

# LIAM MADDEN

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## RESEARCH

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My research is in analysis, linear algebra, optimization, differential topology, and measure theory with applications to power systems, machine learning, and quantum computing. Specifically,

- I derive convergence bounds for online and stochastic optimization algorithms,
- I apply optimization techniques to quantum circuit compilation,
- I investigate the memory capacity and optimization landscape of machine learning models.

## EDUCATION

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|---------------------------------------|-------------|
| <b>University of Colorado Boulder</b> | Boulder, CO |
| Ph.D., Applied Mathematics            | 2017 - 2022 |
| M.S., Applied Mathematics             | 2017 - 2020 |
| <b>GPA: 3.92</b>                      |             |

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|---|---------------------|
| <b>California Polytechnic State University</b>        | San Luis Obispo, CA |
| B.S.'s, Mechanical Engineering and Mathematics        | 2012 - 2017         |
| <b>Magna Cum Laude</b>                                |                     |
| Charles J. Hanks Excellence in Math Award             | 2017                |
| George H. McMeen Scholarship (Mathematics Department) | 2016                |

## POSITIONS

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| <b>DSI Postdoctoral Fellow</b>                     | 2022 - Present |
| University of British Columbia                     |                |
| Advised by Christos Thrampoulidis and Mark Schmidt |                |

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| <b>Research Intern</b>      |      |
| IBM Dublin                  | 2021 |
| IBM Yorktown Heights        | 2020 |
| Advised by Andrea Simonetto |      |

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| <b>Research Assistant</b>                         | 2019 - 2022 |
| University of Colorado Boulder                    |             |
| Advised by Emiliano Dall'Anese and Stephen Becker |             |

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| <b>Teaching Assistant</b>   | 2017 - 2019 |
| University of Colorado Boulder  |             |
| Classes: APPM 1360, Calculus 2 for Engineers                          |             |
| APPM 2350, Calculus 3 for Engineers                                   |             |
| APPM 2360, Introduction to Differential Equations with Linear Algebra |             |

## PAPERS

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Memory Capacity of Two Layer Neural Networks with Smooth Activations. [Liam Madden](#), Christos Thrampoulidis. *arXiv preprint: arXiv:2308.02001*, 2023.

A Stochastic Operator Framework for Optimization and Learning with Sub-Weibull Errors. Nicola Bastianello, Liam Madden, Ruggero Carli, Emiliano Dall’Anese. *arXiv preprint: arxiv:2105.09884*, 2021.

Convergence of the Inexact Online Gradient and Proximal-Gradient Under the Polyak-Lojasiewicz Condition. Seunghyun Kim, Liam Madden, Emiliano Dall’Anese. In *IEEE Conference on Decision and Control*, 2022.

Sketching the Best Approximate Quantum Compiling Problem. Liam Madden, Albert Akhriev, Andrea Simonetto. In *IEEE International Conference on Quantum Computing and Engineering (QCE)*, 2022.

First-Order Methods for Online and Stochastic Optimization, and Approximate Compiling. Liam Madden. Dissertation, *University of Colorado Boulder*, 2022.

Best Approximate Quantum Compiling Problems. Liam Madden, Andrea Simonetto. *ACM Transactions on Quantum Computing*, 3(2):1-29, 2022.

High-probability Convergence Bounds for Non-convex Stochastic Gradient Descent. Liam Madden, Emiliano Dall’Anese, Stephen Becker. *arXiv preprint: arxiv:2006.05610*, 2021.

Bounds for the Tracking Error of First-Order Online Optimization Methods. Liam Madden, Stephen Becker, Emiliano Dall’Anese. *Journal of Optimization Theory and Applications*, 189:437-457, 2021.

Optimization and Learning with Information Streams: Time-varying Algorithms and Applications. Emiliano Dall’Anese, Andrea Simonetto, Stephen Becker, Liam Madden. *IEEE Signal Processing Magazine*, 37(3):71-83, 2020.

Online Sparse Subspace Clustering. Liam Madden, Stephen Becker, Emiliano Dall’Anese. In *IEEE Data Science Workshop (DSW)*, 2019.

## TALKS AND CODE

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Tracking Error Bounds for Smooth Strongly Convex Time-Varying Optimization. Liam Madden. Talk at *SIAM Conference on Optimization*, 2023.

Contributed to “Approximate Quantum Compiler” in *Qiskit Terra*. Documentation: [https://qiskit.org/documentation/apidoc/synthesis\\_aqc.html](https://qiskit.org/documentation/apidoc/synthesis_aqc.html), 2021.

Best Approximate Quantum Compiling Problems. Liam Madden. Scientific/Technical Talk at *European Quantum Technologies Conference (EQTC)*, 2021.