Good Quantum LDPC Codes with Linear Time Decoders

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Abstract

We construct a new explicit family of good quantum low-density parity-check codes which additionally have linear time decoders. Our codes are based on a three-term chain $(\mathbb{F}2^{m\times m})^V \xrightarrow{\delta^0} (\mathbb{F}2^m)^E \xrightarrow{\delta^1} \mathbb{F}2^F$ where V (X-checks) are the vertices, E (qubits) are the edges, and F (Z-checks) are the squares of a left-right Cayley complex, and where the maps are defined based on a pair of constant-size random codes $C_A, C_B : \mathbb{F}2^m \to \mathbb{F}2^\Delta$ where Δ is the regularity of the underlying Cayley graphs.

One of the main ingredients in the analysis is a proof of an essentially-optimal robustness property for the tensor product of two random codes.

References

[1] I. Dinur, M.-H. Hsieh, T.-C. Lin, and T. Vidick, *Good Quantum LDPC Codes with Linear Time Decoders*, arXiv:2206.07750, 2022.