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High-fidelity single-shot Toffoli gate with superconducting elements via quantum control[1] EHSAN ZAHEDINEJAD, JOYDIP GHOSH, BARRY SANDERS, University of Calgary — A single-shot Toffoli, or controlled-controlled-NOT, gate is desirable for classical and quantum information processing. The Toffoli gate alone is universal for reversible computing and, accompanied by the Hadamard gate, forms a universal gate set for quantum computing. The Toffoli gate is a key ingredient for (non-topological) quantum error correction. Currently Toffoli gates are achieved by decomposing into sequentially implemented single- and two-qubit gates, which requires much longer times and yields lower overall fidelities compared to a single-shot implementation. We develop a quantum-control procedure to directly construct single-shot Toffoli gates and devise a scheme for three nearest-neighbor-coupled superconducting transom systems that should operate with 99.9% fidelity under realistic conditions. The gate is achieved by a non-greedy quantum control procedure using our enhanced version of the Differential Evolution algorithm.

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