



Agency for
Science, Technology
and Research



Fujitsu Limited
Agency for Science, Technology and Research (A*STAR)
Singapore Management University
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Fujitsu, SMU, and A*STAR collaborate on traffic management technologies with the Maritime and Port Authority of Singapore

Singapore and Tokyo, April 16, 2018 – Fujitsu Limited, Singapore Management University (SMU), and A*STAR's Institute of High Performance Computing (IHPC), today announced their collaboration to develop innovative new technologies for vessel traffic management in the Port of Singapore, with the support of the Maritime and Port Authority of Singapore (MPA). These predictive technologies will leverage the power of artificial intelligence (AI) and big data analytics to optimize the management of Singapore's port and surrounding waters, which sees an immense volume of seaborne trade and traffic. The technologies will also be validated using real-world data to improve the forecasting of congestion and identification of potential collisions and other risk hotspots before they occur at sea.

The research and development for these new maritime technologies has been conducted under the guidance of the Urban Computing and Engineering Centre of Excellence (UCE CoE), a public-private partnership consisting of the Agency for Science, Technology and Research (A*STAR), SMU, and Fujitsu, that was established in 2014. This collaboration demonstrates the UCE CoE's continued commitment to harnessing high performance computing capabilities in the development of solutions for sustainable urban operations, offering another example of how researchers at UCE CoE are using Singapore to test-bed next generation solutions for real-world issues faced by industry and government. The outcomes of this research and development phase, as well as the practical knowledge and experience gained through the project trials, will be integrated into Fujitsu's future maritime solutions.

Background

The Straits of Singapore and Malacca comprise one of the world's busiest sea lanes.¹ As a globally critical point of passage for seaborne commercial shipping traffic, the continuous enhancement of navigational safety in these crowded waters is a crucial goal.



In view of this goal, the UCE CoE initiated research and development into technologies for maritime vessel traffic management in 2015, employing the diverse strengths of Fujitsu, IHPC, and SMU. IHPC contributed its capabilities in modeling and simulation, as well as probabilistic modeling and machine learning techniques, while SMU provided its expertise in large-scale multi-agent optimization models. Fujitsu Laboratories Ltd. leveraged its data analytics and artificial intelligence technologies to support the endeavour.

About the Newly Developed Technologies

As a result of the collaboration between Fujitsu, IHPC, and SMU, several key technologies are being developed for improving the management of maritime vessel traffic. These include:

- **Prediction models, such as:**
 - A short-term trajectory prediction model that accurately predicts the trajectory of a vessel using machine learning and motion physics
 - A long-term traffic model that can forecast the traffic situation based on the traffic patterns of a large number of vessel types, derived from historical data
- **Risk and hotspot calculation models, such as:**
 - A risk calculation model that can reliably quantify the near-miss risk of a pair of vessels, by integrating various risk models (ensemble risk model)
 - A hotspot model that dynamically reveals changing risk hotspots through spatio-temporal data analysis
- **Intelligent coordination models, such as:**
 - A spatial coordination model that seeks to re-route vessels to avoid near-miss and collision incidents
 - A temporal coordination model that coordinates the passage timing of vessels to reduce hotspots
 - Both of the above models will support real-time decision-making to mitigate predicted risks while minimizing disruptions and ensuring smooth navigation for the vessels

These technologies will eventually be integrated and test-bedded for their potential to enhance navigational safety, such as the ability to detect and recognise a near-miss risk prior to the event



(e.g. 10 minutes beforehand) by combining short-term trajectory prediction with risk calculation. Another target is to forecast and mitigate the dynamically changing hotspot before it is generated (e.g. 30 minutes beforehand) by integrating long-term traffic forecasts, hotspot calculation, and intelligent coordination models.

Comments from the Partners

MPA supports the development of technologies that harness artificial intelligence to enhance navigational safety within the Port of Singapore. Under the agreement, MPA will provide data and information for further research and development and test-bedding of technologies developed by UCE CoE for application in the Singapore waters.

"As Singapore develops future capabilities that will enhance our port operations, research and innovation will remain key to the maritime industry. As part of the recently launched Sea Transport Industry Transformation Map, MPA is supportive of collaborations among local Institutes of Higher Learning and technology companies to explore new technologies that will raise the standards of navigational safety within the Port of Singapore. We look forward to further testing the research outcomes at the MPA Living Lab," said Capt. M Segar, Assistant Chief Executive (Operations), MPA.

"A*STAR is delighted to deepen our existing partnership with Fujitsu, SMU and MPA to solve challenges faced by Singapore and other maritime nations. Such a private-public partnership model leverages capabilities from both public institutions and industry players, strengthens our collaboration through a multi-disciplinary approach, and enhances our collective ability to develop innovative solutions that can meet future maritime needs," said Prof Alfred Huan, Executive Director of A*STAR's IHPC.

"Multi-agent technology has been used extensively in coordinating the movements of unmanned aerial vehicles and unmanned ground vehicles. In this project with MPA, SMU is breaking new grounds in research by proposing a next generation maritime traffic coordination technology that is akin to air traffic control, yet respecting major differences and constraints between air and sea navigation. With the advent of autonomous ships, this technology can potentially disrupt vessel traffic management to reduce human errors and improve navigational safety," said Professor Lau Hoong Chuin, SMU's Lab Director and Lead Investigator of the UCE CoE.



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“Enhancing navigational safety is an enormous challenge as there is no single right path for how to achieve it. That is why we value the collaboration with A*STAR and SMU to welcome bold ideas. We also appreciate the support by MPA to examine the applicability of the solutions, and this is a great match with Fujitsu’s emphasis on “co-creation”. We are pleased to not only contribute technologies, but also to have provided a platform to integrate and test the technologies by different parties,” said Shoji Suzuki, Corporate Executive Advisor, Fujitsu Laboratories. “Fujitsu aims to contribute to enhancing the navigational safety of the Port of Singapore with the technologies proven through the collaboration.”

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Notes

¹ At any given moment there are about 1,000 vessels in the Singapore port, with a ship arriving to or leaving Singapore once every 2-3 minutes. Source: MPA

Press Contacts

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About Fujitsu



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Fujitsu is the leading Japanese information and communication technology (ICT) company, offering a full range of technology products, solutions, and services. Approximately 155,000 Fujitsu people support customers in more than 100 countries. We use our experience and the power of ICT to shape the future of society with our customers. Fujitsu Limited (TSE: 6702) reported consolidated revenues of 4.5 trillion yen (US \$40 billion) for the fiscal year ended March 31, 2017. For more information, please see <http://www.fujitsu.com>

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 Organization, 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 oversees 18 biomedical sciences and physical sciences and engineering research entities primarily located in Biopolis and Fusionopolis. For more information on A*STAR, please visit www.a-star.edu.sg.

About the Singapore Management University (SMU)

A premier university in Asia, the Singapore Management University (SMU) is internationally recognised for its world-class research and distinguished teaching. Established in 2000, SMU's mission is to generate leading-edge research with global impact and to produce broad-based, creative and entrepreneurial leaders for the knowledge-based economy. SMU's education is known for its highly interactive, collaborative and project-based approach to learning.

Home to over 10,000 students across undergraduate, postgraduate professional and postgraduate research programmes, SMU is comprised of six schools: School of Accountancy, Lee Kong Chian School of Business, School of Economics, School of Information Systems,



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School of Law, and School of Social Sciences. SMU offers a wide range of bachelors', masters' and doctoral degree programmes in the disciplinary areas associated with the six schools, as well as in interdisciplinary combinations of these areas.

SMU has an emphasis on generating rigorous, high-impact, and relevant multi-disciplinary research that addresses Asian issues of global relevance. SMU's faculty members collaborate with leading international researchers and universities from USA, Europe, China and India, as well as with partners in the business community and public sector. SMU's city campus is a modern facility located in the heart of downtown Singapore, fostering strategic linkages with business, government and the wider community. www.smu.edu.sg