

Karl Weisenburger

Department of Mathematics, 150 N. University St, West Lafayette, IN 47907

kweisen@purdue.edu • math.purdue.edu/~kweisen

LinkedIn • GitHub

U.S. Citizen

EDUCATION

Ph.D. Candidate in Mathematics

Aug 2022 – Present

Purdue University (West Lafayette, IN)

Advisors: Gregory Buzzard & Charles Bouman

Areas: Bayesian inverse problems, nuisance parameter estimation, tomography

Expected: Spring 2027

B.S. in Applied Mathematics, Minor in Latin

2018 – 2022

Hillsdale College (Hillsdale, MI)

Honors: Summa Cum Laude, GPA 3.95/4.0

RESEARCH EXPERIENCE

Graduate Research Assistant

May 2023 – Present

Purdue University (West Lafayette, IN)

Advisors: Gregory Buzzard, Charles Bouman (Purdue)

Collaborator: Matthew Kemnetz (AFIT)

- Developed **WindDensity-MBIR**, a model-based iterative reconstruction method that recovers high-order wavefront features to within 10–25% error in severely underdetermined regimes (sparse views, narrow field of view, limited angular extent) — even with piston, tip, and tilt removed from the measurements.
- Extended the group’s JAX-based MBIR software package to support multi-axis tomography geometries.

Doctoral Research Fellow (ORISE)

May – Aug 2026

Air Force Institute of Technology (Virtual)

Mentor: Matthew Kemnetz

- Developed a single-shot, limited-angle multistatic method for estimating unmeasured wavefront tip and tilt from higher-order wavefront data.
- Recovers the unknown wavefront tip/tilt coefficients within 20–60% error for non-convecting turbulence regimes, where other estimators don’t apply.
- Compared to leaving tip/tilt unestimated, reduced the error in the estimated wavefront spectral peak frequency from 24% to 6% and the error in estimated peak energy from 20% to within 2%.

AFRL Scholars Program Summer Intern
Air Force Research Laboratory (Virtual)

Summers 2024, 2025

Mentor: Matthew Kemnetz

- Built simulation and reconstruction software for tomographic wavefront sensing.
- Explored the trade space of optical measurement configurations to guide experimental designs for density reconstructions.

Data Analytics Intern
Build Central (Virtual)

May – Aug 2022

- Trained machine-learning models to predict construction project completion dates and built analytics dashboards used by leadership to productize the results.

Laureates Honors Program Researcher
Hillsdale College (Hillsdale, MI)

2021 – 2022

- Selected as one of 20 students for competitive research funding; developed sparse, low-rank decomposition methods to denoise reconstructed neuronal connectivity matrices.

PUBLICATIONS

Refereed Journal

- **K. J. Weisenburger**, G. T. Buzzard, C. A. Bouman, M. R. Kemnetz, “WindDensity-MBIR: Model-based iterative reconstruction for wind tunnel 3D density estimation,” *Optical Engineering* **65**(8), 081820 (2026). <https://doi.org/10.1117/1.OE.65.8.081820>

Conference Proceedings

- **K. J. Weisenburger**, G. T. Buzzard, C. A. Bouman, M. R. Kemnetz, “Tomographic wavefront sensing simulations for wind tunnel measurements,” *Proc. SPIE 13619, Unconventional Imaging, Sensing, and Adaptive Optics 2025*, 136190R (2025). <https://doi.org/10.1117/12.3063657>

SOFTWARE

WindDensity-MBIR — open-source Python implementation of the model-based iterative reconstruction method for wind-tunnel 3D density estimation; reproduces all results and figures from the *Optical Engineering* paper. Documented, pip-installable package with unit and regression tests and GitHub Actions CI.

Code: github.com/Karl-Weisenburger/WindDensity-MBIR

Docs: winddensity-mbir.readthedocs.io

PRESENTATIONS

- *Model-Based Iterative Reconstruction for Wind Tunnel 3D Wavefront Estimation*, DE Student Education Workshop, Directed Energy Professional Society (DEPS) Annual DE Sci-

ence & Technology Symposium (Mar–Apr 2026).

- *Wind Tunnel Tomographic Wavefront Sensing Simulations*, IS&T Electronic Imaging Symposium, Burlingame, CA (Mar 2026).
- *Tomographic Wavefront Sensing Simulations for Wind Tunnel Measurements*, SPIE Optics + Photonics, San Diego, CA (Aug 2025).
- *Tomographic Wavefront Sensing Simulations for Wind Tunnel Measurements*, Directed Energy Professional Society (DEPS) S&T Symposium (May 2025).

TECHNICAL SKILLS

Proficient: Python (JAX, NumPy, SciPy), MATLAB, LaTeX, Git.

Familiar: C++, PyTorch.

GPU & Parallel Computing: JAX vectorization (`vmap`) and JIT compilation for GPU-accelerated numerical code; multi-GPU sharding of parameter sweeps; Slurm on Purdue GPU clusters (Gilbreth, Gautschi).

Methods: Bayesian inverse problems, nuisance parameter estimation, computational tomography, model-based iterative reconstruction (MBIR), sparse / limited-angle reconstruction, numerical optimization.

AWARDS & HONORS

Ruth L. Schulz Memorial Mathematics Prize <i>Hillsdale College</i> (Hillsdale, MI)	Feb 2022
--	-----------------

TEACHING

Graduate Teaching Assistant , <i>Purdue University</i>	2022 – 2023
Teaching Assistant & Math Tutor , <i>Hillsdale College</i>	2021 – 2022

LEADERSHIP & SERVICE

President <i>Hillsdale College Catholic Society</i> (Hillsdale, MI)	2020 – 2021
---	--------------------

- Recruited and managed three student boards; organized speaker events, lecture series, and retreats.

ESTEEM Mentor , <i>St. Thomas Aquinas Community Parish</i>	2025 – Present
---	-----------------------