NUS National University of Singapore
Source: *The Straits Times*, pA28
Date: 16 February 2019

Seven quantum technology projects awarded grants

They aim to develop capabilities needed for industrial application

Cheryl Teh

With quantum technology, space exploration is possible, satellite television works and Google Maps help take us home.

This technology is both hardware and software. It includes superfast chips that can, in seconds, crunch data that would take a traditional computer thousands of years. And hardware – like atomic clocks, which measure time according to vibrations within atoms – that scientists are now attempting to make absolutely accurate.

The importance of this area of research has been further recognised locally, as the National Research Foundation (NRF) last week awarded seven projects grants under the national Quantum Engineering Programme (QEP).

The projects all aim to develop the engineering capabilities needed to commercialise quantum technologies for industrial application.

The QEP, which is managed by the National University of Singapore (NUS), will allow for quantum tech – the science of the very small – to be explored further locally.

One of the grant winners was Assistant Professor Charles Lim, from the Department of Electrical and Computer Engineering at NUS. His project will include hardware for quantum encryption: making faster miniature, cost-effective chips that may be used in smartphones.

These chips might, with the principles of quantum technology, allow for phones that cannot be hacked, and for person-to-person conversations to be made fully encrypted and secure. Modern quantum technology has its roots in the work of renowned physicists Paul Benioff, Yuri Manin, Richard Feynman and David Deutsch. It is a field of physics which explains how matter behaves at the atomic and sub-atomic level.

Superposition, a characteristic of quantum computing, is the idea that a particle can be in two places and states at the same time. This allows quantum computers, unlike binary computers that use either binary codes 1 or 0, to use qubits – which can be a 1, and a 0, simultaneously.

This duality in a qubit allows for quantum computers (which exist today) to hold vast amounts of information in a smaller space. Separately, the effect of "entanglement" is a phenomenon where objects can remain connected by a quantum state, though they may be physically apart by a distance. This property has led to atomic clocks, for absolutely precise timings to be used in telecommunications, the banking industry, space communication and radar technology.

BUILDING SOLUTIONS

We are confident that these research projects under the Quantum Engineering Programme will allow Singapore to build engineering solutions and systems to strengthen our expertise and competitive edge in the global market for quantum devices and applications.

MR GEORGE LOH, programmes director of the National Research Foundation, on the seven projects awarded grants.

But knowledge and inventions in quantum technology are useful in other ways. For example, to prevent security breaches, said Professor Peter Knight, physicist and professor of quantum optics at Imperial College London. "We have learnt to trust entirely the encryption techniques used now, and relying on encryption invented 30 to 40 years ago," Prof Knight said.

"What is computationally hard changes, and becomes dead easy with a quantum computer – decrypting information that could have taken thousands of years can take seconds now, and everything might be at risk if an adversary has a quantum computer," Prof Knight said.

So while a quantum computer can decrypt any organisation's trade secrets, confidential communication, and sensitive data, he added that a more secure, quantum-based communications network can combat this infiltration. He said that new research is being developed – to "see" changes in the links between quantum particles, and detect if someone is trying to intercept communications. This will help to create secure systems, on an unsecure device.

Work is being done in other areas as well.

Dr Charles Altuzarra at the Institute for Quantum Science and Engineering at Texas A&M University in the United States has developed an experiment that could enhance quantum information and cryptography, by manipulating quantum light particles.

The projects under the QEP plan to take quantum research a step further. Mr George Loh, programmes director of NRF, said: "The seven newly awarded research projects are significant as they signify Singapore's ambition to develop quantum devices and applications for commercial use."

"We are confident that these research projects under the Quantum Engineering Programme will allow Singapore to build engineering solutions and systems to strengthen our expertise and competitive edge in the global market for quantum devices and applications," he added.

The projects were chosen from 18 white papers submitted from July last year, and evaluated by an international panel that awarded the grants based on the projects' quality, and relevance to Singapore.

Prof Lim's work involves quantum key distribution, a cryptographic method enabling two parties to produce a wholly unique, random, and shared secret key, that can be used to encrypt and decrypt messages.

"Our proposal is to develop a scalable, robust, and efficient quantum key distribution (QKD) network technology," said Prof Lim.

"The team aims to deliver two QKD prototypes together with chip-based quantum technologies for quantum networks over the next five years," he added.

tienli@sph.com.sg

Source: The Straits Times © Singapore Press Holdings Ltd. Permission required for reproduction.