Zan Chaudhry

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RESEARCH STATEMENT

Research Goal: Use math, physics, computer science and experimental strategies to solve biomedical problems.
Areas of interest: *mathematical modeling, theoretical machine learning, physics of living systems, computational neuroscience, computational immunology, AI in medicine, instrumentation/device development, bioengineering.*

EDUCATION

Johns Hopkins University, MD, U.S.A.   Aug. 2020 - May 2023
Bachelor of Science in Biomedical Engineering
BME Departmental Honors; General Honors; Dean's List (Every Semester)

RESEARCH EXPERIENCE

Laboratory of Structural Cell Biology, National Institutes of Health   Dec. 2023 - Present
Post-Baccalaureate Research Fellow; Dr. Naoko Mizuno
Primary roles and responsibilities:
- Developed computational methods to optimize cryo-ET and sub-tomogram averaging pipelines.
- Leading a team for **CZII-CryoET Object Identification Challenge** to build a conditional VAE-GAN + Diffusion architecture
- Conducted experiments using cryo-FIB, cryo-CLEM, cryo-ET, and cellular micropatterning (PRIMO).
- Advanced theoretical ML by deriving novel characterizations of the convergence behavior of neural networks.
- Designed a tool for automating training to make ML more accessible to end-users **(First-author; submitted manuscript)**.
- Developed a tool for automated detection of optimal cells for cryo-FIB milling **(First-author; manuscript in preparation)**.
Collaborations:
- Collaborated with **ThermoFisher Scientific** to innovate techniques for cryo-FIB milling.
- First cryo-EM images of *in situ* structure of sickle cell fibers, open problem since the 1970s - **presented at two seminars**.
- *In progress:* Determining the *in situ* structure of phase-separated stress granules.

Radiology AI Laboratory, Johns Hopkins School of Medicine   Mar. 2023 - Present
Independent Researcher; Dr. Haris Sair
Primary roles and responsibilities:
- Developed an algorithm using a sparse matrix-vector multiplication for padded convolution **(First author; preprint)**
- Designed a novel method for detecting mislabeled data in convolutional neural networks.
- Using random projections for denoising with Bayesian classification to detect mislabeling that outperformed a recent competitive method from the literature **(First-author; manuscript in preparation)**.
- Investigated GANs for incidental anomaly detection of malignant thyroid nodules in head/neck CT scans.

Neuroengineering and Biomedical Instrumentation Lab, Johns Hopkins University   Feb. 2021 - Jul. 2023
Undergraduate Researcher; Dr. Nitish Thakor and Dr. Mark M. Iskarous.
Primary roles and responsibilities:
- Developed scanning speed and force invariant texture encodings with biophysics-inspired neuron models to provide more robust touch sensation / sensory feedback in neural prostheses..
- Designed and built novel robotic apparatus (including machining/fabrication and control system coding) used for experiments.

 The work from this project led to a **first-author publication** and a **second-author submitted manuscript**.

WORK EXPERIENCE

Biopharmaceutical Development, AstraZeneca   Jun. 2022 - Aug. 2022
Machine Learning Intern; Process and Analytical Sciences Department
- Developed machine learning tools to model stability of protein-based drug candidates.
- Trained ML models on the data to predict degradation, achieving state-of-the-art performance (0.85 AUC).
- **Won AstraZeneca Rising Star Intern Award and remain a formal outside collaborator (signed CDA).**

Zantek, LLC   Jan. 2018 - May 2023
Founder and CEO
- Grew to ~30 full-time employees globally and ~$8M annual revenue from inception to aquisition by AA Medical in 2023.

AWARDS AND HONORS

2024 **Columbia Uni. Healthcare Hackathon Data Analytics Track Winner** - *HeartED; Contributions: C,D,M,P**
2024 **Yale Uni. Healthcare Hackathon $5000 Grand Prize** - *Visionairy; Contributions: B,M,P**
2023 **Rutgers Uni. Healthcare Hackathon $5000 Grand Prize** - *Sixth Sentiment; Contributions: C,D,B,P**
2023 **Johns Hopkins Uni. $1500 BME Catalyst Award** - *R&D Research Grant for BME Design Teams*
2023 **Johns Hopkins Uni. Most Outstanding Design Team Leader** - *BME Outstanding Team Leader Award*
2023 **Johns Hopkins Uni. Richard J. Johns Award** - *award for JHU BME students graduating with >3.9 GPA*
2023 **Most Outstanding DT Leader and $1500 Catalyst Award** - *VentrAlarm; Contributions: C,D,B,M,P**
2022 **AstraZeneca Rising Star Intern Award** - *awarded to ~10 exceptional interns per year globally*
2020 **XPRIZE Next-Gen Mask Challenge $250k Future Forward Award** - **US Patented**; Contributions: C,D,M*
2020 **National Merit Scholar**
2020 **American Mathematics Competition Certificate of Distinction (Top 3%)**
2020 **USA Astronomy and Astrophysics Olympiad National Semi-Finalist**
2019 **Maryland State Science Olympiad, Fermi Questions Gold Medal**
2019 **USA Biology Olympiad National Semi-Finalist (Top 10%)**

*Contributions Key: C = Conception, **D** = Product Design, **B** = Business Design, **M** = Marketing, **P** = Presented in Final Pitch

PUBLICATIONS

1 Mark M. Iskarous and **Zan Chaudhry** et al. (**2024**) Invariant neuromorphic representations of tactile stimuli improve robustness of a real-time texture classification system. *Submitted*: Proceedings of the National Academy of Sciences (PNAS); arXiv:2411.17060.

2 **Zan Chaudhry** and Naoko Mizuno. (**2024**) ExpTest: Automating Learning Rate Searching and Tuning with Insights from Linearized Neural Networks. *Submitted*: IEEE Transactions on Neural Networks and Learning Systems; arXiv:2411.16975.

3 **Zan Chaudhry**. (**2024**) A Simple Sparse Matrix Vector Multiplication Approach to Padded Convolution. arXiv:2411.19419.

4 **Zan Chaudhry**, Sebastian Baxa, and Naoko Mizuno. (**2024**) AutoLamella: A Computer Vision Approach to Optimal Cell Detection for Cryo-FIB Milling. [Code available on GitHub].

5 **Zan Chaudhry**, Noam Rotenberg, Tej Mehta, Craig Jones, Brian Caffo, and Haris Sair. (**2024**) Adaptive Labeling Error Detection (ALED): a Bayesian Approach to Identifying Mislabeled Data. [Author order after ZC and NR subject to change; code available on GitHub].

6 **Zan Chaudhry**, Fangjie Li, Mark Iskarous, and Nitish Thakor. (**2023**) An Automated Tactile Stimulator Apparatus for Neuromorphic Tactile Sensing, *11th International IEEE/EMBS Conference on Neural Engineering (NER)*, Baltimore, MD, USA, pp. 01-04.

US PATENT APPLICATIONS

1 Modular face mask, by Jerry Zhang, Gwyneth Alexander, Saardhak Bhrugubanda, Kaitlyn Grace Calabresi, and **Zan Zafar Chaudhry** et al. (**2023**). **US20230016248A1**

PRESENTATIONS AND WORKSHOPS

2024 NHLBI Cell and Developmental Biology Center Seminar Series (2024) - Selected Speaker
2024 NHLBI Sickle Cell Branch Meeting (2024) - Selected Speaker
2024 NIH AI Symposium (2024) - Selected Speaker
2024 NIH Postbac Poster Day (2024) - Poster Presentation
2023 11th International IEEE/EMBS Conference on Neural Engineering (NER) - Selected Speaker
2022 AstraZeneca Intern Poster Day - Poster Presentation

MENTORING AND TEACHING

Sebastian Baxa, University of Maryland   Oct. 2024 - Present
CS freshman working part-time; mentoring on computer vision project **(IP1)**.

Erin Dobbs, Walter Johnson High School   Jun. 2024 - Aug. 2024
High school summer intern; directly supervised her work on automating
tomogram alignments in IMOD software, presented at NIH Summer Poster Day.
PRIMO Master User (NHLBI Light Microscopy Core)   Mar. 2024 - Present
As an experienced user of the PRIMO micropatterning system, I write
documentation / protocols and train new users (recently Dr. Wasim Sayyad).
Aquilos2 Master User (NIDDK Cryo-Electron Microscopy Core)   Feb. 2024 - Present
As an experienced user of the Aquilos2 cryo-FIB-SEM system, I train new users
(recently, Dr. Yuan Yee Lee and Dr. Chih-Ta Chien).

LEADERSHIP

VentrAlarm, Johns Hopkins University Design Team (DT) Program   Jan. 2022 - May 2023
DT Leader; Clinical Sponsor: Dr. Hooman Soltanian; Faculty Sponsor: Michelle Zwernemann
- DT Program: clinicians (globally) submit clinical problems to the JHU BME department, given to teams of eight undergrads.
- Selected as a team leader by application and faculty interview to tackle the problem: reducing ventral hernia recurrence.
- Developed a resonant inductive coupling method for power and data transmission in implantable post-operative monitoring
- Developed novel soft-magnetic-alloy-cored inductors for frequency dependent magnetic permeability.
- **Won "Most Outstanding DT Leader" and $1500 Catalyst Award.**
- Project to be completed and drafted as first-author manuscript in Spring 2025; discussing IP with tech transfer office.

VOLUNTEERING AND SERVICE

Treasurer, Human Development Foundation DMV Chapter   Sep. 2023 - Present
Raising funds with DMV volunteer team to support education and medical initiatives in Pakistan.
Raised $100k+ in 2023 at DMV Gala, $100k+ in 2024 at DMV Iftar and DMV Spring Gala.
Dog Deputy, Maryland Society for the Prevention of Cruelty to Animals   Jun. 2023 - Dec. 2023
Enriched dogs' stays at the shelter by providing exercise, playing games, and showing them to
potential adopters.
Child Life Volunteer, Harriet Lane Clinic / Johns Hopkins Hospital   Feb. 2023 - Nov. 2023
Enriched children's stay in the hospital/clinic by reading, playing games, playing music, and teaching.
Also helped families care for siblings of patients.
Event Supervisor and Test Writer, Maryland Science Olympiad   Sep. 2020 - Feb. 2024
Writing exams for state and county level middle and high school STEM competitions, as well as
running the competitions as an event supervisor.

REFERENCES

Dr. Naoko Mizuno   **Dr. Haris Sair**
Senior Investigator, Laboratory of Structural Biology   Associate Professor of Radiology
National Institutes of Health, Bethesda   Radiology AI Lab at Johns Hopkins Medical School
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Dr. Nitish Thakor   **Dr. Jared Delmar**
Professor of Biomedical Engineering   Associate Director
Neuroengineering Lab at Johns Hopkins University   Process & Analytical Sciences at AstraZeneca
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