Zachary Stoebner

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Overview

My research interests span **computational imaging**, **computer vision**, **machine learning**, and **optimization**. Currently, I am working on provable learning methods for solving inverse problems, namely image reconstruction and system identification, in Fourier imaging systems with an emphasis on magnetic resonance imaging.

Education

University of Texas at Austin *Austin, TX*

PhD in Electrical & Computer Engineering (Advisor: Prof. Jon Tamir) *August 2022-Present*

- Coursework: Convex Optimization, Probability & Stochastic Processes, Computational MRI, Real Analysis, Advanced Computer Vision, Fourier Optics, Digital Signal Processing, Large-Scale Optimization

Vanderbilt University *Nashville, TN*

BS with Honors in Computer Science & Neuroscience, Minor in Applied Mathematics *May 2021*

MS in Computer Science (Advisor: Prof. Ipek Oguz) *August 2022*

- Thesis: A deep learning-enabled automatic segmentation system for surgical endoscopy
- Coursework: Statistical ML, Systems Theory, Computational Game Theory, Intelligent Systems & Robotics

Research Experience

In Progress

"Generalized system identification with implicit neural representations while jointly reconstructing the image in MRI", **Zachary A. Stoebner**, Jonathan I. Tamir. (2023-Present)

- Investigating methods for nonlinear system identification using implicit neural representations as models of unknown system parameters.
- Leveraging theory and techniques from digital signal processing, optimization, and deep learning.
- Wrote a [library] for generally defining implicit neural representations for inverse problems using PyTorch and Lightning.

"Preconditioned monotone operator learning for fast, memory-efficient, noise-robust compressed sensing MRI", **Zachary A. Stoebner**, Jonathan I. Tamir. (2024-Present)

- Constructing preconditioners with convergence guarantees for the MoDL and MOL compressed sensing reconstruction frameworks using techniques from optimization theory.

Conference

"Segmentation of kidney stones in endoscopic video feeds", **Zachary A. Stoebner**, Daiwei Lu, Seok Hee Hong, Nicholas L. Kavoussi, and Ipek Oguz. *SPIE Medical Imaging 2022: Image Processing* (2022).
[DOI][arXiv]

- Optimized a high-performing (>0.9 Dice, 0.8 Kappa) residual U-Net with PyTorch and Comet for video segmentation and deployed it in live surgeries with OpenCV in Python.
- Built and annotated a novel dataset of endoscopic nephrolithotomy videos using OpenCV in C++.

Journal

"Reducing malware analysis overhead with coverings", Michael Sandborn, **Zachary A. Stoebner**, Westley Weimer, Stephanie Forrest, Ryan Dougherty, Jules White, Kevin Leach. *IEEE-TDSC* (2023).
[DOI][GitHub]

- Developed a high-performing (>90% hit rate) deep multilabel CNN classifier using PyTorch and Comet that predicted which sandboxes will run a stealthy malware sample using its binary image.
- Implemented scheduling algorithms in Python to simulate the analysis framework's scalability given the classifier's predictions and evaluated the algorithms' performance in simulation using NumPy.

"Comprehensive shape analysis of the cortex in Huntington's disease", **Zachary A. Stoebner**, Kilian Hett, Ilwoo Lyu, Hans Johnson, Jane S. Paulsen, Jeffrey Long, Ipek Oguz. *Human Brain Mapping* (2023).
[DOI][GitHub]

- Formulated a linear-mixed model with lme4 in R to describe the cortex from the longitudinal PREDICT-HD dataset, using a novel index for gyrification, sulcal depth, and cortical thickness.
- Investigated novel areas of change associated with Huntington's disease and corroborated the degree of change reported in known areas using SufStat in MATLAB.

Patents

"Systems and Methods for Navigation and Identification during Endoscopic Surgery", Nicholas L. Kavoussi, Ipek Oguz, Jie Ying Wu, **Zachary A. Stoebner**, Daiwei Lu, Ayberk Acar.
VU22148P1 (pending)

Honors & Fellowships

2022-Present **Cockrell Engineering Fellowship**, University of Texas at Austin
2017-2021 **Dean's List**, Vanderbilt University

Teaching Experience

Assistant **held weekly office hours and graded homework*

Spring 2022 **Projects in ML**, CS 3892 *Vanderbilt*
Fall 2021 **Artificial Intelligence**, CS 4260 *Vanderbilt*
Spring 2021 **Deep Learning**, CS 3891 *Vanderbilt*
Fall 2020 **Operating Systems**, CS 3281 *Vanderbilt*
Spring 2020 **Discrete Structures**, CS 2212 *Vanderbilt*
Fall 2019 **Discrete Structures**, CS 2212 *Vanderbilt*

Skills

Theory: Optimization, Deep Learning, Inverse Problems, Digital Signal Processing, Fourier Analysis, Probability
Practice: Python (PyTorch, OpenCV), C++ & C (OpenCV, ITK, VTK), ML Workflow (Jupyter, Lightning, Comet), Visualization (PyPlot, Seaborn), MATLAB, R

Verbal: English (native), Portuguese (fluent), Spanish (advanced), French (basic)
Hobbies: tennis, trail running, backpacking, climbing, photography

References

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