Floquetifying Quantum Error Correction Code

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Abstract — The study of automated steps in Floquetifying Quantum Error Correction Codes.

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Floquetifying Quantum Error Correction Code into Process Code

Process Code

A process code is defined by a set of operations $\mathcal{O} = [O_1, O_2, ...]$ where O_i can be either Pauli string measurement or Clifford gates.

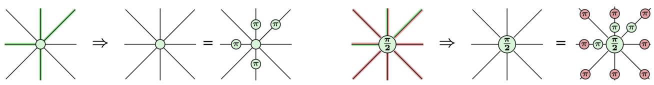
The process code is said to be **established** after T rounds of operations. Established means the size of **Instantaneous Stabilizer Group** (ISG) [1] is constant for $t > T$. For $t > T$, the process code always encodes a constant number of logical qubits [2].

Examples of process code include stabilizer codes, subsystem codes, and Floquet codes.

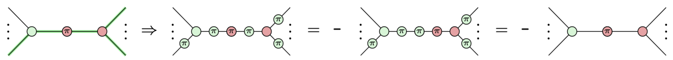
The operations of a process code can be represented using ZX-diagram [2]. For a ZX-diagram D, the linear map associated with D is denoted as $[[D]]$. In the ZX-diagram, a spider leg loosely correspond to a qubit at a given time. An error on a qubit is represented by a tuple (e, t) where t denotes the error type and e denotes the spider leg. Similarily, $E = \{(e_i, t_i)\}_{\{i=1\}}^{n}$ represents a sequence of errors. The notation $D + E$ is used to represent the ZX-diagram after errors are applied. For a sequence of correctable errors E, we denote $[[D + E]] = 0$. Such notation is motivated by the fact that we could always correct these circuits. And, their contribution to computation is with probability 0 [2].

Pauli Web [3]

A Pauli Web is a coloring of legs of a spider with phase $k\pi$ and $\pm\frac{\pi}{2}$ where k is an integer. The coloring of a network of spiders denote **a stabilizer** for state represented by the network of spiders [3]. For example, the Pauli Web in Fig. 1 denotes stabilizers.



Pauli Web can be used for verifying correctability of an error sequence. For example, consider the following part of a linear map. Addition of spiders of the same color on the legs can be viewed as a stabilizer measurment. A linear map that equals to -1 times itself must be zero, therefore correctable.



The generation of Pauli Web can be done with Integer Programming easily according to rules in [2].

Bibliography

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