ASIA UNIVERSITY

QUANTUM

Newsletter

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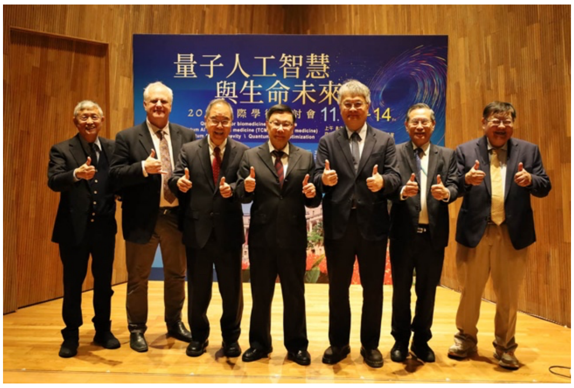
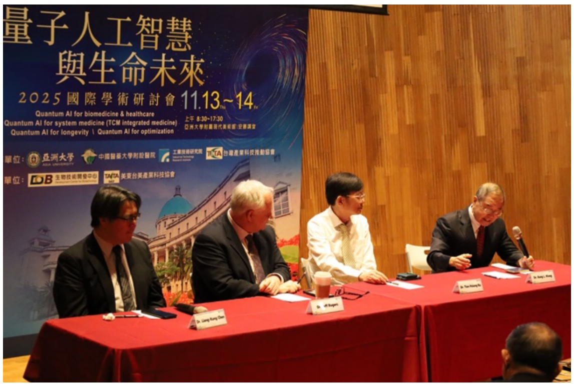
AI and Quantum Research Center (AIQRC), Asia University, Taiwan

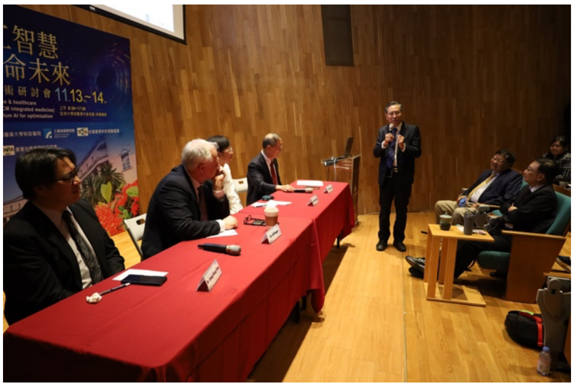
Activity

Time/Place: Nov. 13-14, 2025, Asia University, Taichung

The International Symposium on Quantum AI and the Future of Life took place at Asia University on November 13–14. The event gathered leading domestic and international scholars and experts in artificial intelligence, quantum technology, biomedicine, and traditional Chinese medicine to explore the latest advances in Quantum AI (QAI) and its applications in medicine, life sciences, and longevity technologies.







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A Recent Study on Quantum-Classical Quanvolutional Neural Networks

A recent study examines the optimization and performance of hybrid quantum-classical Quanvolutional Neural Networks (QuanvNNs), addressing a significant gap in existing research. QuanvNNs combine quantum convolutional layers with classical dense layers, but their optimization dynamics have not been well understood. The study evaluates nine optimization methods (Adabelief, RMSProp, Adam, Adagrad, Fromage, SM3, Lion, SGD, and Yogi) across different kernel sizes and circuit depths using MNIST, FashionMNIST, and

CIFAR datasets. The findings show that Adabelief, RMSProp, and Adam consistently lead to faster convergence and higher accuracy, approaching 0.98, while Adagrad, SM3, and Fromage perform poorly, underscoring the importance of selecting the right optimizer for these hybrid models.

A key discovery is that not all classical optimizers are equally effective for hybrid quantum-classical architectures. The study also highlights that QuanvNNs demonstrate superior robustness and generalization, outperforming classical CNNs in few-shot learning tasks with fewer training samples. Moreover, QuanvNNs maintain strong performance under noise, occlusion, and blurring, showing resilience in various perturbation conditions.

Further exploration into randomized QuanvNNs reveals that untrained quantum filters outperform both classical random and trained CNNs, suggesting that quantum transformations offer intrinsic representational strength. These findings position QuanvNNs as promising, noise-tolerant models with enhanced efficiency and potential for a wide range of applications.

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Improvements in Agriculture Involving Image Data Enhancement and Quantum Convolutional Neural Networks

Horticultural crops, encompassing fruits, vegetables, ornamentals, and materials for beverages, medicine, and fragrances, play a multifaceted role in society. In addition to their fundamental economic function of providing food, they significantly contribute to cultural expression, landscape aesthetics, and the overall quality of human life [1-3]. The advent of new data analysis methods has created a golden opportunity to revolutionize the cultivation of horticultural crops through intelligent systems [4].

In order to identify and classify, the morphology of plant, the farmer which potentially harvest utilized computer vision and object-detection models to overcome challenges inherent in field-based imagery, such as occlusion, variable illumination, and complex backgrounds. This successfully deployed for tasks including fruit ripeness classification, leaf disease identification, and the detection of specific plant organs under diverse conditions [5, 6].

Concurrently, QML algorithms show great potential for improving agricultural disease identification and aiding in the development of more efficient, sustainable farming techniques. They have demonstrated very good efficiency in handling large image datasets, particularly for image classification, compared to the traditional classical machine learning methods. This efficiency translates into faster and more accurate results [7].

One prominent example of a QML algorithm is the Quantum Convolutional Neural Network (QCNN), which is used to enhance the capabilities of classical CNNs in agriculture [8]. QCNNs are designed to improve upon the performance of existing CNN models. Furthermore, when integrated with an image enhancement process, these hybrid systems demonstrate significantly better performance metrics [9], as shown Table 1.

Table 1. Performance Metrics compared to other CNNs methods [9].

Metrics review	Accuracy	Precision	Recall	Specificity	F1 score
AlexNet	87.85%	82.72%	98.27%	75.30%	89.83%
LeNet	86.43%	93.27%	86.80%	85.60%	89.92%
GoogLeNet	96.69%	97.11%	97.81%	95.92%	97.46%
VGG-16	77.12%	70.54%	92.38%	62.14%	80%
ResNet 50	67.45%	92.55%	68.41%	60.58%	78.67%
Proposed QCNN	**97.64%**	**98.36%**	**98%**	**96.98%**	**98.18%**

In conclusion, the critical multifaceted role of horticultural crops in society necessitates advanced solutions for their cultivation. This review highlights the transformative potential of intelligent computational systems in meeting this need. Current successes in using computer vision for tasks like ripeness classification and disease detection demonstrate a powerful paradigm shift. Building on this, the emergence of QML, exemplified by QCNNs, represents the next frontier. By delivering superior processing power and accuracy, especially when combined with traditional techniques, QML offers a pathway to overcome existing limitations and unlock unprecedented levels of efficiency and sustainability in horticulture.

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