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Scalable Self-Adaptive Synchronous Triggering System in Superconducting Quantum Computing

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Quantum computers can solve some specific problems which are deeply believed to be intractable for classical computers. However, building large-scale quantum computers should face lots of challenges. The high-precision synchronous control of all qubits is one of the key techniques we address.
Our system serves the Superconducting quantum computing which requires plenty of arbitrary waveform generators (AWG) to work synchronously to drive the quantum processor. The system can achieve the synchronization trigger of all AWGs.
Firstly, the clock generation and distribution system is designed to provide synchronous high-performance reference clocks for each AWG with the synchronized precision less than 20 ps and clock jitters under 200 fs for the initial test, and it can be extended by increasing fan-out units. Next, we design a set of trigger generation firmware elaborately in FPGA, which is controlled by central-computer to generate triggers with configurable counts and intervals. Then the generated trigger fan out to 48 edge-aligned triggers to each AWG as the start signal via a star-like framework which is hardware-compatible with the clock system. Due to routing delay of trigger, reference clock is very likely to capture the rising-edge of the trigger causing a meta-stable state which makes AWGs unsynchronized. Therefore, we develop a self-adaptive firmware that can automatically adjust the trigger, once the meta-stability happens.
With this system, all AWGs can work synchronously, with a synchronization skew less than 20 ps. And the total number of AWGs can be expanded easily in order to manipulate more superconducting qubits.

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Yes

Description

Trigger Sync

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