Cluster State Computing

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Abstract— **Computation can be done via measurement only, the outcome of which is dependant on the initial entangled state – the *cluster state*. This paper will attempt to provide background regarding computation using only measurements, a brief forray into the preparation of cluster states, a discussion of one way quantum computers (1WQC), and the computational power of various configurations of a 1WQC.**

I. Areas

This paper will attempt to discuss some background on cluster states, a correspondence between 1WQC and the more traditional gate array model, and the computational power of this new model.

A. Cluster States

A cluster state is characterized by a set of eigenvalue equations, which are are determined by the distribution of the qubits on some lattice[1]. Briegel and Raussendorf show that any quantum logic circuit can be implemented on a cluster state, which demonstrates universality of the proposed scheme[2]. A method to prepare a one-dimensional cluster state is given in [3], consisting of "cascading" C_z gates on n qubits.

B. Gate Array Correspondence

In his analysis of the reducability of 1WQC to the gate array model, Richard Jozsa gives a polynomial time algorithm to perform the conversion between the two computational models[4].

C. Computational Power and Complexity

In general, measurement based models can be polynomial time reduced to the gate array model, and thus have the same power, but they are more easily parallelizable[4].

References

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[4] Richard Jozsa, "An introduction to measurement based quantum computation," *NATO Science Series, III: Computer and Systems Sciences. Quantum Information Processing-From Theory to Experiment*, vol. 199, pp. 137–158, 2006.