

## Thesis Changes Log

**Name of Candidate:** Luis Ernesto Campos Espinoza

**PhD Program:** Computational And Data Science And Engineering

**Title of Thesis:** On The Trainability Of Variational Quantum Circuits As Algorithmic Models

**Supervisor:** Prof. Jacob Daniel Biamonte

1. Page 5) Acknowledgments were added.
2. Page 17) Clarified that  $N = 2^n$  in statement 5.
3. Page 22) Minor correction to definition 8 to not assume distinct eigenvalues.
4. page 23) Minor changes to the description of Figure 1.
5. Page 24) Fixed the omission of time in the propagator after equation (1.20).
6. Page 25) Corrected  $t^* \rightarrow t$  in equation (1.26).
7. Page 29) Test rephrasing This compilation problem dates back to the start of the field of quantum information processing [94]. It is encountered when implementing algorithms on quantum hardware, as the algorithm may require gates that are not part of the native gate set of the quantum computer [138, 139].
8. Page 32) Modified definition 16 to make it more precise.
9. Page 33) Added information on the number of measurements required when using gradient-based and gradient-less optimizers in a region of barren plateaus.
10. Page 35) added a comment on the classical simulability of barren plateau free cost landscapes.
11. Page 37 rephrased : Then, we define abrupt trainability transitions, which affect variational quantum compilation when using a layer-wise strategy.
12. Page 39) Added information and justification for the use of the L-BFGS-B optimizer in this chapter.
13. Page 39) Added a discussion and justification for the choice of cost function for quantum compilation.
14. Page 48) Added a comment on other target unitaries that could lead to abrupt trainability transitions.
15. Page 49) Changed “the authors” to “we”.

16. Page 52) Added information and justification for the use of the COBYLA optimizer in this chapter.
17. Page 53) Added a discussion on the feasibility and relevance of using the projector  $|\omega\rangle\langle\omega|$ .
18. Page 77) Defined angles the QAOA angles  $\gamma, \beta$ .
19. Page 80) Extended the discussion on the leakage outside of the two dimensional subspace in unstructured search.
20. Page 82) Fixed broken citations.
21. Page 82) Rephrased: "Being by far the most studied limitation, barren plateaus (BP), as pointed out by [59], have come to be seen by many as equivalent to training limitations."
22. Page 85) Rephrased: We anticipate that as understanding of BP increases, there will be renewed interest from the community in other limitations, such as those discussed here. We believe that the insights gained from a broader exploration of training limitations will reinforce the variational model's position as a powerful and relevant approach beyond the NISQ era of quantum computing.
23. Page 85) Extended the discussion on the practical benefits of the research presented, and the relevance of the results for current and future quantum computers.
24. Changed "ansatze" to "ansatzes" throughout the thesis.
25. Changed "layerwise" to "layer-wise" throughout the thesis.
26. Typos were corrected throughout the thesis
27. Extra indents were corrected throughout the thesis