Amin Idelhaj

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Summary

A mathematician with a 2026 PhD from UW-Madison, where the dissertation concerned random walks on high-dimensional expanders, now works in quantum error correction, on decoder benchmarking for the gross code and a neural decoder for bivariate bicycle codes. The aim is a research or software role in the field.

Education

PhD in Mathematics, University of Wisconsin-Madison May 2026
Dissertation: Random Walks on Density-Ramanujan Complexes (paper in preparation).
Advisor: Simon Marshall. Interests: probability, graph theory, analysis on groups, expanders.

BA in Mathematics with Honors, University of Chicago June 2019
Paul R. Cohen Memorial Prize (2019).

Projects

Decoder fixes for sub-distance failures on the gross code | github.com/Daminark/decoder-fixes-gross (in progress, Oct 2026 to present)

- Reproduced the Relay-BP total of 143,350 failing trapping sets against 152,857 in Pacenti, Raveendran and Vasić, within 10 percent, on the $[\![144,12,12]\!]$ bivariate bicycle code.
- Reduced the published list of 92 million trapping sets to 1.3 million representatives under the code's translation symmetry, after verifying it is the full automorphism group of the detector error model.
- Benchmarking decoder fixes (BP+OSD, BP+LSD, Relay-BP, weight-4 fault augmentation) on the same failures; results December 2026.

Cascade neural decoder for bivariate bicycle codes | (in progress, Nov 2026 to present)

- Reimplementing the Cascade decoder (Gu, Bonilla Ataides, Lukin, Yelin, 2026) in PyTorch from the paper, with translation-equivariance tests and a BP+OSD baseline on the same samples as the first milestones.

Clifford noise reduction (CliNR) in Stim | github.com/Daminark/clifford-noise-reduction

- Implemented the CliNR scheme (Delfosse and Tham, PRL 2025) and its CZ variant, with analytic bounds and Monte Carlo estimators whose confidence intervals account for the clustering from drawing checks.
- Measured how tight the bounds are as a guide to choosing parameters (up to 25.8 times above the simulated rate).

Experience

Graduate Assistant and Dissertator, University of Wisconsin-Madison Aug 2019 to May 2026
Graduate Assistant, Aug 2019 to Jul 2025. Dissertator, Aug 2025 to May 2026.

- Instructor of record for Preparatory Algebra (course design, lectures, assessment).
- Teaching assistant for calculus for STEM and business students (discussion sections of 25 to 30, office hours, grading); Outstanding TA Award, 2021.
- Coordinated the Graduate Peer Mentor Program and mentored in the Directed Reading Program.

Training

Quantum Computing Boot Camp, The Erdős Institute Summer 2026
Completed two projects, state preparation and then CliNR; the CliNR project received Top Project recognition.

Summer School on High-Dimensional Expanders, Ghent University 2023

Talks

Random Walks on Ramanujan Graphs, GTA Conference, Temple University 2024
Kazhdan's Property (T), GTA Conference, Temple University 2025

Skills

Python, Stim, Git; decoders used: Relay-BP, ldpc (BP+OSD)