香港科技大學(廣州)
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY (GUANGZHOU)

Floquet Code

Definition and Low-weight Measurement

Yusheng Zhao

HKUST(GZ)

2024-10-17

香港科技大學(廣州)
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY (GUANGZHOU)

Outline

香港科技大學(廣州)
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY (GUANGZHOU)

Outline

Floquet Code needs more attention

- "Quantum error-correcting codes are a key ingredient for fault-tolerant quantum computation." [1]
- Design of quantum error correction codes concerns the improvement of [2]

  a) Code distance
  b) Ease of implementing logical gates
  c) Tradeoffs between the number of logical qubits and distance

- Surface code is not optimal by standard a) and c) [3] but has higher threshold in practice [4] due to **low-weight measurement** and **lower connectivity** hardware requirements compare to many families of qLDPC codes [5, 6]
- Floquet code is a family of codes that pushes these strength of surface code even further [7]

香港科技大學(廣州)
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY (GUANGZHOU)

Outline

香港科技大學(廣州)
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY (GUANGZHOU)

Outline

香港科技大學(廣州)
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY (GUANGZHOU)

Outline

香港科技大學(廣州)
THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY (GUANGZHOU)

Outline

Terms

- “The teraquop footprint is the number of physical qubits required to create a logical qubit reliable

enough to survive one trillion operations."

Bibliography

1. Dua, A., Tantivasadakarn, N., Sullivan, J., Ellison, T. D.: Engineering 3D Floquet Codes by Rewinding. PRX Quantum. 5, 20305–20306 (2024). https://doi.org/10.1103/PRXQuantum.5.020305
2. Fu, X., Gottesman, D.: Error Correction in Dynamical Codes, http://arxiv.org/abs/2403.04163

Terms

3. Bravyi, S., Poulin, D., Terhal, B.: Tradeoffs for Reliable Quantum Information Storage in 2D Systems. Physical Review Letters. 104, 50503–50504 (2010). https://doi.org/10.1103/PhysRevLett.104.050503

4. Fowler, A. G., Mariantoni, M., Martinis, J. M., Cleland, A. N.: Surface Codes: Towards Practical Large-Scale Quantum Computation. Physical Review A. 86, 32324–32325 (2012). https://doi.org/10.1103/PhysRevA.86.032324

5. Higgott, O., Breuckmann, N. P.: Constructions and Performance of Hyperbolic and Semi-Hyperbolic Floquet Codes, http://arxiv.org/abs/2308.03750

6. McEwen, M., Bacon, D., Gidney, C.: Relaxing Hardware Requirements for Surface Code Circuits Using Time-dynamics. Quantum. 7, 1172–1173 (2023). https://doi.org/10.22331/q-2023-11-07-1172

Terms

7. Gidney, C., Newman, M., Fowler, A., Broughton, M.: A Fault-Tolerant Honeycomb Memory. Quantum. 5, 605–606 (2021). https://doi.org/10.22331/q-2021-12-20-605