CP-15-01

Algorithms and Architectures for the 'Late NISQ' and 'Early Fault-Tolerant' Eras

Simon Benjamin

University of Oxford

Abstract

I will discuss the opportunities for quantum advantage in the anticipated eras of 'late NISQ' (meaning, many physical qubits) and the early fault-tolerant (meaning, a modest number of encoded qubits). In both these periods, we will need to closely match algorithms to architectures in order to have good prospects for quantum advantage. The specific themes I will touch on include the practicality of error mitigation and error correction (e.g. [1] and [2]), leading into architectural concepts such as multicore and looped-pipeline processors [3,4]. I will note that compilation (also known as circuit synthesis) is vital to extract maximum value, and can be done either classically or using a quantum devices [5]. Finally I will describe an approach to chemistry simulation that is compatible with the Early FT Era, with the prospect of handling classically-intractable dynamics using only hundreds of logical qubits [6].

[1] arXiv:2210.00921
[2] arXiv:2211.08468
[3] Phys. Rev. Applied 18, 044064 (2022)
[4] arXiv:2203.13123
[5] arXiv:2206.11245 and arXiv:2206.11246;
[6] arXiv:2202.05864