David Rich
Research Methods
Peer Review

- **Paper Title:** An algorithm for DNA read alignment on quantum accelerators
- **Authors:** Aritra Sarkar, Zaid Al-Ars, Carmen G. Almudever, Koen Bertels Department of Quantum & Computer Engineering Delft University of Technology, The Netherlands
- **Link:** **https://arxiv.org/pdf/1909.05563.pdf**

1) **Key Results: please summarize what you consider to be the outstanding features of the work.**

   - While this is mostly proof-of-concept/correctness, it's great to the types of applications and potential speedups that will be possible with quantum computing.
   - The algorithm methodology is reasonably well-explained.

2) **Validity: Does the manuscript have flaws which should prohibit its publication? If so, provide details.**

   - No, no overwhelming flaws in research methods or results.

3) **Originality & Significance: If the conclusions are not original, please provide relevant references. On a more subjective note, do you feel that the results presented are of immediate interest to many people in your discipline, or to people from several disciplines?**

   - Yes, while much of the promise of quantum computing revolution still feels far away, exploration into the implementation of scalable quantum algorithms is a critical step in this burgeoning field. And the addition of finding practical and interdisciplinary applications serves to help drive interest in its future.

4) **Data & Methodology: Validity of approach, quality of data, quality of presentation. Please note that we expect out reviewers to review all data, including supplementary information.**

   - Presentation of the data was good. Unfortunately, because the data was most theoretical or proof-of-correctness, there wasn't much for results.

5) **Appropriate use of statistics and treatment of uncertainties: All error bars should be defined in the corresponding figure legends. Please include in your report a specific comment on the appropriateness of any statistical tests, and the accuracy of the description of any error bars and probability values.**

   - The only statistics in the paper are the quantum Solution State probabilities, which seems valid.

6) **Conclusions: Are the conclusions and data interpretation robust, valid, and reliable?**

- The conclusions seem valid, though mostly speculative. The nature of the paper means there was little possibility for concrete testing. If, as they say, they were the first to implement such an algorithm, there is really no room for comparative analysis. Plus, since most of the work was done with simulation, I don't know how effective any sort of timed tests would be. So comparison of classical computing methods beyond algorithmic growth analysis may not be possible.

7) **Suggested improvements: Please list additional experiments or data that could help strengthening the work in a revision.**

- They used the toy example of pattern matching with the pattern *CA*. It may have been interesting to see how those results extended to more complex patterns, especially how it affects the Solution State.
- Depending of the journal, this paper expected the reader to have considerable understanding of quantum computing. This high threshold of accessibility could be detrimental if trying to publish in a bioinformatics or interdisciplinary magazine. Perhaps more introduction could focus on a brief overview of quantum computing concepts.
- Some deeper explanation of the quantum gate logic would've been nice. For example, I don't believe the *R* or *C* gates are defined.
- Some more information in the "No-cloning" section talks about needing to repeat the experiment multiple times, but no indication of number of times or potential cost.

8) **References: Does this manuscript reference previous literature appropriately?**

- Yes, it generally seems to be well annotated.

9) **Clarity & Context: Is the abstract clear, accessible? Are abstract introductions and conclusions appropriate?**

- Yes, the abstract does a good job explaining the contents of the paper, though it could use some
- The introduction was good, but could use more general information on quantum computing. Concepts like Hadamard gates are brought up and never explained.
- Conclusion is generally good.
- The conclusion and introduction seem a bit at odds with each other. The introduction seems to lead with the quantum computing as the primary motivation, while the conclusion starts with the genomics realm.

10) **Please indicate any particular part of the manuscript, data, or analyses that you feel is outside the scope of your expertise, or that you were unable to assess fully.**

- My understanding of quantum computing is shaky at best, so much of the qubit and gate complexity sections were unclear to me.