Nicholas Konz

Applied Machine Learning Researcher

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ABOUT ME

Machine learning (ML) researcher with experience in applied ML problems, whose Ph.D. research specializes in medical image analysis. Proficient at ML research that covers a broad spectrum of application-focused to foundational; skilled with using deep learning to solve challenging problems on real-world data, as well as being interested in how foundational ML concepts behave differently and need to be adapted for medical image analysis and other applied computer vision domains. Also drawn to the intersection of machine learning and science: understanding deep learning through a scientific lens, and leveraging it for scientific modeling, discovery, and applications in science-adjacent domains, influenced by a background in physics.

EDUCATION

2021 – 2025 (EXPECTED) **Doctor of Philosophy (Electrical and Computer Engineering)**
GPA: 3.88/4.00, SIGMA XI
Duke University

2016 – 2020 **Physics B.S. and Mathematics B.A.**
GPA: 3.91/4.00, HIGHEST HONORS, HIGHEST DISTINCTION, PHI BETA KAPPA
University of North Carolina at Chapel Hill

WORK EXPERIENCE

Doctoral Researcher

JAN 2021 – DEC 2025 (EXPECTED)

Duke University, Durham, NC, USA

- **Key skills:** Deep Learning, Computer Vision, Generative Models, Domain Adaptation and Image-to-Image Translation, Anomaly Detection.
- Ph.D. research which has contributed a diverse range of novel ML methodologies and discoveries in medical image analysis:
  1) Discovered and modeled key discrepancies in how neural networks learn and generalize differently from medical images compared to natural images. Contributed methodologies for the guided generation of medical images, including new models and evaluation metrics. Led diverse advancements in machine learning for breast imaging (*e.g.*, MRI and DBT) in clinically impactful areas such as self-supervised anomaly detection, domain adaptation, and tumor detection.
  2) Published multiple first-author papers in top machine learning and medical image analysis conferences (*e.g.*, ICLR, MICCAI, MIDL) and journals (*e.g.*, Medical Image Analysis).
  3) All research projects have a focus on the public release of usable and documented code, datasets, and other accompanying materials to benefit the research community, which have gained hundreds of stars on GitHub.

Data Scientist Intern

MAY 2023 – JULY 2023

Pacific Northwest National Laboratory, Richland, WA, USA

- **Key skills:** Adversarial Machine Learning, AI Interpretability.
- Research in ML robustness and interpretability resulted in a first-author oral paper presentation at the ATTRIB workshop at NeurIPS 2023 and a third-author paper at EMNLP 2023, in addition to various internal projects.

Research Assistant

AUG 2017 – DEC 2020

UNC/Skynet Robotic Telescope Network, Chapel Hill, NC, USA

- **Key skills:** Statistical Algorithms, Outlier Detection, Numerical Methods, Monte Carlo Methods, Open Source.
- Undergraduate research in statistical computational methods for astronomy, focused on developing a suite of algorithms for robust outlier detection and uncertainty-aware model fitting. Resulted in the release of public code packages, web interfaces, and accompanying publications. Senior honors thesis can be found here.

TECHNICAL SKILLS

PROGRAMMING	Python (NumPy, Pandas, scikit-learn, etc.), PyTorch, C++/C, Bash, LaTeX, JavaScript, HTML
DEVOPS	Git, Open Source, Docker, Vim, C++-to-Python wrapping

PROFESSIONAL SKILLS

COMMUNICATION	Experienced speaker at international conferences and workshops. Confident in presenting and explaining project ideas to peers, leadership, and collaborators.
WRITING	Accomplished in academic writing as an author and reviewer in leading conferences and journals. Major contributor to several large grant proposals (*e.g.*, NIH R01).
PROJECT MANAGEMENT	Experienced mentor and manager of peers, junior researchers and students in various projects. Proficient in planning, organizing, and coordinating resources/tasks to achieve goals effectively.

SELECTED PUBLICATIONS

N. Konz, M. A. Mazurowski."The Effect of Intrinsic Dataset Properties on Generalization: Unraveling Learning Differences Between Natural and Medical Images". ***ICLR*, 2024**

N. Konz, Y. Chen, H. Gu, H. Dong, M.A. Mazurowski. "Anatomically-Controllable Medical Image Generation with Segmentation-Guided Diffusion Models". ***MICCAI*, 2024**

N. Konz, M.A. Mazurowski. "Pre-processing and Compression: Understanding Hidden Representation Refinement Across Imaging Domains via Intrinsic Dimension". ***NeurIPS Workshop on Scientific Methods for Understanding Deep Learning*, 2024**

N. Konz, Y. Chen, H. Gu, H. Dong, M.A. Mazurowski. "Rethinking Perceptual Metrics for Medical Image Translation". ***MIDL* (Short Paper Track), 2024**

N. Konz, H. Dong, M.A. Mazurowski. "Unsupervised anomaly localization in high-resolution breast scans using deep pluralistic image completion". ***Medical Image Analysis*, 2023**

N. Konz*, M. Buda*, et al. "A Competition, Benchmark, Code and Data for Using Artificial Intelligence to Detect Lesions in Digital Breast Tomosynthesis". ***JAMA Network Open*, 2023**

N. Konz, C. Godfrey, M. Shapiro, J. Tu, H. Kvinge, D. Brown. "Attributing Learned Concepts in Neural Networks to Training Data". ***NeurIPS Workshop on Attributing Model Behavior at Scale (Oral)*, 2023**

N. Konz, M.A. Mazurowski. "Reverse Engineering Breast MRIs: Predicting Acquisition Parameters Directly from Images". ***MIDL*, 2023**

N. Konz, H. Gu, H. Dong, M. A. Mazurowski. "The Intrinsic Manifolds of Radiological Images and their Role in Deep Learning". ***MICCAI*, 2022.**

Full list on Google Scholar.

REVIEWING EXPERIENCE

CONFERENCES	ICLR, CVPR, ICCV, ECCV, MICCAI, WACV, MIDL
JOURNALS	IEEE Transactions on Medical Imaging, IEEE Journal of Biomedical and Health Informatics, MELBA, Scientific Data, Journal of Digital Imaging, Mathematics and Computers in Simulation
WORKSHOPS	NeurIPS: Workshop on Scientific Methods for Understanding Deep Learning

TEACHING/MENTORING EXPERIENCE

Graduate Teaching Assistant 2022 – 2023

Duke University, Durham, NC

- For ECE 685D: Introduction to Deep Learning under Prof. Vahid Tarokh. Responsibilities included lecturing, teaching lab sections, leading projects, office hours, assignment and exam creation, and grading.

Undergraduate Teaching Assistant 2017 – 2018

UNC Chapel Hill, Chapel Hill, NC

- For MATH 528: Mathematical Methods for the Physical Sciences, MATH 233: Multivariable Calculus, and PHYS 119: Introductory Calculus-Based Electromagnetism.

Educator/Coordinator 2018 – PRESENT

Green Bank Radio Observatory, Green Bank, WV

- For ERIRA, a yearly week-long intensive radio astronomy research program for early college students led by Prof. Daniel Reichart of UNC Chapel Hill. Projects led involve machine learning for astronomy.

TALKS AND TUTORIALS

What Actually is Artificial Intelligence, and How Does it Relate to Astronomy? | Talk AUG. 2024 AND 2022
Educational Research in Radio Astronomy (ERIRA) 2022 and 2024, Green Bank Radio Observatory/UNC Chapel Hill.

The Intrinsic Manifolds of Radiological Images and their Role in Deep Learning | Talk OCT. 2022
The Pacific Northwest Seminar on Topology, Algebra, and Geometry in Data Science, Univ. of Washington Math Dept.

Train a Neural Network to Detect Breast MRI Tumors with PyTorch | Online Tutorial 2022
Part 1 and Part 2; featured on the Editors' Picks of Towards Data Science.

RELEVANT COURSEWORK

(Graduate and Undergraduate)

COMPUTER SCIENCE	Deep Learning, Advanced Topics in Deep Learning, Probabilistic Machine Learning, Generative Models, Natural Language Processing, Adversarial Machine Learning, Engineering Deep Neural Networks, Vector Space Methods, Numerical Techniques, Physical Modeling
MATHEMATICS	Multivariable Calculus, Linear Algebra, Probability, Real Analysis, Complex Analysis, Ordinary Differential Equations I & II, Partial Differential Equations, Fourier Analysis
PHYSICS & ASTRONOMY	Classical Mechanics, Electromagnetism I & II, Quantum Mechanics I & II, Quantum Computing, Cosmology, Astrophysics, Thermodynamics, Experimental Techniques, Astronomical Data