic systems, Ray's journey has been marked by a relentless pursuit of knowledge and a thirst for exploration.

Driven by a desire to share his passion with others and inspire the next generation of innovators, Ray volunteers his time to teach students the art of robotics. Through hands-on workshops and engaging demonstrations, he instills in young minds the joy of creation and the thrill of seeing their ideas come to life in the form of mechanical marvels.

4.1 MNE Graduate Ray FOK won several international robotics contests

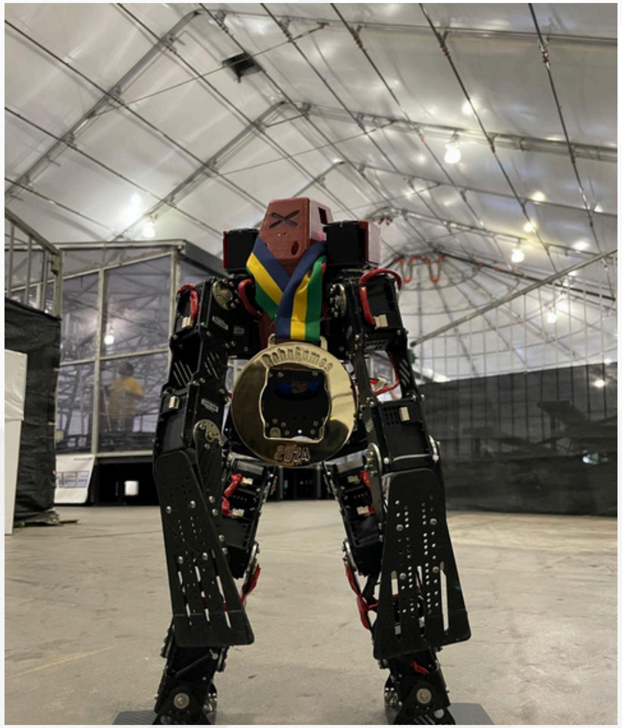
As a research assistant at CityU, Ray has found a supportive environment that allows him the flexibility to fully embrace his dreams and aspirations in the field of robotics. Here, amidst state-of-the-art labs and cutting-edge research facilities, Ray continues to push the boundaries of what is possible, exploring new frontiers in artificial intelligence and automation.

Ray's dedication and expertise have not gone unnoticed on the global stage, as he has participated in several prestigious world competitions, showcasing his skills and talents to an international audience. His success in these competitions reflects not only his technical proficiency but also his ability to collaborate effectively with diverse teams and navigate the complexities of competitive environments.

As an alumnus of CityU, Ray serves as a shining example of the transformative power of education and the impact that one individual can have on the world around them. His journey from a young robot enthusiast to a respected researcher and mentor is a testament to the endless possibilities that lie ahead for those who dare to dream big and work tirelessly to turn those dreams into reality.

Let Ray’s story inspire us all to reach for the stars, to mentor the next generation of innovators, and to leave a legacy that will continue to shape the future of robotics and technology for years to come.

Mr. Ray FOK (left)


Robot designed by Ray

4.2 Graduation speech by Student Representative - Vincen Woenarta

Student Representative - Vincen Woenarta

> **Today is a day of celebration. It's a day when we come together to acknowledge the years of hard work, perseverance, and dedication that have brought us to this incredible milestone.**

Vincen Woenarta, representing the Class of 2024 as a graduate of MNE, began his address by celebrating the collective achievements and perseverance of his fellow graduates. He expressed heartfelt gratitude to his family for their unwavering support, to classmates for sharing the journey, and to professors and the department for their guidance in both academic and non-academic pursuits. Reflecting on his personal journey, Vincen shared that he initially believed hard work alone would guarantee success. However, through his academic experiences, he realised that success is a combination of effort and luck, shaped by numerous external factors. He emphasised how fortunate he and his fellow graduates are to be alive and to have studied at a prestigious Asian university, highlighting the astronomical odds against their existence.

4.2 Graduation speech by Student Representative - Vincen Woenarta

Vincen pointed out the tendency to overestimate individual contributions to success while overlooking the support and opportunities provided by others. He urged his peers not to become arrogant about their accomplishments, reminding them that failure is not a defeat but a necessary stepping stone to success. Challenges should not define self-worth; rather, resilience and determination are key to navigating setbacks. As the graduates prepare to embark on the next chapter of their lives, Vincen encouraged them to carry forward the lessons of humility and perseverance. He stressed the importance of recognising success as a collective experience and urged graduates to extend a helping hand to those who may not have enjoyed the same privileges.

> **“We tend to underestimate our abilities when facing failure or setbacks. We question our worth, doubt our potential, and allow the fear of failure to hold us back. We let our setbacks define us, forgetting that failure is not a destination but a steppingstone to success. While luck may open doors, our determination and perseverance enable us to walk through them.”**

4.2 Graduation speech by Student Representative - Vincen Woenarta

"Class of 2024, as we step into the world as graduates, let us embody humility and perseverance. Let us strive to make a positive impact, inspire those around us, and create a future filled with compassion, understanding, and shared success. Let us always remember that our success is not solely our own but is intertwined with the success of others."

He concluded with a call to embody these values. Vincen encouraged the Class of 2024 to create a compassionate future filled with shared success, affirming that their achievements are deeply interconnected with the success of others. He then congratulated his fellow graduates, wishing them growth, fulfillment, and unwavering belief in their capabilities, emphasising the importance of making a difference in the world.

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