(Sonia) Minseo Kim

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RESEARCH INTEREST

I am broadly interested in developing computational imaging algorithms that tackle complex inverse problems across diverse scientific domains such as medical imaging, astronomical imaging, X-ray crystallography, and optical imaging, leveraging AI tools like generative models and physics-informed neural networks to enhance reconstruction. I am passionate about bridging the gap between computational methods and real-world imaging challenges to advance scientific discovery.

EDUCATION

Stanford University — Stanford, CA
M.S. in Electrical Engineering — *Sept 2024 – April 2026*
GPA: 4.0/4.0

- **Depth area:** Signal Processing, Control and Optimization
- **Breadth area:** Physical Technology and Science
- **Course Highlights:** Modern Optics, Computational Imaging, Convex Optimization, Virtual Reality

University of Michigan — Ann Arbor, MI
B.S.E. in Electrical Engineering & B.S.E. in Data Science with Honors, Minor in Mathematics — *Sept 2021 - May 2024*
Summa Cum Laude

- **Honors/Awards:** Admitted to College of Engineering Honors Program, all terms University Honors & Dean's List (GPA higher than 3.5), William J. Branstrom Freshman Prize (awarded to top 5% of freshman class - Fall 2021)
- **Course Highlights:** Matrix Methods for Signal Processing, Deep Learning, Computer Vision, Bayesian Statistics

WORK EXPERIENCE

Zoox, Inc. (Amazon's autonomous vehicle subsidiary) — Foster City, CA
Digital Signal Processing Intern in Advanced Hardware Engineering Team — *May 2024 – Aug 2024*

- Engineered multimodal AI models (PANN, AudioCLIP, ImageBind, etc.) to mine audio data based on text queries
- Developed an intuitive front-end search engine for a text-based audio mining system
- Preprocessed vehicle data with advanced DSP techniques, including filtering and noise suppression algorithms
- Implemented a fast and efficient decoder network for the UnO system, predicting future 3D occupancy using past LiDAR scans and a ResNet-processed 2D feature map

RESEARCH EXPERIENCE

Kavli Institute for Particle Astrophysics and Cosmology (KIPAC) — Stanford, CA
Graduate Researcher in the Center for Decoding the Universe — *Nov 2025 – Present*

- Designing a galaxy foundation model that explicitly parameterizes the astronomical imaging pipeline (PSF, noise, instrument response, observing conditions) across diverse telescopes and resolutions, enabling multi-scale representations of galaxies and inference of underlying physical properties

SLAC National Accelerator Laboratory — Stanford, CA
Graduate Researcher in the Machine Learning and Computer Vision, Linac Coherent Light Source — *June 2025 – Present*

- Leading a data-guided AI approach that fuses X-ray crystallography measurements directly into protein structure generation, converting raw diffraction signals into accurate, experiment-consistent models
- Building fast ensemble sampling in the diffusion model inference time to capture dynamic protein conformations
- Authored a competitive Stanford Human-Centered Artificial Intelligence research grant proposal for this project
- M.Kim, H.Mai, F.Poitevin, and G.Wetzstein, "Guided AlphaFold3 for Solving Inverse Problems in X-ray Crystallography," in conference paper preparation, 2026.

Professor Gordon Wetzstein's Research Group — Stanford, CA
Graduate Researcher in the Department of Electrical Engineering — *Sept 2024 – Present*

- Developing advanced algorithms for more accurate and efficient posterior sampling method
- M.Kim, A.Levy, G.Wetzstein, "Dual Ascent Diffusion for Inverse Problems," under review, 2025. (Project website)
- Designed an interactive course assignment for EE 367: Computational Imaging (Winter 2025) on diffusion models for solving inverse problems with hands-on experimentation on posterior sampling methods and diverse applications
- Presented with a 30-minute talk at the Center for Decoding the Universe Annual Conference
- Appointed Teaching Assistant, EE 367, Winter 2026

Professor Jeffrey A. Fessler's Research Group Ann Arbor, MI
Undergraduate Researcher in the Department of Electrical Engineering and Computer Science

Multiscale Wavelet Diffusion Model for Complex-valued Looping Star MRI Reconstruction *July 2024 – Present*
- Developing a Wavelet Score-based Generative Model to efficiently reconstruct undersampled MRI images by leveraging wavelet transforms across scales, learning high-frequency details with less training data (achieving +4dB over baselines)
- M.Kim, Z.Li, J.Hu, and J.A.Fessler, "Multiscale Wavelet Diffusion Model for Complex-valued Looping Star MRI Reconstruction," in conference paper preparation, 2025.

Deep Learning Models for Undersampled MRI (Honors capstone final report) *May 2023 – May 2024*
- Leveraged deep learning techniques by implementing a score-based diffusion model with diffusion posterior sampling to improve the reconstruction quality of undersampled MRI data (utilized the fastMRI kspace dataset)
- Presented with a 30-minute symposium at the 2023 SIAM Great Lakes Conference
- Received an Honorable Mention Award at the 2024 Michigan Student Symposium for Interdisciplinary Statistical Sciences

Julia Software for Image Reconstruction *Dec 2021 – Apr 2023*
- Implemented 2D branchless distance-driven forward projection and backprojection algorithm for computed tomography (CT) reconstruction using the Julia language
- Implementation merged to the official JuliaImageRecon/Sinograms.jl package for public use (see documentation)
- Converted the code into PyTorch, now released as part of MIRTorch
- G.Wang, N.Shah, K.Zhu, T.Luo, N.Murthy, Z.Li, M.Kim, D.C.Noll, and J.A.Fessler, "MIRTorch: An Open Source PyTorch-based Differentiable Image Reconstruction Toolbox", under review at JOSS, 2024.

Professor Lia Corrales' Research Group Ann Arbor, MI
Undergraduate Researcher in the Department of Astronomy *Oct 2022 – May 2024*
- Designed the multiple interstellar dust scattering physics model and developed mathematical proofs to derive halo intensity using analytic and numerical methods
- Implemented the method in Astropy and applied the algorithm to X-ray binary GX 13+1 with data collected by NASA XRISM

COURSE PROJECT HIGHLIGHTS

EE 267: Virtual Reality (Final report) Spring 2025
- Adapted parallax attention architecture for consistent stereo image inpainting
- Trained on 48k stereo image pairs from Flickr1024 dataset and tested on 1k stereo image pairs from KITTI2012 dataset

PSYCH 221: Image Systems Engineering Fall 2024
- Developed digital twins of optical systems by comparing polynomial-based RTFs with MLPs for accurate ray mapping
- Generated ray data using Zemax and trained machine learning models to improve generalization in optical system simulations

EE 236A: Modern Optics Fall 2024
- Simulated JWST's Optical Telescope Element (OTE) in Zemax to analyze aberrations and optimize infrared imaging quality
- Modeled segmented mirrors and TMA architecture to evaluate imaging performance and stability

EECS 452: Digital Signal Processing Design Lab (Final report) Winter 2024
- Designed a low-cost embedded real-time motion capture system that can accurately localize and track points in 3D space
- Implemented Unscented Kalman Filter for 3D marker reconstruction and image processing algorithms to identify markers

EECS 442: Computer Vision Fall 2023
- Implemented deep learning architectures, Mask R-CNN and UNet, to deblend and classify galaxy, stars, and cosmic rays in simulated astronomical images
- Evaluated the network using test and validation data sets, and quantified the performance using precision-recall and AP

EECS 351: Digital Signal Processing and Analysis (Project website) Winter 2023
- Implemented algorithms for the noisy matrix completion (a.k.a. image inpainting) problem using optimization methods
- Low-rank matrix completion with pre-designed dictionaries and deep learning methods, e.g., diffusion models and GAN

LEADERSHIP EXPERIENCE

Electrical and Computer Engineering (ECE) Department Ann Arbor, MI
Student Ambassador *Aug 2023 – May 2024*

- Led on-campus and off-campus recruitment events and external relationships and community events such as career fair, graduate symposium, and alumni networking events
- Managed leadership workshops and gave presentations to small and large groups
- Provided tours of the ECE building for potential students, alumni, and others
- Assisted in answering questions from prospective students, both in person and via email

M-HEAL (Project MEND) Ann Arbor, MI
Electrical Engineering Subteam Lead *Aug 2022 – May 2024*

- Created a high-fidelity prototype to minimize the risk of injury during fall incidents among high fall-risk older adults (65+) in hospitalized and assisted living environments in the Dominican Republic
- Implemented the hazard detection algorithms in C and designed hardware circuits for the fall hazard sensor
- Communicated with the local assisted living facility staff and conducted needs assessment at the local community to investigate the patient mobility and plan for possible engineered solutions

Society of Women Engineers Ann Arbor, MI
Strategic Planning Committee Professional Excellence Leader *April 2022 – Aug 2023*

- Coordinated "finding your leadership style" workshop to help aid the section in achieving professional excellence
- Organized the annual Women in Leadership Conference (100 attendees) with professional female leaders in STEM
- Established one-to-one mentoring sessions for students with alumni for career planning and mock interviews
- Dedicated 8+ weekly hours volunteering to help club members secure corporate/university sponsorship and funding
- Trained 2+ new club leaders in leadership and event organization

TEACHING EXPERIENCE

Course Assistant & Grader Ann Arbor, MI
MATH 156: Applied Honors Calculus II *Aug 2022 – Dec 2022*

- Assisted in answering students' questions to deepen and extend understanding of the course material (125 students)
- Provided timely, quality feedback to students through Gradescope about assignments and exams

AP/IB/SAT Tutor Ann Arbor, MI
Subjects: AP Calculus BC, AP Chemistry, IB Physics, IB English Literature, SAT *Aug 2021 – Present*

- Guided 4+ high school students to straight A's through personalized online tutoring sessions
- Provide comprehensive academic support, including mentoring in study skills, test-taking strategies, and career guidance, by creating engaging instructional materials

SKILLS

Software skills: C, C++, Python (PyTorch, Astropy, scikit-learn), MATLAB, Julia, SQL, JavaScript, MongoDB, R, HTML, CSS, UNIX, CAD, Altium, Simulink, LTspice, VSCode, Git, LaTeX, Protobuf, Bazel, Zemax, Chimera
Hardware skills: Circuit Design, Vector Network Analyzer, Oscilloscope, Logic Analyzer, Microcontrollers
Native/Bilingual Proficiency: English, Korean, Chinese