亞洲大學 ASIA UNIVERSITY

QUANTUM

Newsletter issue 10-2025, Dec. 12, 2025

AI and Quantum Research Center (AIQRC), Asia University, Taiwan

Activity

[1] Dec. 13, 2025.
Professor Ka-Lok Ng delivered a presentation at theICSB GIW conference, held at Hong Kong University.
Title: The Rise of Quantum Computing in Biomedical Research

[2] Dec. 9, 2025.
Samuel YC Chen, Wells Fargo, USA – Visiting Scholar at AIQRC Center

[3] Dec. 5, 2025.
Professor Ka-Lok Ng delivered a presentation at the National Science Council's Smart Computing Research Achievements Meeting & 2025 International Workshop on Consumer Electronics, held in Room A116 at Asia University.
Title: Realizing Quantum Advantage with Quantum Machine Learning for Biomedical Data Classification

[4] Nov. 27, 2025.
AIQRC has signed a Memorandum of Understanding (MOU) to partner with a local instrument manufacturer.

Classical & Quantum Causal Inference in Randomized Controlled Trials

Randomized controlled trials (RCTs) are considered the gold standard for evaluating therapeutic effects by assigning patients randomly to different groups at the start of the study. But to be confident in the results, these studies usually need a lot of participants, i.e. larger sample size, which can be hard to achieve in rare diseases, early-stage trials, or very targeted therapies. When only a small number of patients can be enrolled, standard RCT methods may not have enough power to clearly show whether a treatment helps or harms.

Causal inference is a set of statistical tools that can help make better use of small datasets while still focusing on cause-and-effect questions. These methods can improve RCT analyses by adjusting for important patient characteristics, combining trial data with carefully chosen external information, and checking how sensitive results are to remaining uncertainties. Used thoughtfully, causal inference can strengthen conclusions about treatment benefits and risks when running a large traditional trial is not possible. [1,2]

Quantum causal inference builds on ideas from quantum computing to study cause-and-effect in a different way than today's machine learning–based methods. Instead of just looking for patterns in data, quantum approaches can represent complex relationships in a richer mathematical space, which may help capture situations where many factors interact in non-simple ways. In theory, this can reduce the amount of data needed and make some calculations faster, which is especially appealing when sample sizes are small or when decisions must be made quickly.[3]

Many machine learning–based causal methods usually depend on large datasets to reliably learn complicated models and to avoid “overfitting”. They can struggle when the data are limited or when relationships are highly nonlinear. Quantum approaches, such as quantum kernel methods and quantum causal discovery algorithms, have may offer an advantage here by exploring more possible causal structures in parallel and by handling uncertainty in a more fine-grained way, potentially giving clearer answers from limited data. These ideas are still mostly at the research stage, but current results suggest that quantum causal inference could become a powerful partner to classical and machine learning–based methods for drawing cause-and-effect conclusions from scarce or noisy data.[4]

References

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2. Helske, Jouni, Santtu Tikka, and Juha Karvanen. "Estimation of causal effects with small data in the presence of trapdoor variables." Journal of the Royal Statistical Society Series A: Statistics in Society 184.3 (2021): 1030-1051.
3. Ried, Katja, et al. "A quantum advantage for inferring causal structure." Nature Physics 11.5 (2015): 414-420.
4. Terada, Yu, et al. "Quantum-enhanced causal discovery for a small number of samples." *arXiv preprint arXiv:2501.05007* (2025).

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