Encyclopedia of Stabilizer Code Operations

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Contents

1 Lattice Surgery

1.1 HERE Code

1. Shapes

   - Textbook shape d=7: 7×7 physical qubits

     ```
      ∧ ∧ ∧
      XOXOXO⟩
     ⟨OXOXOX
      XOXOXO⟩
     ⟨OXOXOX
      XOXOXO⟩
     ⟨OXOXOX
       ∨ ∨ ∨
     ```

   - (more)

2. **MORE** "Logical contributions" of physical qubit neighborhoods

   - In the bulk: 1-(1/4+1/4+1/4+1/4) = 0

```
O X
 .
X O
```

- On an edge: 1-(1/4-1/4-1/2) = 0

```
X
 .
O )
```

- Convex corner : 1-(1/4-1/2) = 1/4

```
∧
 .
O )
```

- etc
- etc
- etc

1.2 TODO Memory

1.2.1 Syndrome measurement

1.2.2 Decoding

1.2.3 Fixing

1.3 HERE Operations

1.3.1 MORE Single qubit Clifford gates

1. Pauli-{X,Z} gates

   Transversal (Only if length of observable is odd)[1]
   - Space-time cost: Time = 1 cycle
   - Error cost:
     - **Z**: with *virtual* Z-gate: 0
     - **X**, **Z** w/o virtual Z-gate: loads of 1-qubit gates

   Virtual P Flip *frame* of every physical qubit & **propagate**
   - ??? This doesn't look like it makes any sense...

   Virtual L Flip sign of logical op[1]

2. Pauli-Y gate

   Transversal (Only if lengths of Z,X observables are both odd)[1]

   Apply →Z→X→ or →X→Z→; e.g., `X{virt}, Ztrans`
   - difference is global phase
   - can be done in parallel

[1] arXiv:2307.03233 "Compilation of a simple chemistry application" (Riverlane)

1.3.2 HERE State preparation

1. **MORE** $\pm$Z, $\pm$X

   - $+\sigma$ where $\sigma \in$ {Z,X}:

     ```
     for q in dataqubits:
         q.init(+σ)
     EC(d times)
     ```

   TODO There's sure to be a shortcut for preparing -Z and -X

2. **TODO** $\pm$Y

2 Footnotes = Bibliography

1. Riverlane [1]