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Transferring the state of a quantum register to a single oscillator: a simple circuit verses numerical optimization[1]

KURT JACOBS, XIAOTING WANG, University of Massachusetts at Boston, FREDERICK STRAUCH, Williams College — We consider the problem of swapping a quantum state between a register of qubits and a single quantum oscillator. We design a mesoscopic quantum circuit to do this, using an off-resonant interaction, based on the concept of coherent feedback control. We consider an explicit realization of this circuit, and perform simulations of its performance. We then take a different approach, in which we couple the register directly to the resonator, including inter-qubit couplings and local controls, and use numerical optimization to search for a control protocol that will achieve the swap with very high fidelity. Our results show that the protocols found using numerical searches are superior in speed and fidelity to the manually-designed circuit. We also explore how the time and complexity of the protocols increases with the problem size.

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