ARUNKUMAR KANNAN

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ABOUT ME

[1] **Research:** My research is in the area of Generative-AI, Multi-modal Foundation models (FM) and State-Space models. Broadly, my doctoral work lies at the intersection of (3D/4D) functional imaging, deep learning, computer vision, image processing, and image analysis. Specifically, I am enthusiastic about leveraging structured state-space sequence models (Mamba) to learn long context spatio-temporal representations in medical imaging-based video sequences by incorporating prior-domain knowledge using FMs like BioMedCLIP.

[2] **Skills:** State-space models, Transformer, Diffusion models, CLIP, Unsupervised/Self-supervised learning, Pytorch, Linux, CUDA, Python

EDUCATION

The Johns Hopkins University, United States *August 2022 - Present*
Ph.D., student
Department of Electrical and Computer Engineering
Thesis Advisor: Prof. Brian Caffo, Department of Biostatistics

University of British Columbia, Vancouver, Canada *September 2019 - May 2022*
Master of Applied Science
School of Biomedical Engineering (CGPA: 4.00/4.33)
Thesis Advisor: Prof. Rafeef Garbi

SSN College of Engineering, India *July 2015 - April 2019*
Bachelor of Engineering
Department of Biomedical Engineering (CGPA: 9.04/10.00, *Rank: 2/948*)
Thesis Advisor: Prof. Geethanjali Balasubramanian

RESEARCH INTERESTS

Video Understanding, State-space Models (Mamba), Diffusion Models for Medical Imaging, Neuroscience, ML Explainability

PREPRINT

[A2] **Kannan, A.**, Lindquist,M., Caffo, B., (2025). *BrainMT: A Hybrid Mamba-Transformer Architecture for Modeling Long-Range Dependencies in Functional MRI Data.* Under review for MICCAI 2025.

[A2] Pal, B[1]., **Kannan, A**[1]., Kathirvel, R. P., OToole, A. J., Chellappa, R. (2023). *Gaussian Harmony: Attaining Fairness in Diffusion-based Face Generation Models.* arXiv preprint arXiv:2312.14976.

JOURNAL ARTICLES

[J1] **Kannan, A.**, Hodgson, A., Mulpuri, K., Garbi, R. (2021). *Leveraging voxel-wise segmentation uncertainty to improve reliability in assessment of paediatric dysplasia of the hip.* International Journal of Computer Assisted Radiology and Surgery, 16(7), 1121-1129. *[Impact factor 3.421; 2021]*

PEER-REVIEWED CONFERENCE PROCEEDINGS

[C1] **Kannan, A.**, Caffo, B., Venkataraman, A., (2024). *GAMing the Brain: Investigating the Cross-modal Relationships between Functional Connectivity and Structural Features using Generalized Additive Models.* MICCAI Machine Learning in Clinical Neuroimaging workshop 2024

[C2] Pal, B[1]., **Kannan, A**[1]., Kathirvel, R. P., OToole, A. J., Chellappa, R. (2024). *GAMMA-FACE: GAussian Mixture Models Amend Diffusion Models for Bias Mitigation in Face Images.* ECCV 2024

[C3] Sushmitha, S., Tanushree Devi, B., Mahesh, V., Geethanjali, B., **Kannan, A**., Pavithran, P. (2021). *Virtual Reality Therapy in Prolonging Attention Spans for ADHD.* In: Rizvanov, A.A., Singh, B.K., Ganasala, P. (eds) Advances in Biomedical Engineering and Technology. Lecture Notes in Bioengineering. Springer, Singapore.

[C4] **Kannan, A**., Hodgson, A., Mulpuri, K., Garbi, R. (2020). *Uncertainty Estimation for Assessment of 3D US Scan Adequacy and DDH Metric Reliability.* In Uncertainty for Safe Utilization of Machine Learning in Medical Imaging, and Graphs in Biomedical Image Analysis (pp. 97-105). Springer, Cham.

[C5] Pavithran, P. G., **Kannan, A**., Seshadri, N. G., Singh, B. K., Mahesh, V., Geethanjali, B. (2019, March). *Index of Theta/Alpha ratio to quantify visual-spatial attention in dyslexics using Electroencephalogram.* In 2019 5th International Conference on Advanced Computing and Communication Systems (ICACCS) (pp. 417-422). IEEE.

DISSERTATIONS

[D1] **Kannan, A**. *Uncertainty-based assessment of hip joint segmentation and 3D ultrasound scan adequacy in paediatric dysplasia measurement using deep learning.* Master of Applied Science Thesis. University of British Columbia, Vancouver, Canada, 2022.

BOOK CHAPTERS AND VOLUMES

[B1] Lindquist, M., Smith, B., **Kannan, A**., Zhao, A., Caffo, B. (2024). *Measuring the Functioning Human Brain* Annual Review of Statistics and Its Application (In Press).

[B2] **Kannan, A**., Pavithran, P. G., Bagyaraj, S. (2020). *Design and development of command prompt assist device for locked in syndrome patients.* In Smart Healthcare for Disease Diagnosis and Prevention (pp. 7-13). Academic Press.

ACADEMIC AND RESEARCH POSITIONS

Graduate Teaching Assistant *August 2023 - Present*
Johns Hopkins University
Department of Electrical and Computer Engineering
Courses: ECE 651: Random Signal Analysis, ECE 623: Medical Image Analysis, ECE 637: Foundations of Reinforcement Learning

Graduate Research Assistant *September 2019 - February 2022*
University of British Columbia
Supervisor: Prof. Rafeef Garbi
Projects: Uncertainty Estimation for Assessment of 3D US Scan Adequacy and DDH Metric Reliability, Leveraging voxel-wise segmentation uncertainty to improve reliability in assessment of paediatric dysplasia of the hip, Model Calibration Using Deep Ensembles for Enhanced Reliability of Paediatric Hip Dysplasia Assessment from 3D Ultrasound.

Graduate Teaching Assistant *June 2020 - April 2021*
University of British Columbia
Department of Electrical and Computer Engineering
Courses: Digital Signal and Image Processing, Signals and Systems

RELEVANT GRADUATE COURSES

- Probabilistic Machine Learning (JHU)
- Compressive Sensing and Sparse Recovery (JHU)
- High-dimensional Probability (JHU)
- Machine Perception (JHU)
- Statistical Theory (JHU)
- Causal Inference (JHU)

[1]denotes equal contribution

- Bayesian Statistics (JHU)
- Fundamentals of Visual Computing (UBC)
- Machine Learning and Data Mining (UBC)
- Advanced Machine Learning for Engineers (UBC)

AWARDS AND HONOURS

Johns Hopkins ECE Departmental Fellowship 2022-2023

Graduate Research Assistanship 2019-2022
Awarded by Prof. Rafeef Garbi to carry out master's thesis research in BiSICL lab at UBC.

International Tuition Award 2019-2021
UBC award incoming graduate students to recognize their outstanding academic achievement during the course of their undergraduate studies.

Dean's Medal of Honor 2019
Awarded by SSNCE for securing 2nd rank among 948 candidates in the biomedical engineering program for the best academic performance in the university examinations held during 2015-19.

Undergraduate Merit Scholarship 2016-2019
Awarded by SSNCE for three years under the category of exemplary and outstanding for the best academic performance in the university examinations held during 2015-19.

Smart India Hackathon Finalist 2018
Selected amongst 12 out of 200 teams all over India to participate in the finale of Smart India Hackathon under medical devices theme organized by the Ministry of India.

CONFERENCE, WORKSHOP & POSTER PRESENTATIONS

2024 **GAMing the Brain: Investigating the Cross-Modal Relationships between Functional Connectivity and Structural Features using Generalized Additive Models**
Statistical Methods in Imaging Conference, Indiana University, Indianapolis, IN
International Workshop on Machine Learning in Clinical Neuroimaging, Marrakech, Morocco

2021 **Leveraging Voxel-wise Segmentation Uncertainty to Improve Reliability in Assessment of Paediatric Dysplasia of the Hip**
Information Processing in Computer-Assisted Interventions, Munich, Germany (*Virtual*)

2020 **Uncertainty Estimation for Assessment of 3D US Scan Adequacy and DDH Metric Reliability**
MICCAI UNSURE workshop, Lima, Peru (*Virtual*)

PROFESSIONAL ACTIVITIES

Reviewer, **MICCAI**, 2025
Reviewer, **MICCAI GRAIL workshop**, 2024
Reviewer, **MICCAI UNSURE workshop**, 2021
Chair, **IEEE EMBS society**, SSNCE, 2018

VOLUNTARY ACTIVITIES

Volunteer, **Maryland SPCA**, 2024