CLASSICAL SIMULATION OF MEASUREMENT-BASED QUANTUM COMPUTATION ON HIGHER-GENUS SURFACE-CODE STATES

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AUTHORS
Goff, Leonard
Raussendorf, Robert

ABSTRACT

We consider the efficiency of classically simulating measurement-based quantum computation on surface-code states. We devise a method for calculating the elements of the probability distribution for the classical output of the quantum computation. The operational cost of this method is polynomial in the size of the surface-code state, but in the worst case scales as 2(2g) in the genus g of the surface embedding the code. However, there are states in the code space for which the simulation becomes efficient. In general, the simulation cost is exponential in the entanglement contained in a certain effective state, capturing the encoded state, the encoding, and the local postmeasurement states. The same efficiencies hold, with additional assumptions on the temporal order of measurements and on the tessellations of the code surfaces, for the harder task of sampling from the distribution of the computational output.