A TEMPLATE FOR ARXIV STYLE *

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ABSTRACT

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***K*eywords** First keyword · Second keyword · More

1 Introduction

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2 Contribution

3 Notation and Definitions

Definitions and assumptions

- We will use j when referring to a stabilizer, i when referring to a generator, k when referring to a bit
- We take $\boldsymbol{e}_Z$ to be the error vector
- We take $\boldsymbol{\sigma}_Z$
- Let $\mathcal{C}_Z$ be a code which can correct Z errors and $\mathcal{C}_X$ be a code a which can correct X errors.

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- Let $H_X \in F_2^{M \times N}$ be the parity check matrix for $\mathcal{C}_X$ as well as the generator for $\mathcal{C}_Z$.
- Let $H_Z \in F_2^{M \times N}$ be the parity check matrix for $\mathcal{C}_Z$ as well as the generator for $\mathcal{C}_X$.
- Let M be the number of stabilizers. Let us also only consider the case where M is the number of generators. This results from when H_Z and H_X have the same number of rows.
- Let N be the number of bits.
- Assume H_X is the adjacency matrix of a (δ, γ)-`left-expander` bipartite graph where A is the set of bits and B is the set of stabilizers. Assume the graph is Δ_B, Δ_S regular.

For the rest of the paper, we will only consider Z errors. The algorithm and analysis remain the same if considering X errors, but H_Z must be used as the generator matrix and H_X must be used as the parity check matrix.

- Note, - error vec $\boldsymbol{m}e$, syndrome vec $\boldsymbol{m}\sigma$, - Let there be M stabilizers and consequently M generators - Let there be N bits - Let H_X, H_Z - The rest of the paper will assume that we are only dealing with generator matric H_X, Z errors, parity check matric H_z and syndrome σ_Z - Let the code be formed by (δ, γ) left, bipartite, expander code with regularity where the left is B (for bits) and right is S (for stabilizer). Let it be Δ_B, Δ_S regular

Notation

4 Background

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4.1 Small Set Flip

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$$\xi_{ij}(t) = P(x_t = i, x_{t+1} = j | y, v, w; \theta) = \frac{\alpha_i(t) a_{ij}^{w_t} \beta_j(t+1) b_j^{v_{t+1}}(y_{t+1})}{\sum_{i=1}^{N} \sum_{j=1}^{N} \alpha_i(t) a_{ij}^{w_t} \beta_j(t+1) b_j^{v_{t+1}}(y_{t+1})} \tag{1}$$

4.1.1 Headings: third level

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5 Algorithm: K-Top Probabilistic Flip Method (K-Top PFM)

5.1 A Moral Reason/ Intuition

The algorithm is essentially the same as Small Set Bit Flip [TODO: CITE] with a minor difference, only a constant number of generators are checked. The idea here is that given a syndrome σ and a parity check matrix, H_X, the ith row

Algorithm 1: `sort-top-K(T)`

Data: A vector $T \in \mathbb{Z}_2^N$
Result: A set S of the top K indices in T

$S \leftarrow$ `indices of a descending radix sort of` T`'s rows`;
return A set of the top K indices in S;

Algorithm 2: `probabilistic-set-flip(`E`)`

Data: A syndrome $\sigma_0 \in \mathbb{F}_2^M$
Result: Deduced error $\widehat{E}$ if the algorithm converges and $\perp$ otherwise

$\widehat{E} \leftarrow 0^N$;
$\sigma \leftarrow \sigma_0$;
while $\exists F \in \mathscr{F} : |\sigma| - |\sigma \oplus \sigma_X(\boldsymbol{k})| > 0$ **do**
  $T \leftarrow H_Z H_X^T \sigma$;
  `generators` $\leftarrow$ `sort-top-K(`T`)`;
  `to-check` $\leftarrow \bigcup_{i \in \texttt{generators}} \mathcal{P}(\mathcal{C}_{Z_i})$;
  $\boldsymbol{k} \leftarrow \arg\max_{\boldsymbol{k} \in \texttt{to-check}} \frac{|\sigma| - |\sigma \oplus \sigma_X(\boldsymbol{k})|}{|\boldsymbol{k}|}$;
  $\widehat{E} \leftarrow \widehat{E} \oplus \boldsymbol{k}$;
  $\sigma \leftarrow \sigma \oplus \sigma_X(\boldsymbol{k})$;
end
return $\widehat{E}$ if $|\sigma| = 0$, $\perp$ otherwise.

of $H_X^T \sigma$ equals the number of error-ed checks that a qubit touches. Then, the kth row of $H_Z H_X^T \sigma$ is roughly correlated to the number of error-ed checks that the qubits in the kth generator touch. This rough correlation comes from the fact that we are working with expander codes. So then, if you get the generators touching the most error-ed stabilizers, it would stand to reason that flipping some subset of qubits from a "highly error-ed generator" would result in decreasing the syndrome.

6 PFM Analysis

7 PFM Numerical Simulations

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8 PFM Future Outlook

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9 Conclusion

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10 Acknowledgments

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11 Examples of citations, figures, tables, references

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The documentation for `natbib` may be found at

http://mirrors.ctan.org/macros/latex/contrib/natbib/natnotes.pdf

Of note is the command `\citet`, which produces citations appropriate for use in inline text. For example,

```
\citet{hasselmo} investigated\dots
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produces

> Hasselmo, et al. (1995) investigated…

https://www.ctan.org/pkg/booktabs

11.1 Figures

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11.2 Tables

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11.3 Lists

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[2] Sample of the first footnote.

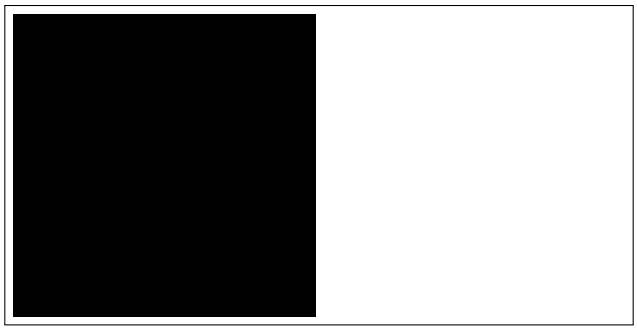

Figure 1: Sample figure caption.

Table 1: Sample table title

	Part	
Name	Description	Size (μm)
Dendrite	Input terminal	$\sim$100
Axon	Output terminal	$\sim$10
Soma	Cell body	up to 10^6

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12 Conclusion

Your conclusion here

Acknowledgments

This was was supported in part by.....

References

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