

Samvaad Talk Series

Theme: Medical AI

February-March 2022



Theme coordinator: Prof. Neelam Sinha,
VLSA (Vision, Language and Speech Analytics) SIG; IIIT Bangalore

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Title: TBD

Speaker: Prof. Neelam Sinha, IIIT Bangalore

Date: March 28, 2 pm IST

Title: Medical Image Segmentation with Self-Supervision Learning

Speaker: Prof. Viswanath G, IIIT Bangalore

Time: February 21, 2022, 2 pm IST

Abstract:

Accurate segmentation of internal body organs, tissues, lesions etc. from medical images (CT, MRI etc.) are of great value in diagnosis and treatment of various diseases. Supervised techniques for training segmentation targets require large and reliable annotations which are difficult to procure in medical images due to following reasons. - 1) Image acquisition is expensive, complex and not standardized across various medical equipment. 2) Segmentation annotation require subject matter expertise unlike in case of natural images. 3) Constant need to adapt to new type of segmentation targets (e.g. a new kind of lesion, a new sub-region in an anatomical structure) arises very often in medical domain. Self-supervision-based learning techniques have been gaining lot of interest recently and the availability of many un-labelled medical image data opens up the scope of learning the nature of image data in a self-supervised setting. In this talk we will review some of the recent successful techniques for medical image segmentation under self-supervised setting. I will also discuss our efforts and recent results for the same cause.

Speaker Biography:

Dr. Viswanath Gopalakrishnan finished his B.Tech from National Institute of Technology, Calicut and received Ph.D. from School of Computer Engineering, Nanyang Technological University, Singapore in year 2011. His Ph.D. topic was focused on building computational models for identifying salient regions in images and videos. From 2011 - 2019 he worked with Samsung Research Institute, Bangalore on various research topics of interest in the area Computer Vision and Machine Learning. He is serving as faculty in IIITB since January 2020. His current research areas of interest are in Vision & Language multimodal fusion, Self-Supervision / Few-Shot learning techniques for image/video segmentation.

Title: AI in Blood Cancer Imaging

Speaker: Prof. Anubha Gupta, IIIT Delhi

Time: February 28, 2022, 2 pm IST

Abstract:

SBILab, IIIT-Delhi and AIIMS, New Delhi have been collaborating in the area of blood cancer imaging for the past 6 years. During this time, we have worked on two blood cancer types: B-ALL and Multiple Myeloma. We have also released four curated datasets publicly and also organized two medical imaging challenges in the International conferences. We have built deep learning based inhouse solutions for blood cancer diagnosis. In this talk, we will briefly discuss the problem statement, datasets, workflow, the data challenges, and the solutions proposed.

Speaker Biography:

Anubha Gupta received her B.Tech and M.Tech from Delhi University, India in 1991 and 1997 in Electronics and Communication Engineering. She received her PhD. from Indian Institute of Technology (IIT), Delhi, India in 2006 in Electrical Engineering. She did her second Master's as a full-time student from the University of Maryland, College Park, USA from 2008-2010 in Education. She worked as Assistant Director with the Ministry of Information and Broadcasting, Govt. of India (through Indian Engineering Services) from 1993 to 1999 and, as faculty at NSUT-Delhi (2000-2008) and IIIT-Hyderabad (2011-2013), India. Currently, she is working as Professor at IIIT-Delhi. She has authored/co-authored more than 100 technical papers in scientific journals and conferences. She has published research papers in both engineering and education. A lot of exciting work is being taken up in her lab: SBILab (Lab: <http://sbilab.iiitd.edu.in/index.html>). Her research interests include applications of machine learning in cancer genomics, cancer imaging, biomedical signal and image processing including fMRI, MRI, EEG, ECG signal processing, and Wavelets in deep learning. Dr. Gupta is a senior member of IEEE Signal Processing Society (SPS) and a member of IEEE Women in Engineering Society. She is an Associate Editor of IEEE Access journal, IEEE SPS Magazine eNewsletter, Frontiers in Neuroscience, and IETE Journal of Research. She is also the technical committee member of BISP committee of IEEE SPS Society for Jan 2022- Dec 2024.

Title: Computation and plasticity in the brain: Towards remedying the oversimplifications

Speaker: Prof. Rishikesh Narayanan, IISc Bangalore

Time: March 07, 2022, 2 pm IST

Abstract:

In this talk, the following (subset of) oversimplifications in assessing computation and plasticity in the brain will be discussed. Some approaches over the decades to remedy these oversimplifications will be presented.

Oversimplification #1. Neurons are simple algebraic summation units with a threshold nonlinearity.

Oversimplification #2. Neural circuits are made of repeating homogeneous computational units.

Oversimplification #3. Learning and memory in biological systems is accomplished exclusively through synaptic changes.

Oversimplification #4. There is a unique solution to how biological learning is accomplished, and our goal is to find that solution.

Oversimplification #5. Glial cells are glue.

Some of the several other oversimplifications. One or more of the following attributes of the brain, spanning all scales, are typically ignored in the design and/or analyses of processing/plasticity experiments: (i) Feedback loops (ii) Stochasticity and noise (iii) Continual adaptation (iv) Pleiotropy (v) Secondary and off-target effects of perturbations (vi) Subject-to-subject variability (vii) Plasticity-stability balance (viii) Catastrophic forgetting (ix) Neuromodulation (x) Short-term dynamics of cells and synapses.

Speaker Biography:

Rishikesh Narayanan obtained his Masters and Ph.D. from the Department of Electrical Engineering at the Indian Institute of Science (IISc), Bangalore. Subsequently, he held two postdoctoral positions, the first one at the National Centre for Biological Sciences, Bangalore and the second one at the University of Texas at Austin. He returned to IISc in July 2009, and currently serves as a Professor at the Molecular Biophysics Unit in IISc. The overall goal of research in his laboratory is to mechanistically understand the ability of neurons and their networks to concomitantly achieve efficient neural coding and activity homeostasis. Specific topics of exploration include degeneracy in encoding neural systems, active dendritic physiology, neural coding and homeostasis, neuronal plasticity, and calcium signaling in neurons and glia. His laboratory employs a combination of experimental (electrophysiological recordings from the rat hippocampus) and computational techniques to address outstanding questions in the field of cellular neurophysiology.

Title: Compressed Sensing MRI: k-space Sampling to Reconstruction

Speaker: Dr. Raji Mathew, IISc Bangalore

Time: March 14, 2022, 2 pm IST

Abstract:

Magnetic resonance imaging (MRI) is a non-invasive medical imaging modality for the visualization of soft tissues. Despite the capability of providing high-resolution images, the difficulties associated with lengthy acquisition time necessitates reconstruction of the final image from a limited number of k-space samples. These k-space data samples are acquired through the careful manipulation of amplitude, duration, and shape of the gradient waveform. The commonly adopted strategy to sample the k-space values is to select a sampling trajectory and then design the corresponding gradient waveforms for it. Following the data acquisition, dedicated reconstruction algorithms are applied to recover the underlying image. These algorithms can be either linear methods in k-space or image domain, or non-linear approaches that utilize the compressed sensing (CS) theory. In the talk we will explore two aspects in the context of CS MRI. The first part deals with the design aspects of variable density sampling which is required for achieving efficient CS based reconstruction. The second part deals with the CS reconstruction with a focus on the selection of appropriate regularization parameter. Here, we will explore the estimation of an iteration-dependent parameter, outlined as an optimization problem by inclusion of an extra prior to the CS MRI cost function.

Speaker Biography:

Raji Susan Mathew is a C V Raman Post-doctoral Fellow in the Medical Imaging Group, Department of Computational and Data Sciences, IISc Bangalore. She obtained her Ph.D. degree in the area of MR image reconstruction from Indian Institute of Information Technology and Management-Kerala. Prior to this, she received bachelor's degree in Electronics and Communication Engineering from the Mahatma Gandhi university, Kottayam and master's degree in Signal Processing from the Cochin university of science and technology, Kochi in 2011 and 2013. Her research interest lies in the field of medical image processing, medical signal processing and reconstruction using deep learning and classical techniques.

Title: Quantifying human brain white matter microstructural organization using track weighted imaging

Speaker: Dr. Rajikha Raja, University of Arkansas for Medical Sciences

Time: March 21, 2022, 2 pm IST (subject to change based on time-zone differences)

Abstract:

Studying human brain white matter is critical as it helps to understand the brain plasticity due to maturation and microstructural alterations due to disease. Non-invasive mapping and quantification of white matter microstructure is challenging without histological data. Diffusion weighted magnetic resonance imaging (DW-MRI) is an advanced imaging technique widely used in characterizing white matter structure and connectivity. In this talk, a novel DW-MRI contrast known as track weighted imaging (TWI) is presented along with few applications. TWI enables quantification of white matter track properties and has the advantage of providing a variety of contrast maps based on the track property of interest. In-vivo studies aiming at exploring the white matter microstructural alterations owing to dementia and brain maturation utilizing TWI are discussed.

Speaker Biography:

Dr. Rajikha Raja is a postdoctoral researcher in the Brain Imaging Lab, University of Arkansas for Medical Sciences and involved in pediatric brain development analysis. Previously, she worked at The Mind Research Network, Albuquerque and Georgia State University, Atlanta, where she did brain imaging research studies using diffusion MRI techniques to understand about dementia and psychiatric disorders. She holds a PhD from IIIT-Bangalore, India. Her doctoral research investigated reconstruction and analysis of diffusion MR and DCE-MR images. Prior to joining research, she had several years of industrial experience working majorly in imaging and medical domains. Her research interests center around neuroimaging with a focus on developing new techniques for analyzing multimodal MR data and new diffusion MRI models specific to brain development and disorders.