

Stanford EE Computer Systems Colloquium

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*This lecture will be live streamed with possible participation using Zoom.
Eventually the video will be posted to the EE380 archive on YouTube.*

Venue for live talk. 4:00-5:30 PM Pacific Standard Time (UTC-8) with remote capture and possible participation.

Zoom live presentation. Use this link to join the live talk.

<https://stanford.zoom.us/j/96868121090?pwd=UVdTYzY4VXIHRm0zMmVLK0VQREIzQT09>

Highly optimized quantum circuits synthesized via data-flow engines

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Abstract

The formulation of quantum programs in terms of the fewest number of gate operations is crucial to retrieve meaningful results from the noisy quantum processors accessible these days. In this talk I will describe the adaptive circuit compression algorithm [1] developed by our group and implemented in the SQUANDER package [2]. We scaled up the scope of our quantum compiler to synthesize circuits up to 9 qubits solely from the unitary associated with the quantum program. Such capabilities were not demonstrated before by any optimization based quantum gate synthesis tool. This significant improvement was achieved

by the utilization of a data-flow engine (DFE) based quantum computer simulator, developed in the collaboration of the Eötvös Loránd University and the Wigner Research Center (Hungary), Maxeler Technologies and Groq. The quantum computer simulator was designed to simulate arbitrary quantum circuit consisting of single qubit rotations and controlled two-qubit gates on Field Programmable Gate Array (FPGA) chips. In our benchmark comparison with the QISKIT package, the circuits produced by the SQUANDER package (with the DFE accelerator support) were compressed by 97% in average, while the fidelity of the circuits were still close to unity by an error of 10^{-4} . In the talk I will also discuss possibilities to further improve the synthesis procedure and scale up our approach to higher number of qubits.

[1] P. Rakyta, Z. Zimborás, Efficient quantum gate decomposition via adaptive circuit compression, arXiv:2203.04426 (2022).[2]

<https://github.com/rakytap/sequential-quantum-gate-decomposer>

Speaker:

Peter Rakyta is a researcher fellow at the Department of Physics of Complex Systems of Eötvös Loránd University.

During his work he developed deep experiences in modelling quantum mechanical systems. Simulations performed by the software package [Eötvös Quantum Utilities](#) provided the central results in most of his research work. In 2020 he turned his attention to quantum informatics. Currently he is involved in several projects related to programming and simulating quantum computers. His first result in the area is the currently most efficient [algorithm](#) to decompose an arbitrary unitary into a sequence of quantum logical gates

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