KAO KITICHOTKUL

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EDUCATION

Boston University Ph.D. in Electrical Engineering, *advised by Vivek Goyal* — GPA 4.0/4, Expected Dec 2025
Stanford University M.S. in Electrical Engineering — GPA 4.0/4.3, Jun 2022
Stanford University B.S. in Electrical Engineering, *distinction* — GPA 4.1/4.3, Jun 2022

RESEARCH INTERESTS

Computational Imaging, Statistical Signal Processing, Machine Learning, Lidar

WORK EXPERIENCE

Mitsubishi Electric Research Laboratories — May - Dec 2024 & Jun - Nov 2025
Research Scientist Intern

- Invent Doppler SPL, enabling direct velocity estimation using single-photon lidar (SPL) for the first time.
- Develop a velocity-aware probabilistic model of SPL and design a maximum likelihood algorithm with Fourier analysis to jointly estimate range (sub-centimeter) and velocity (≤ 0.1 m/s) at 50 frames/s under high noise.
- Design research agenda, build codebase, and conduct optics experiments in collaboration with the team.
- Result in first-author publications in ICASSP 2025 and Optica (12% acceptance rate).

Boston University — Sep 2023 - May 2024 & Jan - May 2025
Teaching Assistant

- Teach "Probability, Statistics, and Data Science for Engineers" for 3 semesters with 200+ students per term.
- Deliver lectures, design exams, facilitate discussions, manage course communications, and grade assessments.

Agoda — Jun 2021 - Aug 2021
Data Science Intern

- Build LLM-based system to generate travel content with text and images, cutting writing time by ∼70%.
- Finetune language models and design data retrieval and prompting pipeline for multimodal article generation.

RESEARCH EXPERIENCE

Boston University — Sep 2022 - Present
Doctoral Researcher

- Conduct research in **computational imaging**, focusing on single-photon lidar, leading to 5 publications to date.
- Plan research agenda, collaborate cross-functionally within the lab, and present findings in weekly meetings.
- *High-flux Free-running Single-Photon Lidar*
  - Derive estimators and error bounds for high-flux SPL using **random point process theory**, allowing 4x higher flux than traditional high-flux SPL with 100x speed-up over previous free-running methods.
  - Develop 3D regularization algorithm leveraging pretrained **diffusion models** for point cloud denoising.
- *Equivariant Self-supervised Learning for Deep Equilibrium Models*
  - Develop algorithm for training **deep equilibrium models** for imaging inverse problems without ground truths by leveraging data symmetries, achieving performance within 1.3 dB PSNR of supervised learning.
  - Mentor an undergraduate student in designing and conducting experiments on CT and MRI reconstruction.
- *Plug-and-play Particle Beam Microscopy Denoising [IEEE Trans. Comp. Imag.]*
  - Propose algorithms for particle beam microscopy denoising by combining **convex optimization** algorithms with **deep learning**, achieving 4x reduction in root-mean-square error compared to conventional methods.
  - Analyze convergence of proposed methods via **monotone operator theory** and conduct experiments.
- *Image Reconstruction from Readout-Multiplexed Single-Photon Detector Arrays [CVPR 2025, highlight]*
  - Propose image reconstruction algorithms for row-column coupled superconducting nanowire detector arrays, achieving 4x speed-up without loss of accuracy and enabling scalability to megapixel resolutions.

Stanford Computational Imaging Lab — Jun 2020 - Jun 2022
Undergraduate Researcher

- Develop model-based deep learning algorithms with per-pixel uncertainty quantification using Stein's unbiased risk estimate for accelerated MRI [ICASSP 2021], along with self-supervised method for on-the-fly finetuning.

Spakowitz Research Group Jun 2019 - Sep 2019
Undergraduate Researcher

- Investigate effect of topological constraints on bacterial DNA using Monte Carlo simulation and knot theory.
- Contribute to Fortran codebase for molecular dynamic simulation of biological polymers.

PUBLICATIONS

R. Kitichotkul, J. Rapp, Y. Ma, and H. Mansour, "Simultaneous Range and Velocity Measurement with Doppler Single-Photon Lidar," *Optica*, 12:604-613, 2025. **12% acceptance rate.**

R. Kitichotkul, J. Rapp, Y. Ma, and H. Mansour, "Doppler Single-Photon Lidar," in *ICASSP* 2025.

R. Kitichotkul, J. Rapp, and V. K. Goyal, "The Role of Detection Times in Reflectivity Estimation With Single-Photon Lidar," *IEEE J. Sel. Topics Quantum Electron.*, 30(1):1-14, Jan-Feb 2024.

R. Kitichotkul, C. A. Metzler, F. Ong, and G. Wetzstein, "SUREMap: Predicting Uncertainty in CNN-Based Image Reconstructions Using Stein's Unbiased Risk Estimate" in *ICASSP* 2021.

S. Bharadwaj, R. Kitichotkul, A. Agarwal, V. K. Goyal, "Image Reconstruction from Readout-Multiplexed Single-Photon Detector Arrays," in *CVPR* 2025. **Highlight (13.5%).**

A. Agarwal, L. Kasaei, X. He, R. Kitichotkul, *et al.,* "Shot noise-mitigated secondary electron imaging with ion count-aided microscopy," *Proc. Nat. Acad. Sci.*, 121(31):e2401246121, 2024. **14% acceptance rate.**

S. Bharadwaj, R. Kitichotkul, A. Agarwal, and V. K. Goyal, "Mitigating Misattributions in Single-Photon Detector Arrays with Row-Column Readouts" in *CLEO*, 2024.

M. Peng, R. Kitichotkul, S. W. Seidel, C. Yu, and V. K Goyal, "Denoising Particle Beam Micrographs With Plug-and-Play Methods," *IEEE Trans. Comput. Imaging*, 9:581-593, 2023.

SKILLS

Programming	Python, Pytorch, C, C++, MATLAB, Linux, Git
Technical Skills	Machine Learning, Generative AI, Convex Optimization, Inverse Problems, Lidar
Languages	Thai (native), Japanese (JLPT N3)

AWARDS

IEEE Signal Processing Society Travel Grant for ICASSP 2025	2025
Distinguished Fellowship in Intelligent, Autonomous & Secure Systems, Boston University	2022
Terman Scholastic Award (top 5% of graduating class), School of Engineering, Stanford University	2022
Project Design Award, Department of Electrical Engineering, Stanford University	2020
King's Scholarship, Thai Government	2017
Gold medal, International Chemistry Olympiad	2016
Silver medal, International Chemistry Olympiad	2015

SERVICE AND ACTIVITIES

Boston University RISE High School Program 2023 - 2025
Mentor

- Mentor high school student to conduct research on machine learning and signal processing for electron microscopy.
- Guide development of self-supervised learning algorithms for deep equilibrium models for inverse problems.

ECE PhD Open House, Boston University 2023 - 2024
Panelist

- Speak on panels about academics and student life for the department's open house for prospective PhD students.

Stanford Thai Student Association 2019 - 2020
Financial Officer

- Manage budget and led the organization of high-impact events, such as industry recruiting sessions, meetings with government officials, and cultural gatherings with 400+ participants.

Reviewer for

- IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI)

- IEEE Transactions on Computational Imaging (TCI)
- IEEE Journal of Special Topics in Quantum Electronics (JSTQE)
- APL Photonics
- Optics Express

INVITED TALKS

High-flux Free-running Single-Photon Lidar, *CISE Graduate Student Workshop, Boston University* 2025
Model-based Deep Learning for Imaging Inverse Problems, *Chulalongkorn University* 2025

PROJECTS

Training Input-Convex Neural Networks using Convex Optimization 2021
Signal Processing for Machine Learning Class Project *Individual project*

- Develop method for training two-layer input-convex neural networks via convex optimization, enabling training to global optimality in polynomial time. Demonstrate applications in model predictive control.

Text-guided Image Generation using Score-based Model 2021
Deep Generative Models Class Project *Group of 2*

- Propose method for generating images that align with the semantic meaning of text captions by leveraging CLIP-based loss to guide the diffusion model's generative process.

Sparse + Low-rank Approximation of Matrix Inverse 2021
Convex Optimization Class Project *Group of 3*

- Propose and implement scalable convex optimization approach to estimate low-rank correction of sparse approximate matrix inverse, improving preconditioning in the preconditioned conjugate gradient algorithm.

Combining CTC with Seq2Seq Produces Better Transcriptions 2021
Natural Language Understanding Class Project *Group of 3*

- Propose sequence-to-sequence framework for improving transcription accuracy of outputs from end-to-end automatic speech recognition (ASR) systems by leveraging pretrained end-to-end models.
- Finetune sequence-to-sequence models. Found that BART outperforms encoder-decoder systems pretrained with masked-language modeling in reducing the word error rate.

Training CNN for Mixed Poisson-Gaussian Noisy Images Without Ground Truth 2020
Machine Learning Class Project *Group of 2*

- Develop loss function for self-supervised training of image denoisers without requiring ground truths under mixed Poisson-Gaussian noise using unbiased risk estimate. Demonstrate training CNN denoisers for astrophotography.

Real-time Classification of Musical Chords with Non-Negative Least Squares 2020
Digital Signal Processing Class Project *Group of 2*

- Propose method for musical chord detection based on digital signal processing and constrained least squares.
- Implement the detection system for real-time chord classification in C and C++ on the iOS platform.
- Win 2020 Project Design Award from the Department of Electrical Engineering, Stanford University.

Variants of SURE-LET Approach to Image Denoising 2020
Computational Imaging and Display Class Project *Individual project*

- Implement Gaussian and Poisson denoising algorithms based on the SURE-LET approach which minimizes an estimated error by combining denoised images with different denoising strengths.

Reducing Regret in Q-Learning with Ensemble Mechanics 2019
Artificial Intelligence: Principles and Techniques Class Project *Group of 3*

- Propose adaptive algorithm for action-selection strategy in Q-learning which improves upon Value-Based Difference Exploration. Demonstrate proposed approach with reinforcement learning tasks from OpenAI Gym.