1 Similar Works

1.1 Deep Reinforcement Learning for Quantum Gate Control

1.1.1 Summary

The paper states that approximation of unitary evolution in a quantum linear control (due to Pontryagin's principle) will be equivalent to choice of a sequence of unitary matrices from a limited set.

To find the proper sequence, an RL problem can be defined:

- time is discretized.
- current state is accumulative evolution from the beginning. (continuous state space)
- action is the current evolution which is a function of control parameter. (limited discrete actions)
- transitions are totally certain (but will be modeled uncertainly).
- reward (at the last turn) is related to fidelity.

1.1.2 Notes

p.2, *"$d = 16$"*: in a 4-d space, a hypercube has 2^4 corners. it can be proved in a linear system corners are solution not planes (which has degrees of freedom).

p.4, *"$argmax_a$"*: typo. it must be $\max_a$

p.5, *"state transfer problem"*: lack of reasoning why RL can escape the trap, or reasoning on meaningfulness of experiments numbers that shows performance outreach (e.q. escaping the trap)

1.2 Other Works

GRAPE, Genetics Algorithm

2 Problem

Suppose you have a number of N qubits, which are set to the state $|10000\rangle$ (I assume for definiteness that $N = 5$). How you can use machine learning to transform this state to a demanded state given by

$$|\psi\rangle = a_1 |10000\rangle + a_2 |01000\rangle + a_3 |00100\rangle + a_4 |00010\rangle + a_5 |00001\rangle$$

Here we say that the evolution is restricted to the one-particle sector (since there is only one single 1 in a background of zeros).

You can then try to generalize this problem to arbitrary N and to the case where the number of 1's in each state is k (to the k-particle sector).

2.1 Methods

- Solovey-Kitaev Algorithm (needs modification)
- A* Search (proper hueristics)
- Text-like Generative Model (needs investigation)