Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

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Inventors

Andreas Spanias
Aradhita Sharma
Leslie Miller
Glen Uehara

Contact

Physical Sciences Team

Quantum Fourier Transform Tools for Signal Analysis-Synthesis and Compression

Quantum computing (QC) is a multidisciplinary field comprising aspects of computer science, physics, and mathematics that utilizes quantum mechanics to solve complex problems faster than on classical computers (e.g., QC promises to process data with estimated speeds exceeding 100 million times relative to classical computers). Signal processing is a field involving computationally expensive methods that are commonly affected by conventional hardware limitations. Thus, quantum computers are susceptible to noise from various sources such as external environmental interactions, crosstalk caused by neighboring qubits when excited by lasers, and quantum implementation errors. There is a need for tools that can aid in the design of quantum computers.

Researchers at Arizona State University have developed a tool for signal analysis-synthesis and compression. Specifically, a system and method for quantum circuits for quantum Fourier transform (QFT) and inverse QFT (IQFT) for use in signal analysis-synthesis and compression. The tool includes a QFT-based circuit designed for signal analysis-synthesis. The QFT components of the circuit are chosen based on optimization of signal compression per the tool. The tool also examines QFT resolution, precision in terms of qubits, and provides measurements regarding the effects of quantum measurement noise.

Related publication: Signal Analysis-Synthesis Using the Quantum Fourier Transform

Potential Application:

- Quantum computing (QC)

Benefits and Advantages:

- QFT-based circuit designed for signal analysis-synthesis
  - QFT components selected for signal compression via peak-pricing
  - QFT components selected for signal compression via perceptual selection
  - QFT components selected that are above the masking threshold for compression