Lyle Regenwetter

Massachusetts Institute of Technology

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Education

Massachusetts Institute of Technology *2020 – Present*
- Ph.D. Candidate (May 2026 anticipated)
- S.M. in Mechanical Engineering (May 2022)

University of Illinois Urbana–Champaign *2016 – 2020*
- B.S. in Mechanical Engineering with highest honors
- B.S. in Electrical Engineering with high honors
- Minor in Computer Science

Research Experience

MIT Design Computation and Digital Engineering Lab *2020 - Present*

Graduate Research Assistant, Inaugural Member (Advisor: Prof. Faez Ahmed) *Cambridge, MA*
- Investigating GenAI + design optimization frameworks with GenAI's flexibility and optimization's precision guarantees.
- Pioneering new GenAI formulations that train on counterexamples and use 1/8 the data, yet violate 1/6 the constraints.
- Advancing datasets and benchmarks for GenAI in engineering, used at 15+ institutions and in 30+ publications.
- Developing synthetic data that resembles engineering data to train foundation models for engineering design.

UIUC Networked Autonomous Vehicles Laboratory *2019 - 2020*

Undergraduate Research Assistant (Advisor: Prof. Geir E. Dullerud) *Urbana, IL*
- Led design, localization, and control of autonomous hovercraft for research on multimodal drone swarms.

UIUC Smith Research Group *2019 - 2020*

Undergraduate Research Assistant (Advisor: Prof. Kyle C. Smith) *Urbana, IL*
- Designed, optimized, and developed recirculation system for Cation Intercalation Desalination (CID) cell.

UIUC Center for Plasma-Material Interactions *2017 - 2019*

Undergraduate Research Assistant (Advisor: Prof. David N. Ruzic) *Urbana, IL*
- Designed magnet pack geometry and electrical pulse waveform to optimize atomic deposition processes.

Journal Publications

J1. Generative Optimization: A Perspective on AI-Enhanced Problem Solving in Engineering. Picard, C.; Regenwetter, L.; Nobari, A. H.; Srivastava, A.; Ahmed, F. (2025). **Nature,** *Under Review*

J2. NITO: Neural Implicit Fields for Resolution-free and Domain-Adaptable Topology Optimization. Nobari, A. H.; Regenwetter, L.; Giannone, G.; Ahmed, F. (2025). **Transactions on Machine Learning Research.** Project page

J3. Multi-Objective Counterfactuals for Design: A Model-Agnostic Counterfactual Search Method for Multi-Modal Design Modifications. Regenwetter, L.; Abu Obaideh, Y.; Ahmed, F. (2025). **Journal of Mechanical Design,** 147(2), 021401. Project page

J4. Constraining Generative Models for Engineering Design with Negative Data. Regenwetter, L.; Giannone, G.; Srivastava, A.; Gutfreund, D.; Ahmed, F. (2024). **Transactions on Machine Learning Research.** Project page

J5. Beyond Statistical Similarity: Rethinking Metrics for Deep Generative Models in Engineering Design. Regenwetter, L.; Srivastava, A.; Gutfreund, D.; Ahmed, F. (2023). **Computer Aided Design,** 165, 103609. Project page; News article. Most cited CAD paper published since 2023

J6. FRAMED: An AutoML Approach for Structural Performance Prediction of Bicycle Frames. Regenwetter, L.; Weaver, C.; Ahmed, F. (2023). **Computer Aided Design,** 156, 103446. Project page

J7. Deep Generative Models in Engineering Design: A Review. Regenwetter, L.; Nobari, A. H.; Ahmed, F. (2022). **Journal of Mechanical Design,** 144(7), 071704. Most cited JMD paper published since 2020; Most accessed in JMD (2024)

J8. BIKED: A Dataset for Computational Bicycle Design with Machine Learning Benchmarks. Regenwetter, L.; Curry, B.; Ahmed, F. (2022). **Journal of Mechanical Design,** 144(3), 031706. Project page

J9. Low porosity, high areal-capacity Prussian blue analogue electrodes enhance salt removal and thermodynamic efficiency in symmetric Faradaic deionization with automated fluid control. Reale, E. R.; Regenwetter, L.; Agrawal, A.; Dardon, B.; DiCola, N.; Sanagala, S.; Smith, K. C.. (2021). **Water Research X,** 13, 100116. News article

Peer-Reviewed Conference Publications

C1. BikeBench: A Bicycle Design Benchmark for Generative Models with Objectives and Constraints. Regenwetter, L.; Abu Obaideh, Y.; Chiotti, F.; Lykourentzou, Y.; Ahmed, F. (2025). **Advances in Neural Information Processing Systems.** Project page

C2. Optimize Any Topology: A Foundation Model for Shape- and Resolution-Free Topology Optimization. Nobari, A. H.; Regenwetter, L.; Picard, C.; Han, L.; Ahmed, F. (2025). **Advances in Neural Information Processing Systems**

C3. From Positive to Negative: On the Role of Negative Data in Enhancing Generative Models for Engineering Constraint Satisfaction. Regenwetter, L.; Ahmed, F. (2024). **International Conference on Dynamic Data-Driven Application Systems**

C4. Towards Domain-Adaptive Resolution-Free 3D Topology Optimization with Neural Implicit Fields. Nobari, A. H.; Regenwetter, L.; Ahmed, F. (2024). **International Design Engineering Technical Conferences,** 88360. Project page

C5. Counterfactuals for Design: A Model-Agnostic Method for Design Recommendations. Regenwetter, L.; Abu Obaideh, Y.; Ahmed, F. (2023). **International Design Engineering Technical Conferences,** 87301. Project page

C6. Learning from Invalid Data: On Constraint Satisfaction in Generative Models. Giannone, G.; Regenwetter, L.; Srivastava, A.; Gutfreund, D.; Ahmed, F. (2022). **NeurIPS Workshop on Diffusion Models**. Project page

C7. Design Target Achievement Index: A Differentiable Metric to Enhance Deep Generative Models in Multi-Objective Inverse Design. Regenwetter, L.; Ahmed, F. (2022). **International Design Engineering Technical Conferences,** 86236. Project page

C8. Towards Goal, Feasibility, and Diversity-Oriented Deep Generative Models in Design. Regenwetter, L.; Ahmed, F. (2022). **ICML Workshop on Machine Learning in Computational Design**

C9. BIKED: A Dataset and Machine Learning Benchmarks for Data-Driven Bicycle Design. Regenwetter, L.; Curry, B.; Ahmed, F. (2021). **International Design Engineering Technical Conferences,** 85383. Project page

Select Research Presentations

P1. BikeBench: A Bicycle Design Benchmark for Generative Models with Objectives and Constraints (2025). **Neural Information Processing Systems,** San Diego, CA. Project page. Poster

P2. Optimize Any Topology: A Foundation Model for Shape- and Resolution-Free Topology Optimization (2025). **Neural Information Processing Systems,** San Diego, CA. Poster

P3. Towards Machines that Design Machines (2025). **NSF Workshop on AI in EDSE,** West Lafayette, IN. Poster

P4. Selecting the Best Counterexamples: Examining the Role of Negative Data Quality in Negative-Data Generative Models (2025). **International Design Engineering Technical Conferences,** Anaheim, CA. Project page. Talk

P5. Is Our Data Special? A Meta-Analysis of Engineering Datasets (2025). **International Design Engineering Technical Conferences,** Anaheim, CA. Talk

P6. Bike-Bench: A Bicycle Design Benchmark for Generative Models with Objectives and Constraints (2025). **International Design Engineering Technical Conferences,** Anaheim, CA. Project page. Talk

P7. Generative AI for Design Synthesis: Objectives, Evaluation, and Challenges (2025). **IDETC: Data to Design Workshop,** Anaheim, CA. Invited talk

P8. From Positive to Negative: On the Role of Negative Data in Enhancing Generative Models for Eng. Constraint Satisfaction (2024). **Intl. Conference on Dynamic Data-Driven Application Systems,** New Brunswick, NJ. Project page. Talk

P9. Training Generative Models to Satisfy Design Constraints with Negative Data (2024). **International Design Engineering Technical Conferences,** Washington, DC. Project page. Talk

P10. Design Synthesis with Generative AI
(2024). **IDETC: Data to Design Workshop,** Washington, DC. Invited talk

P11. Computation in Design: Bridging the Gap from Data to Reality
(2024). **Boston Design Week Opening Ceremony,** Cambridge, MA. Invited talk; Panel

P12. Constraining Generative Models for Engineering Design with Negative Data
(2023). **NeurIPS Diffusion Models Workshop,** New Orleans, LA. Project page. Poster

P13. Design Target Achievement Index: A Differentiable Metric to Enhance Generative Models in Multi-Objective Inverse Design
(2022). **International Design Engineering Technical Conferences,** St. Louis, MO. Project page. Talk

P14. Towards Goal, Feasibility, and Diversity-Oriented Deep Generative Models in Design
(2022). **ICML Workshop on Machine Learning in Computational Design,** Baltimore, MD. Poster

P15. BIKED: A Dataset and Machine Learning Benchmarks for Data-Driven Bicycle Design
(2021). **International Design Engineering Technical Conferences,** Virtual. Project page. Talk

Teaching & Advising

Teaching Assistant *2021 - Present*

MIT 2.155/6: Artificial Intelligence and Machine Learning for Engineering Design (News article) *Cambridge, MA*

- Designed challenge problems, course demos, and reading assignments for first five course offerings.
- Average instructor evaluation score: 6.7/7.0 over 78 evaluations.

Undergraduate Research Supervisor *2021 - 2025*

Massachusetts Institute of Technology *Cambridge, MA*

- Supervised 8 MIT undergraduate researchers, scoping projects, guiding methods, and supervising analysis.
- These students are coauthors of J6, and P5, and have contributed to J3, C1, C5, P1, and P6.

High School Research Mentor *2020 - 2025*

Various Volunteering & Research Programs *Virtual*

- Mentored 20+ high school scholars' research projects and first publications in engineering and computer science.
- Students' achievements include 5+ national science fair honors, 5+ preprints, 3 conference talks, and 2 journal papers.

Industry Experience

Apple *2025*

ML Intern, All-Scale Modeling Team, Exploratory Design *Cupertino, CA*

- Developed advanced algorithmic optimization and ML techniques for computational design simulations.
- Delivered substantial performance improvements and memory footprint reduction.
- Led technical feasibility analysis and project scoping for Apple product simulation frameworks.

Boeing *2019*

Electrical Engineering Intern *Huntsville, AL*

- Improved feedback logic for a variety of sensors on remote silo doors by eliminating failure points and complexity.
- Identified and corrected multiple critical errors and consolidated design components in a central design system.

Denso *2018*

Process Engineering Research and Development Intern *Battle Creek, MI*

- Developed a contactless measurement system for part verification using infrared laser array.
- Identified $5.4 million discrepancy in scrap accounting via field investigation, reported to Denso global president.
- Led systematic investigation into 3D printing and post-processing methods for service part fabrication.

Scholarships & Honors

2024 MIT Morningside Academy of Design Fellow
2022 NSF Graduate Research Fellowship, Honorable Mention
2022 ASME-CIE Hackathon, Third Place
2020 ASME-IMECE Hackathon, Runner-up
2020 UIUC Dean's list (9x)
2020 UIUC Kenneth J. Trigger Award
2019 Association for Facilities Engineering Scholar
2016 UIUC Chancellor's Scholar
2016 UIUC Edmund J. James Scholar

Service

Reviewing

- **Journals**: Design Science (2×), Ain Shams Engineering Journal (1×), Archives of Computational Methods in Engineering (1x), Computer-Aided Design (1×), Discover Mechanical Engineering (1×), Engineering Applications of Artificial Intelligence (1×), Engineering Computations (1×), Frontiers in Built Environment (1x), Journal of Computational Design and Engineering (1×), Journal of Computing and Information Science in Engineering (1×), npj Artificial Intelligence (1×), Scientific Reports (1×), and Sports Engineering (1×).
- **Conferences**: International Design Engineering Technical Conferences (10×)

Conference Organization

ASME International Design Engineering Technical Conferences

- Session chair and review coordinator (2025-present)
- Initiated new conference session: 'Cultivating Datasets for Engineering Design' (2025)

Skills

AI/ML	ML fundamentals, generative, supervised, DL (CNN, transformer, etc.), RL, autoML, explainability, foundation models
Optimization	Heuristic (GA, PSO, SA, etc.), gradient-based (SGD, BFGS, Adam, etc.), continuous, discrete, constrained
Design	Mechanical (product, machine, robot), electrical (PCB, power, digital), CAD (CREO, Solidworks, KiCAD, etc.), simulation
Coding	Advanced: Python, torch, TF, scipy, numpy, sklearn, LaTeX; Proficient: Matlab, C++; Intermediate: C, Julia, HTML
Computing	Algorithms, parallelism, numerical methods, linear solvers (GE, Krylov, preconditioning, etc.), sparse computation
Grant Writing	MIT CAPD Certification: Formal instruction, exercises, and assessment in grant writing techniques and methods