PhD Position in Quantum Computing

A PhD position is available in the Quantum Optics Research Group at UNSW Canberra. The project focus is on applying compressive sensing methods in quantum computing experiments. The successful applicant would need to apply for a UNSW Scholarship (Domestic or International). Quantum Optics Research Group will endorse this application. The current annual stipend is $24,928 (tax free). A successful International applicant will also receive A Tuition fee Scholarship which would also include Overseas Student Health cover.

Measuring the state of a quantum system lies at the heart of quantum communication, quantum control and quantum computation, which hold promise for dramatic improvements in communication security and complex computational problem solving. It is important to note that due to the nature of quantum systems, in order to obtain a satisfactory measurement result, the measurement apparatus has to be well characterised as well. Quantum tomography is a classic paradigm of quantum measurement, which applies equally to apparatus, state and process characterisation. A description of a quantum state is reconstructed from a series of repeated measurements, by using different post processing techniques.

By making use of quantum information encoding and processing, a quantum computer can outperform modern supercomputers by orders of magnitude. In communications, unprecedented levels of security and channel capacity can be achieved. However, quantum information is not easily accessible and measurable. Just as the computing and storage capacity grows immensely with the complexity of the quantum system, so does the number of measurements required to characterise its state, or states of its subsystems. Even for the simplest system (a single qubit), large amounts of data have to be collected (and processed) from multiple measurements performed on the same experiment. One or more parameters are changed in every iteration, resulting in a different experiment configuration. A great challenge in creating a working quantum computer is to set up an efficient scheme for this, where the power and the speed of the quantum computer will not be hampered by the complexity and difficulty of actually running it. The problem is particularly pronounced in continuous-variable experiments, where the set from which the parameters can be chosen is not only infinite but uncountably infinite. In order to reduce the number of experimental configurations required to estimate the state of a quantum system with satisfactory accuracy, compressive sensing and optimisation techniques can be applied to experiment design. The aim is to choose a small subset of possible experimental configurations that will yield the majority of information about the system state, and perform data acquisition only for those configurations. While some information is lost, the loss is insignificant compared to reductions in complexity and running/processing times.

Our goal is to apply compressive sensing and optimisation techniques, proven to work in discrete-variable experiments, to the maximum likelihood estimation approach in continuous-variable quantum homodyne tomography. Starting with classical and non-classical states of light, the approach can in future be extended to other applications of tomography.

Prospective student(s) should contact Aleksandar Davidović (a.davidovic@adfa.edu.au or a.davidovic@unsw.edu.au) with their academic transcript and a CV. Shortlisted applicants should be available for an interview (video chat). More information about UNSW Canberra scholarships can be found here: http://sas.unsw.adfa.edu.au/rsu/scholarships/index.html