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Quantum gates with optimal bandwidth in noisy environments GUANG HAO LOW, YODER THEODORE, ISAAC CHUANG, Massachusetts Inst of Tech-MIT — The traditional approach of open-loop quantum error correction suppresses certain systematic imperfections ϵ in quantum control to higher orders $\epsilon^{\mathcal{O}(\mathcal{L})}$ by a well-designed sequence of L imperfect quantum gates. However, this philosophy of maximal flatness leads to an ϵ -bandwidth that scales poorly with length and a residual that is easily overwhelmed by unaccounted sources of noise. We advance the paradigm of equiripple compensated gates that directly optimize for bandwidth given the limitations imposed by noise of magnitude δ , leading to dramatically improved performance. Where ϵ represent amplitude errors, we provide a formalism that generalizes both approaches and is effective at finding such gates. With it, we provide in closed-form the phase angles for an optimal family of population inversion gates with an $\bar{\epsilon}$ -bandwidth of $\mathcal{O}(\frac{\log \delta^{-\infty}}{\mathcal{L}})$ – a quadratic improvement over optimal maximally flat variants. We also construct optimal NOT gates and discuss extensions to other gates and error models.

> Guang Hao Low Massachusetts Inst of Tech-MIT

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