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SenSIP Seminar Series

From Quantum Control to Variational Quantum Algorithms and back

Presenter: Christian Arenz, Assistant Professor, ECEE

February 18, 2022, 3:00 PM

Hybrid Format; GWC 487 and Zoom https://asu.zoom.us/j/89580268502

Abstract

In order to utilize quantum mechanical features for quantum computational tasks, it is crucial to control the dynamics of the quantum system under consideration in a precise and effective manner. Quantum control theory provides and excellent framework for meeting these challenges. The goal of quantum control is to steer the dynamics of a quantum system towards a desired target using shaped electromagnetic fields. In this talk, I will discuss how to determine whether such optimal controls exist for a given control task, followed by describing iterative strategies that allow for finding optimal control fields in the laboratory. I will focus on control tasks of high relevance for quantum information science, such as the preparation of a target quantum state or the implementation of a quantum logic gate.

I go on to outline how the performance of a full quantum algorithm can be improved using optimal control methods. That is, I will draw connections between Variational Quantum Algorithms aimed at solving high value problems using quantum and classical computing resrouces in parallel, and quantum optimal control experiments.

Finally, I come back to the question of how optimal controls can be found efficiently. I will argue that future quantum devices can play a pivotal role in finding optimal control fields for complex systems.

Biography:

Christian joined Arizona State University as an assistant professor in the School of Electrical, Computer and Energy Engineering in January 2022. Prior to joining ASU he was a lecturer and an associate research scholar at Princeton University. Previously, he completed his PhD in applied mathematics at Aberystwyth University in 2016, where he focused on the control of open and noisy quantum systems. He completed his master's degree equivalent in theoretical physics from Saarland University in 2012, where he studied quantum optical systems.

Christian's current research centers on using tools from control theory to advance quantum information science. His work targets applications such as the design of robust and efficient controls for quantum computing, and the development of quantum algorithms for optimization and machine learning tasks.

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