

Nicholas (Nick) Konz

Machine Learning Researcher

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ABOUT ME

Machine learning (ML) researcher with expertise ranging from foundational deep learning to application-oriented computer vision (namely medical image analysis). Proficient in conducting research that bridges foundational concepts with application-driven problem solving, ensuring both methodological rigor and real-world relevance. Skilled at leveraging deep learning to address challenging real-world data problems, with a particular interest in how foundational methods must adapt to applied domains such as medical imaging. Drawn to the intersection of ML and science—both using a scientific lens to understand deep learning and applying it to modeling, discovery, and applications in adjacent scientific domains—building on an undergraduate background in physics and mathematics.

For future research, I am interested in a core challenge in multimodal learning: creating unified representations across diverse modalities (imaging, text, video, etc.) when relevant features are subtle and vary notably across modalities, a common difficulty in domains such as healthcare. My approach will leverage the geometric intrinsic manifold properties of the data to understand how to create representations that are generalizable across different real-world scenarios.

EDUCATION

JAN 2021 – DEC 2025 (EXPECTED) **Ph.D. in Electrical and Computer Engineering**

GPA: 3.90/4.00
Duke University

AUG 2016 – MAY 2020 **B.S. in Physics and B.A. in Mathematics**

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, Generalization Analysis, Anomaly Detection.
- **Key contributions:** 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, Interpretable Machine Learning.
- **Key contributions:** Research in AI robustness and interpretability which 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.

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

- **Key skills:** Statistical Algorithms, Outlier Detection, Numerical Methods, Monte Carlo Methods, Open Source.
- **Key contributions:** 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 presenter at international conferences and workshops.
Skilled at communicating complex ideas to peers, leadership, and collaborators.

WRITING Accomplished academic writer and reviewer for leading conferences and journals.
Major contributor to multiple competitive grant proposals (e.g., NIH R01).

PROJECT MANAGEMENT Proven mentor, leader, and collaborator in both lab and multi-institutional projects.
Proficient in planning, organizing, and coordinating resources to achieve research goals effectively.

SELECTED PUBLICATIONS

H. Gu*, Y. Chen*, **N. Konz**, Q. Li, M. A. Mazurowski. “Are Vision Foundation Models Ready for Out-of-the-Box Medical Image Registration?”. *MICCAI Workshop on AI and Imaging for Diagnostic and Treatment Challenges in Breast Care (Oral, Best Paper Award)*, 2025 [🔗](#)

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 [🔗](#)

H. Dong, **N. Konz**, H. Gu, M.A. Mazurowski. “Medical Image Segmentation with InTEnt: Integrated Entropy Weighting for Single Image Test-Time Adaptation”. *CVPR Workshop on Domain Adaptation, Explainability, Fairness in AI for Medical Image Analysis (Oral)*, 2024 [🔗](#)

N. Konz, Y. Chen, H. Gu, H. Dong, M.A. Mazurowski. “Rethinking Perceptual Metrics for Medical Image Translation”. *MIDL (Short Paper Track)*, 2024 [🔗](#)

D. Brown, C. Godfrey, **N. Konz**, J. Tu, H. Kvinge. “Understanding the Inner-workings of Language Models Through Representation Dissimilarity”. *EMNLP*, 2023. [🔗](#)

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*, H. Gu, A. Saha, J. Yang, J. Chłędowski, 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, updated list on [Google Scholar](#). “*” denotes equal contribution.

SELECTED PRE-PRINTS (UNDER REVIEW)

H. Dong, Y. Chen, H. Gu, **N. Konz**, Y. Chen, Q. Li, M. A. Mazurowski. “MRI-CORE: A Foundation Model for Magnetic Resonance Imaging”. [arXiv:2506.12186, 2025](#)

N. Konz*, R. Osuala*, P. Verma, Y. Chen, H. Gu, H. Dong, Y. Chen, A. Marshall, L. Garrucho, K. Kushibar, D. M. Lang, G. S. Kim, L. J. Grimm, J. M. Lewin, J. S. Duncan, J. A. Schnabel, O. Diaz, K. Lekadir, M. A. Mazurowski. “Fréchet Radiomic Distance (FRD): A Versatile Metric for Comparing Medical Imaging Datasets”. [arXiv:2412.01496, 2024](#)

Y. Zhang*, **N. Konz***, K. Kramer, M. A. Mazurowski. “Quantifying the Limits of Segmentation Foundation Models: Modeling Challenges in Segmenting Tree-Like and Low-Contrast Objects”. [arXiv:2412.04243, 2024](#)

Y. Chen, **N. Konz**, H. Gu, H. Dong, Y. Chen, L. Li, J. Lee, M. A. Mazurowski. “ContourDiff: Unpaired Image-to-Image Translation with Structural Consistency for Medical Imaging”. [arXiv:2403.10786, 2024](#)

REVIEWING EXPERIENCE

CONFERENCES ICLR, CVPR, ICCV, ECCV, MICCAI, WACV, MIDL

JOURNALS IEEE Transactions on Pattern Analysis and Machine Intelligence, IEEE Transactions on Medical Imaging, IEEE Transactions on Image Processing, IEEE Journal of Biomedical and Health Informatics, Neural Networks, Machine Learning for Biomedical Imaging (MELBA), Scientific Data, Artificial Intelligence In Medicine, 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

- As a sophomore, TA'd for MATH 528: Mathematical Methods for the Physical Sciences (ODEs II, Fourier Analysis, etc.), MATH 233: Multivariable Calculus, and PHYS 119: Introductory Calculus-Based Electromagnetism.

Educator/Coordinator

2018 – PRESENT

Green Bank Radio Observatory, Green Bank, WV / UNC Chapel Hill

- 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 close mentorship in deep learning for astronomy.

TALKS AND TUTORIALS

What Actually is Artificial Intelligence, and How Does it Relate to Astronomy? | Talk AUG. 2025, 2024 AND 2022
Educational Research in Radio Astronomy (ERIRA) 2022, 2024, and 2025, 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, Numerical Techniques, Physical Modeling
MATHEMATICS	Multivariable Calculus, Linear Algebra, Probability, Real Analysis, Complex Analysis, Ordinary Differential Equations I & II, Partial Differential Equations, Fourier Analysis, Vector Space Methods
PHYSICS & ASTRONOMY	Classical Mechanics, Electromagnetism I & II, Quantum Mechanics I & II, Quantum Computing, Cosmology, Astrophysics, Thermodynamics/Stat. Mech., Experimental Techniques, Astronomical Data

HONORS AND AWARDS

Judges' Choice Award

2022

Pratt School of Engineering, Duke University, Durham, NC

For my paper, "The Intrinsic Manifolds of Radiological Images and their Role in Deep Learning", presented at the Pratt School of Engineering Fall 2022 poster session.

Benjamin Swalin Orchestra Award

2020

Department of Music, UNC Chapel Hill, Chapel Hill, NC

This award was established in 2000 in honor of Maestro Swalin, former conductor of the UNC Symphony Orchestra and subsequently Music Director of the North Carolina Symphony for 33 years. The award is given to graduating seniors who have made significant contributions in artistry and leadership to the UNC orchestra program during their undergraduate years. The recipients are determined by the orchestra director.

NC Space Summer Research Grant

2019

NC Space Grant, NASA

Each year, NC Space Grant awards Undergraduate Research Scholarships to students who are pursuing careers in science, technology, engineering and mathematics (STEM) fields that support NASA's Mission Directorates. This competitively awarded program engages the future STEM workforce in basic and/or applied aerospace-related research projects and facilitates the development of mentor relationships between students, faculty and the NASA community. (For my research in statistical techniques for astronomy).

Robert Shelton Award for Outstanding Research

2019

Department of Physics and Astronomy, UNC Chapel Hill, Chapel Hill, NC

For my research in statistical techniques for astronomy.

Most Innovative Hack

2018

HackNC 2018 Hackathon, UNC Chapel Hill, Chapel Hill, NC

For our five-person team project, "Simulating the Spread of Ideas with Epidemiology" at the 2018 HackNC 24 hour hackathon.

Earl Nelson Mitchell Scholarship in Physics

2018

Department of Physics and Astronomy, UNC Chapel Hill, Chapel Hill, NC

Recommended for this scholarship by faculty in the department in recognition of outstanding academic record; The Earl Nelson Mitchell Scholarship was an estate gift to the University, with a provision to establish a scholarship to an outstanding junior or senior majoring in Physics or Astronomy.

NC Space Spring Undergraduate Scholarship

2018

NC Space Grant, NASA

The NC Space Grant Undergraduate Scholarship Program is a competitive scholarship program funded by NASA with the goals of: increasing participation in STEM-related research and careers by students, establishing relationships with a faculty member and a NC Space Grant Undergraduate Research Scholar or Graduate Fellow, and interacting with faculty/other scholars to learn more about the STEM discipline and current research projects and opportunities. (For my research in statistical techniques for astronomy).