UNIVERSITY OF TECHNOLOGY SYDNEY

Quantum Computation Laboratory

The Quantum Computation Laboratory (QCL) was established in September 2008 by Distinguished Professor Mingsheng Ying as one of five research laboratories in the Centre for Quantum Computation & Intelligent Systems, a University of Technology, Sydney Priority Investment Research Program. QCL researches and develops software for quantum computation and techniques for quantum information processing.

Quantum Computation research uses quantum mechanics to develop computer technology. Quantum computers are much more powerful than classical ones and new software is required for them to check errors which, because of their atomic size, they will be highly susceptible to. It is therefore extremely important to understand how to correct these errors.

QCL is committed to exploring research into software for quantum computers by studying theoretical questions arising in the field of quantum computation and information, and its power from the viewpoint of theoretical computer science and classical information theory. QCL is also dedicated to understanding the fundamental differences between classical information processing models and their quantum counterparts in order to further expose the power of quantum computation. The Lab seeks to understand entanglement as a resource, and to develop a quantitative entanglement theory; and to explore connections between Artificial Intelligence and quantum computing.

This technology will result in next-generation enterprise intelligent information systems. It will advance our understanding of the limits of quantum computation and information, as well as lead to new, efficient quantum algorithms and information processing methods.

Since its beginnings, the QCL has achieved breakthrough research by:

- development of Floyd-Hoare logic for verification of both partial and total correctness of quantum programs, which forms the logical foundation for quantum computing;
- solving the long-standing problem of "Bisimulation for quantum process" to enable a comprehensive framework for modelling and reasoning about concurrent quantum systems; and
- characterising the perfect distinguishability of quantum operations (a fundamental problem in quantum information science).

The lab has also achieved:

- two ARC Future Fellowships
- one ARC Discovery Project

QCL is recognised as a world-class laboratory for quantum computation and quantum information. In the short time since its establishment, it has achieved *highly significant research breakthroughs*, published a large number of publications in high-profile journals, and established collaborative research links with several internationally renown leaders in the quantum computation field.

For more information, contact the Quantum Computation Laboratory by email at: qcis-centre@it.uts.edu.au, or visit their website at: http://quantum-lab.org (within the QCIS website at: www.qcis.uts.edu.au.

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