Floquetifying Quantum Error Correction Code

Yusheng Zhao and Clemens Schumann

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

Yusheng Zhao
HKUST(GZ), 1 Duxue Rd, Nanshan District, Guangzhou, Guangdong, China, email: yushengzhao2020@outlook.com

Clemens Schumann
, , email:

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].

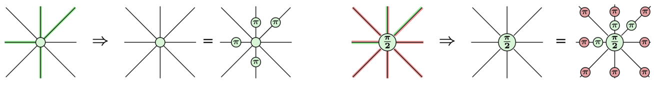
Examples of process code include stabilizer codes, subsystem codes, and Floquet codes.

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, $E = \{(e_i, t_i)\}^n_{\{i=1\}}$ 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

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 is such that adding π phase spiders of the same color on the legs preserves linear map represented by the ZX-diagram.

A usecase of Pauli Web is to verify code distance for a process code.



Bibliography

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2. Rodatz, B., Poór, B., Kissinger, A.: Floquetifying stabiliser codes with distance-preserving rewrites. arXiv preprint arXiv:2410.17240. (2024)