Avinash Kori

Artificial Intelligence

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Research Interests

My primary interest lies in solving research problems involving causal inference, explainable AI, deep learning, knowledge graphs, and their applications on real-life data.

Education

2015–2020 **Indian Institute of Technology Madras (IIT-M)**
Bachelor of Technology and Master of Technology in Engineering Design
Specilization: Biomedical Engineering, Minor: Artificial Intelligence
CGPA: 8.36/10.0

Awards

2021 3^{rd} **position,** *among 50+ teams*, in DBT breast lesion detection challenge, SPIE'21

2019 3^{rd} **position,** *among 50+ teams*, in Signet ring cell detection challenge, MICCAI'19

2019 8^{th} **position,** *among 50+ teams*, in Colon tissue segmentation challenge, MICCAI'19

2018 1^{st} **position,** *among 150+ teams*, in deep learning-based surgical tool annotation challenge, MICCAI'18

2018 1^{st} **position,** *among 100+ teams*, in Combined Radiology and Pathology Classification Challenge, MICCAI'18

2018 4^{th} **position,** *among 250+ teams*, in automatic Diabetic Retinopathy Grading, using Deep Learning, ISBI'18 (by using 1% of actual data)

2017 1^{st} **position,** *among 8000+ teams*, IndiaHacks'17 Fintech Domain

2017 1^{st} **position,** in Global Fintech Hackcelerator'17 Singapore

2016 1^{st} **position,** *among 150+ teams*, Code.fun.do 2016

Invited Presentations and Posters

2021 **W3PHIAI AAAI21** - *"Spotlight presentation on Interpreting Deep Neural Networks for Medical Imaging using Concept Graphs"*

2019 **LMRL NeurIPS** - *"Poster presentation on Memory Augmented Networks for Associative Deep Learning Models"*

2019 **Grand Pathology MICCAI** - *"Spotlight presentation on Signet ring cell detection"*

2018 **EndoVIS MICCAI** - *"Spotlight presentation on Automatic surgical tool detection"*

2018 **CRPC MICCAI** - *"Spotlight presentation on Radio-histopath disease classification"*

2018 **BraTS MICCAI** - *"Poster presentation for automated brain tumor segmentation"*

2018 **ICONIP** - *"Spotlight presentation on the modified fitzhughnagumo system for an improved neuronal behavior"*

Teaching and Mentorship

2019–2019 **ED6001: Medical Image Analysis,** *IIT-M*: Conduct sessions, formulate and evaluate programming assignments for computer vision and medical imaging

2019–2019 **ED2160: Digital and Analog Systems Lab,** *IIT-M*: Mentoring group of students to develop and help them understand various concepts and digital and analog systems

2019–2019 **SIP: Summer Innovation Project,** *CFI*: Mentoring group of students to develop and an algorithm for head and neck CT segmentation to detect organ at risk

Services

2020–present **Ad hoc reviewer**: Frontiers in neuroscience

2019–present **Ad hoc reviewer**: IEEE Transition in neural networks and learning systems

2018–2020 **Intel AI, Student Ambassador**

Research Experience

2020–present **Co-Founder and CTO**

Blurgs Pvt. Ltd, Bangalore, India

- Democratizing AI services for drone industry

2020–2021 **ML Research Engineer**

Elaitra, London, UK

- Worked on mammography/tomography images for detection of breast lesions using deep learning methods

2020–2020 **Post Baccalaureate Research Assistant**

Robert Bosch Center for Data Science and Artificial Intelligence, Chennai, India

- Developed an ante-hoc interpretability methods for deep convolutional neural network, with an adaptive regularization of weights

2019–2020 **Graduate Research Assistant**

Medical Image Reconstruction Lab, IIT-M, India

- Developed a CNN interpretability pipeline including dissection, activation maximization, occlusion, and causal trails, to analyse the explainability of segmentation and classification models

2019–2020 **Visiting Researcher**

Poldrack Lab, Stanford University, US

- Developed a fully automated pipeline for de-identification for MRI brain scans, along with MRI quality control tool using Deep 3D Convolutional Neural Networks, which will eventually be integrated with BIDs validator

2018–2019 **Deep Learning, Deep Reinforcement Learning Research Engineer**

Siemens, Bangalore, India

- Developed deep reinforcement learning algorithm for drone navigation, extending the work on UNREAL (reinforcement learning with unsupervised auxiliary tasks) along with Development of generalized reinforcement learning algorithm using Meta-Learning based reward function

2018–2019 **Computational Neuroscience Researcher**

Chandra Sripada's Lab, UMich, US

- Developed 3D CNN based algorithm to identify depression using brain sMRI (structural MRI) data with 68% accuracy
- Implemented 2D CNN for Fetal brain segmentation using fMRI (functional MRI) data with 96% of dice score

2018–2019 **Computational Neuroscience Researcher**

Computational Neuro-Science Lab, IIT-M, India

- Developed Oscillatory Neural Field Model (NFM) to understand the functioning and behaviour of the brain, by extending the Fitzhugh Nagumo (FN) neuronal model to work in both oscillatory and amplitude regime

2017–2018 **Medical Imaging Researcher**

Medical Image Reconstruction Lab, IIT-M, India

- Developed tools for Bidirectional CT to MRI conversion, using style transfer algorithm, with additional regularizers to preserve the structural integrity of these scans
- Developed zero-shot learning based deep learning technique for real-time multi-modal image registration on 2D MRI slices

Journal Publications

2020 **Kori A**, Khened M, Rajkumar H, Srinivasan B, Krishnamurthi G. A Generalized Deep Learning Framework for Whole-Slide Image Segmentation and Analysis. arXiv preprint arXiv:2001.00258. 2021 Jan.(In review, Nature, scientific reports)

2020 Natekar P, **Kori A**, Krishnamurthi G. Demystifying Brain Tumour Segmentation Networks: Interpretability and Uncertainty Analysis. Frontiers in Computational Neuroscience, Brain Imaging Methods. 2020 Feb 07. (https://doi.org/10.3389/fncom.2020.00006)

2020 Kurc T, Bakas S, Ren X, **Kori A**, ... Segmentation and Classification in Digital Pathology for Glioma Research: Challenges and Deep Learning Approaches. Frontiers in Neuroscience, Brain Imaging Methods. 2020 Jan 1;

2020 Porwal P, Pachade S, Kokare M, Deshmukh G, Son J, Bae W, Liu L, Wang J, **Kori A**, ... IDRiD: Diabetic Retinopathy–Segmentation and Grading Challenge. Medical image analysis. 2020 Jan 1; 59:101561.

Conference Publications

2021 Bansal, S., **Kori, A.**, Zulfikar, W., Wexler, J., Markiewicz, C., Feingold, F., Poldrack, R., and Esteban, O., 2021. High-sensitivity detection of facial features on MRI brain scans with a convolutional network (Under review MICCAI-21)

2021 **Kori, A.**, Natekar, P., Krishnamurthi, G. and Srinivasan, B., 2021. Abstracting Deep Neural Networks into Concept Graphs for Concept Level Interpretability. arXiv preprint arXiv:2008.06457. (accepted in AAAIw21 **overall best paper**)

2019 **Kori A**, Sharma M. Dynamic Regularizer with an Informative Prior. arXiv preprint arXiv:1910.14241. 2019 Oct 31.

2018 **Kori A**, Soni M, Pranjal B, Khened M, Alex V, Krishnamurthi G. Ensemble of Fully Convolutional Neural Network for Brain Tumor Segmentation from Magnetic Resonance Images. InInternational MICCAI Brainlesion Workshop 2018 Sep 16 (pp. 485-496). Springer, Cham.

2018 **Kori A**, Bagari A, Kumar A, Khened M, Krishnamurthi G. A Combined Radio-Histological Approach for Classification of Low Grade Gliomas. InInternational MICCAI Brainlesion Workshop 2018 Sep 16 (pp. 416-427). Springer, Cham.

2018 Kumar BS, **Kori A**, Elango S, Chakravarthy VS. Phase and Amplitude Modulation in a Neural Oscillatory Model of the Orientation Map. InInternational Conference on Neural Information Processing 2018 Dec 13 (pp. 215-226). Springer, Cham.

Other Publications

2020 **Kori A**. Dynamic Behavior of Coupled Neuron System from a Game-Theoretic Standpoint. bioarxiv preprint biorxiv:10.1101/2020.04.18.046235v1. 2020 April 20.

2020 Agrawal, V, **Kori, A**, Anand, V.K, and Krishnamurthi, G, 2020. Structurally aware bidirectional unpaired image to image translation between CT and MR. arXiv preprint arXiv:2006.03374. 2020 Jun 5.

2019 **Kori A**, Krishnamurthi G. Zero shot learning for multi-modal real time image registration. arXiv preprint arXiv:1908.06213. 2019 Aug 17.

2018 Kaluva KC, Khened M, **Kori A**, Krishnamurthi G. 2d-densely connected convolution neural networks for automatic liver and tumor segmentation. arXiv preprint arXiv:1802.02182. 2018 Jan 5.

2018 **Kori A**, Chennamsetty SS, Alex V. Ensemble of Convolutional Neural Networks for Automatic Grading of Diabetic Retinopathy and Macular Edema. arXiv preprint arXiv:1809.04228. 2018 Sep 12.

2018 **Kori A**, Krishnamurthi G, Srinivasan B. Enhanced Image Classification With Data Augmentation Using Position Coordinates. arXiv preprint arXiv:1802.02183. 2018 Jan 5.

Manuscripts Under Preparation

2021 Antehoc Interpretability of DCNN using Causal Structural Models

Patent

2019 **Generalized reward structures based smart traffic management toolkit** - *Patent filed by Siemens, by the end of my six month internship (**e-file no. 2020E04083 IN**)*

Open-source Contributions

2019–present **BioExp**: Explainability and causal inference of a deep learning models

2019–present **DigiPathAI**: Digital Histopathology analysis tool

2019–present **NFM**: Neural Field Model

2018–present **DeepBrainSeg**: Automated brain tumor segmentation tool box

Courses

- Brain Research and Machine Intelligence
- Reinforcement Learning
- Applied Time Series Analysis
- Industrial Mathematical modelling
- Nonlinear Optimization
- Machine Learning and Applications
- Principles of Medical Image Analysis
- Probabilistic Graphical Models
- Stochastic Modelling
- Game Theory
- Dynamical Systems

Skills

DataAnalytics Python, Tensorflow, Pytorch, Keras, R, OpenCV

Web Dev Django, AngularJS, HTML

Other C, GIT, ROS, Arduino

Referrals

IIT-M **Dr. Ganapathy Krishnamurthi** - *gankrish@smail.iitm.ac.in*

IIT-M **Dr. Srinivasan Balaji** - *sbalaji@smail.iitm.ac.in*

Siemens **Mr. Varghese Kollerathu** - *varghese.kollerathu@siemens.com*