

Balamurali Murugesan

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RESEARCH INTERESTS

Application of deep learning to computer vision and medical image analysis.

EDUCATION

- **Indian Institute of Technology Madras (IIT Madras)** Chennai, India
Master of Science in Electrical Engineering; CGPA: (8.18/10.0) Aug. 2018 – Present
- **College Of Engineering, Guindy (CEG)** Chennai, India
Bachelor of Engineering in Biomedical Engineering; CGPA: (8.01/10.0) Aug. 2010 – July. 2014

EXPERIENCE

- **Healthcare Technology Innovation Centre, IIT Madras** Chennai, India
Project associate June 2016 - Present
 - **Annotation tools:** Annotation tools were created for obtaining segmentation and localization ground truth from high-resolution nissl stain images in collaboration with Cold Spring Harbor Laboratory (CSHL), NewYork, USA.
 - **Processing high resolution images:** Application was developed to process high resolution images in efficient manner using univa grid engine in collaboration with CSHL, NewYork, USA.
 - **Challenge hosting:** HRNTS - High resolution neuronal tissue segmentation challenge was hosted in Medical Image Computing and Computer Assisted Intervention (MICCAI 2017) in collaboration with CSHL, NewYork, USA.
 - **Automatic Polyp detection in Colonoscopy videos:** Automatic Polyp detection increases the attentiveness of colonoscopists. Deep learning based algorithms were developed to localize polyp in the colon image.
 - **Clamp detection and status identification in life sciences:** Analysis of work-flows in life sciences could assist researchers. Object detection and classification networks were used to detect clamp and report open or close status in collaboration with GE Healthcare, Bengaluru, India.
 - **Deep learning for fast MRI reconstruction:** Accelerating the MRI acquisition time can reduce the scan cost. Deep learning networks are developed to provide better reconstruction with minimal k-space data in collaboration with GE Healthcare, Bengaluru, India. (Current work)
- **International Institute Of Information Technology Hyderabad (IIIT-H)** Hyderabad, India
Summer student July 2017
 - **Summer school on computer vision:** Sessions introduced advancements of computer vision using deep learning. Selective topics: Semantic segmentation, Network visualization and Image synthesis.
- **Computational Neuroscience Lab, IIT Madras** Chennai, India
Project associate Jun 2015 - Apr 2016
 - **Telugu handwritten recognition:** Developed a telugu handwritten recognition system in collaboration with Centre for Development of Advanced Computing.
 - **Bharati - Common script for India:** Bharati is proposed as a common script for all the regional languages to avoid communication barrier. Worked on font design and character recognition.
- **Assistive Technology lab, IIT Madras** Chennai, India
Project associate Nov 2014 - Apr 2015
 - **iGest:** Device to assist physiotherapist track their patient activities. Built a complete product with contributions in hardware, software and algorithms development.

PUBLICATIONS

- **Medical Image analysis:**
 1. **Murugesan, B.** et al. KD-MRI: A knowledge distillation framework for image reconstruction and image restoration in MRI workflow, in *Medical Imaging with Deep Learning* (MIDL 2020).
 2. Ramanarayanan, S, **Murugesan, B.** et al. MAC-ReconNet: A Multiple Acquisition Context based Convolutional Neural Network for MR Image Reconstruction using Dynamic Weight Prediction, in *Medical Imaging with Deep Learning* (MIDL 2020).

3. Ramanarayanan, S, **Murugesan, B.** et al. MRI Super-Resolution using Laplacian Pyramid Convolutional Neural Networks with Isotropic Undecimated Wavelet Loss, in International Conference of *Engineering in Medicine and Biology Society* (EMBC 2020).
4. Orlando, J. I. et al. REFUGE Challenge: A unified framework for evaluating automated methods for glaucoma assessment from fundus photographs, *Medical Image Analysis* (MedIA 2020).
5. **Murugesan, B.** et al. A context based deep learning approach for unbalanced medical image segmentation, in *International Symposium on Biomedical Imaging* (ISBI 2020).
6. Ramanarayanan, S, **Murugesan, B.** et al. DC-WCNN: A Deep Cascade of Wavelet Based Convolutional Neural Networks for MR Image Reconstruction, in *International Symposium on Biomedical Imaging* (ISBI 2020).
7. **Murugesan, B.** et al. Recon-GLGAN: A Global-Local Context Based Generative Adversarial Network for MRI Reconstruction, in *Machine Learning for Medical Image Reconstruction* (MLMIR 2019).
8. **Murugesan, B.** et al. Conv-MCD: A Plug-and-Play Multi-task Module for Medical Image Segmentation, in *Machine Learning in Medical Imaging* (MLMI 2019).
9. **Murugesan, B.** et al. Psi-Net: Shape and boundary aware joint multi-task deep network for medical image segmentation, in International Conference of *Engineering in Medicine and Biology Society* (EMBC 2019).
10. **Murugesan, B.** et al. Deep detection and classification of mitotic figures, in *Medical Imaging: Digital Pathology* (SPIE 2018).

• Biosignal analysis:

1. Vijayarangan, S, Ravichandran, V, **Murugesan, B.** et al. RPnet: A Deep Learning approach for robust R Peak detection in noisy ECG, in International Conference of *Engineering in Medicine and Biology Society* (EMBC 2020).
2. Vijayarangan, S, **Murugesan, B.** et al. Interpreting Deep Neural Networks for Single-Lead ECG Arrhythmia Classification, in International Conference of *Engineering in Medicine and Biology Society* (EMBC 2020).
3. Ravichandran, V, **Murugesan, B.** et al. RespNet: A deep learning model for extraction of respiration from photoplethysmogram, in International Conference of *Engineering in Medicine and Biology Society* (EMBC 2019).
4. Ravichandran, V, **Murugesan, B.** et al. Deep Network for Capacitive ECG Denoising, in International Symposium on *Medical Measurements and Applications* (MeMeA 2019).
5. **Murugesan, B.** et al. ECGNet: Deep Network for Arrhythmia Classification, in International Symposium on *Medical Measurements and Applications* (MeMeA 2018).

SELECTED PROJECTS

- **Software for Optical Mark Reader (OMR):** In collaboration with Hashbytes Technology Solutions, OMR recognition software was developed. It was used by the Government of Tamil Nadu and Karnataka to process 3.5 million sheets in total.
- **Classify product images in supermarket:** Hackerearth hosted a challenge in collaboration with largest retailer in Germany with the theme, Product Classification. State-of-the-art deep networks like DenseNet and ResNet were used as ensemble to provide us place in top 5%.
- **Face recognition – A tool for person verification:** Lynk conducted hackathon with the theme, Face Verification. Deep learning networks were developed to localize and compare faces with improved accuracy.

PROFESSIONAL ACTIVITIES

- **Reviewer:** ML4H 2019, CHIL 2020, MICCAI 2020, NeurIPS 2020.
- **Workshops:** Conducted two day workshop on Deep Learning, Deep Learning for Self driving Cars in Kurukshetra (International techno-management fest, College Of Engineering, Guindy) 2017 and 2018.
- **Challenges in medical image analysis:** Placed 3rd in glaucoma classification task in REFUGE challenge, OMIA workshop, MICCAI 2018. Placed 2nd in Polyp Localization task in EndoVis challenge, MICCAI 2018.
- **Articles:** Contributed to Do It Yourself column in Electronics For You (EFY) magazine. Design and Development of an Assistive Device for Speech Impaired. October 2015 Issue Vol. 47 No. 10.

COURSEWORK

Image Signal Processing, Deep Learning for Imaging, Geometry & Photometry-based Computer Vision, Fundamentals of Linear Optimization, Digital Video Processing.

PROGRAMMING SKILLS

- **Languages:** Python, Matlab, Javascript, C++, SQL.
- **Modules:** Pytorch, Scikit-learn, OpenCV, Skimage, Django, OpenLayers.