Structured Quantum Programming

Bernhard Ömer

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Abstract

While classical computing science has developed a variety of methods and programming languages around the concept of the universal computer, the typical description of quantum algorithms still uses a purely mathematical, non-constructive formalism which makes no difference between a hydrogen atom and a quantum computer.

In this talk, we will investigate

- how the concept of structured programming languages, the most widely used classical formalism for describing and implementing algorithms, can be adopted to the field of quantum computing

- how non-classical features like entanglement, the non-observability of quantum states and the reversible nature of quantum mechanics can be dealt with, and

- how fundamental elements of quantum algorithms like elementary gates, quantum registers, unitary operators or measurements can be reflected semantically.

The experimental language QCL will serve as an example for an actual quantum programming language built on the above principles. An free QCL interpreter for Linux, which also integrates a numerical simulator to emulate quantum computers of arbitrary size, is available from

> http://tph.tuwien.ac.at/~oemer/qcl.html