Quantum Computation and a Universal Quantum Computer

Antonio Lagana

School of Chemistry and Physics

The University of Adelaide

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Contents

Glossary

1WQC One-Way Quantum Computing

CPU Central Processing Unit

EPR Einstein Podolsky Rosen

GRK Grover Radhakrishnan

GSQC Ground State Quantum Computation

HQC Holonomic Quantum Computing

I/O Input Output

QAC Quantum Adiabatic Computing

QFT Quantum Fourier Transform

QGA Quantum Gate Array

QTM Quantum Turing Machine

UQC Universal Quantum Computer

UQTM Universal Quantum Turing Machine

UTM Universal Turing Machine

Abstract

This thesis covers two main topics in quantum computing: universal quantum computation and quantum search. We first demonstrate how a quantum harmonic oscillator can be used to implement the universal set of quantum gates and thereby serve as one possible building block for a universal quantum computer. We then address the core and primary focus of this thesis, the theoretical construction of a machine that can compute every computable function, that is, a universal (i.e.*programmable*) quantum computer. We thereby settle the questions that have been raised over the years regarding the validity of the UQTM proposed by Deutsch in 1985. We then demonstrate how to interface the universal quantum computer to external quantum devices by developing programs that implement well-known oracle based algorithms, including the well-known Grover search algorithm, using networked quantum oracle devices. Finally, we develop a partial search oracle and explore symmetry based partial search algorithms utilizing this oracle.

Declaration

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Antonio A. Lagana

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