Joint CQSE & NCTS Online Seminar

2021
Sep. 24, Friday

TIME Sep. 24, 2021, 2:30~3:30pm
TITLE Randomised benchmarking for non-Markovian noise
SPEAKER Dr. Pedro FigueroaRomero
Quantum Computing Research Center, Hon Hai Research Institute
LINK https://meet.google.com/odw-oosb-jpw

Abstract:

In the far-reaching goal of reaching fault tolerance in quantum computers, setting a benchmark for the diverse types of noise that can arise in quantum devices constitutes one of the first steps. In the last decade, randomised benchmarking (RB) has become the gold standard for estimating average error rates of a given gate-set with little resources. State-of-the-art RB protocols can estimate average noise for very general gate-sets and diverse aims, normally predicting error rates that decay as a linear combination of exponentials in the number of gates of a computation. Deviations from an exponential decay behaviour are generally assumed to belong to the realm of non-Markovian (temporally correlated) noise, which has largely been unexplored theoretically in the context of quantum errors.

In my talk, I will describe how we employed a recently developed framework describing non-Markovian quantum phenomena to derive an analytical expression for the average sequence fidelity of an RB experiment with non-Markovian noise. We did this as a first approach for the Clifford group, which can be realised efficiently on a quantum processor. Consequently, we proposed a set of methods, implementable with current experimental setups, to quantitatively estimate the effects of non-Markovianity in RB, the timescales of the memory of non-Markovian noise, and to diagnose the (in)coherence of non-Markovian noise. Our work constitutes one of the very first steps in the characterisation of errors beyond the Markovian and time independent regime and our methods can be directly imported in different benchmarking techniques, serving both as a theoretical bedrock for more general development and insights, as well as a testing ground in practical scenarios.

Biography Brief:

Pedro Figueroa-Romero is a theoretical physicist from Mexico City, Mexico; he concluded his PhD in January 2021 with a thesis on Equilibration and Typicality of Quantum Stochastic Processes under supervision of Prof. Kavan Modi at Monash University in Melbourne, Australia. He is currently a postdoctoral researcher at the Foxconn Quantum Computing Research Center working with Prof. Min-Hsiu Hsieh.

His research interests include Quantum Nonlocality, Quantum Foundations and Quantum Information Theory.