

Samuel Ehrenstein

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Interests

AI + Health, Medical Imaging, 3D Computer Vision, Computational Geometry, Machine Learning, Neural Rendering, Generative Models

Education

University of North Carolina at Chapel Hill

Ph.D. in Computer Science

Advisor: Stephen M. Pizer

Chapel Hill, NC

Aug 2021 - Present

University of North Carolina at Chapel Hill

M.S. in Computer Science

Advisor: Stephen M. Pizer

Chapel Hill, NC

Aug 2021 - May 2023

Case Western Reserve University

B.A. in Physics and Computer Science

Specialization: Internet of Things + Medical Image Synthesis

Cleveland, OH

Aug 2017 - May 2021

Experience

University of North Carolina at Chapel Hill

Graduate Research Assistant (Advisor: Stephen M. Pizer)

Chapel Hill, NC

Aug 2021 - Present

- Worked with coauthors to design and implement a novel method of monocular depth estimation for endoscopy. Demonstrated competitive or superior performance to the state-of-the-art method on a number of metrics.
- Proposed and implemented a novel algorithm for estimating the position and area of occluded surface in colonoscopy.
- Developed image-processing methods to perform weakly-supervised semantic segmentation of geometric features of the colon surface, outperforming the state of the art by 30 percentage points on overall accuracy.

Case Western Reserve University

Undergraduate Research Assistant (Advisor: Mahdi Bayat)

Cleveland, OH

Apr 2020 - Aug 2021

- Developed a novel method, employing deep learning and numerical image processing, for producing images of blood vessels under 1mm diameter from ultrasound scans without contrast agents.
- Demonstrated the competitive performance of a novel method for fast low-rank approximation of spatiotemporal data.

University of California, San Diego

REU Research Assistant (Advisors: Ryan Kastner and Curt Schurgers)

La Jolla, CA

June 2019 - Aug 2019

- Employed transfer learning to map the extent and health of mangroves using aerial photography.
- Participated in data collection in Baja California Sur, Mexico, by flying drones and exploring mangrove forests on foot.

Publications

- 5 Paruchuri, A., **Ehrenstein, S.**, Wang, S., Fried, I., Pizer, S.M., Niethammer, M., and Sengupta, R. (2024). Leveraging Near-Field Lighting for Monocular Depth Estimation from Endoscopy Videos. Under review. *arXiv:2403.17915*.
- 4 **Ehrenstein, S.**, McGill, S., Rosenman, J., and Pizer, S. (2023). Scribble-Supervised Semantic Segmentation for Haustral Fold Detection [Lecture]. Presented at Computer Assisted Radiology and Surgery Congress 2023. Munich, Germany.
- 3 Zhang, Y., Frahm, J. M., **Ehrenstein, S.**, McGill, S. K., Rosenman, J. G., Wang, S., and Pizer, S. M. (2021). ColDE: A Depth Estimation Framework for Colonoscopy Reconstruction. *arXiv preprint arXiv:2111.10371*.
- 2 **Ehrenstein, S.**, Abenojar, E., Perera, R., Exner, A., and Bayat, M. (2021). Rank-Assisted Deep Residual Reconstruction Network for Non-Contrast Ultrasound Imaging of Blood Microvessels. IEEE International Ultrasonics Symposium (IUS). Virtual.
- 1 **Ehrenstein, S.**, and Bayat, M. (2021). Deep Learning For Accessible Non-Contrast Ultrasound Imaging of Blood Microvessels. NVIDIA GPU Technology Conference (GTC). Virtual.

Skills

Design	User interface design, Information visualization, Solidworks, Fusion 360, Canva, Illustrator
Programming	Python (NumPy, SciPy, PyTorch, Pytorch3D, OpenCV, Altair, Open3D), Java, C++, MATLAB (Deep Learning Toolbox), Bash, SQL
Hardware	Soldering, Oscilloscope, Logic analyzer, Spectrum analyzer, 3D printer, Laser and waterjet cutter, CNC mill

Graduate Coursework

3D Generative Models, Bioinformatics, Computational Perception, Cryptography, Generative Modeling, Image Processing, Information Visualization, Machine Learning, Neural Rendering, Object Statistics, Shape Representation and Statistics, Vision Transformers

Other Projects

Data Vis

Portfolio of data visualization

Chapel Hill, NC

2023-present

- Created various visualizations of data for my own curiosity. Most use Altair, but some are with D3.js.
- Subjects include voting patterns, origins of the names of states, and US public universities.

S-reps in Curved Space for Frame-to-Frame Alignment

Chapel Hill, NC

COMP 790 - Shape Representation and Statistics Project

Spring 2023

Instructor: Stephen Pizer

- Proposed and implemented a novel algorithm for constructing skeletal representations (S-reps) of shapes defined on curved surfaces, i.e. 2D manifolds embedded in 3D space.
- Demonstrated the potential of this method for downstream tasks, including frame-to-frame camera pose estimation.

URAGAN: Medical Image Registration With StyleGAN 2

Chapel Hill, NC

COMP 790 - Neural Rendering Project

In collaboration with: Nurislam Tursynbek

Fall 2022

Instructor: Roni Sengupta

- Trained StyleGAN 2, along with latent-space encoders, to learn a latent space in which the function warping one image to another is linear. When decoded, this provides a warping function for even out-of-domain images.
- Achieved comparable in-domain and out-of-domain results to state-of-the-art methods.
- Code: <https://github.com/NurislamT/URAGAN>

DEQ-GAN: Deep Equilibrium Networks for Image Generation

Chapel Hill, NC

COMP 755 - Machine Learning Project

In collaboration with: Mahathir Monjur, Sharmin Akhtar, Ken Liu

Fall 2021

Instructor: Junier Oliva

- Utilized Deep Equilibrium Networks (DEQ), a type of network that uses a root-finding algorithm to approximate the steady state of an infinitely-deep network, as the generator of a GAN.
- Demonstrated the viability of this method across several generative domains, including faces, dogs, and Pokémon.
- Code: <https://github.com/Monjur-Mahathir/DEQ-GAN-755-PROJECT>

Outreach & Academic Service

Outreach

UNC-CH Computer Science Student Association President, Fall 2023 - Present

UNC-CH Computer Science Student Association Officer, Fall 2022 - Fall 2023

UNC CS Fellowship Panel Organizer, Fall 2022 and Fall 2023

Decoding Graduate Programs in CS Panel Member, Fall 2023

Academic Service

Student representative, UNC CS Dept. Faculty

Member, UNC CS. dept. Graduate Curriculum Committee, 2024-present

Int.J. Computer-Aided Radiology and Surgery, Reviewer (2023)