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**: Developed annotation tools to obtain segmentation and localization ground truth from high-resolution nissl stain images in collaboration with Cold Spring Harbor Laboratory (CSHL), New York, USA.
  - **Processing high resolution images**: Developed an application to efficiently track and process high resolution images on the Univa Grid Engine in collaboration with CSHL, New York, USA.
  - **Challenge hosting**: Hosted HRNTS - High resolution neuronal tissue segmentation challenge in Medical Image Computing and Computer Assisted Intervention (MICCAI 2017) in collaboration with CSHL, New York, USA.
  - **Clamp detection and status identification in life sciences**: Automated analysis of work-flows in life sciences can assist researchers. Used object detection and classification networks to locate 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. Developed deep learning networks 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.

Selected Publications (🎓)

- **Medical Image analysis**:

1. **B. Murugesan** *et al.* A Deep Cascade of Ensemble of Dual Domain Networks with Gradient-based T1 Assistance and Perceptual Refinement for Fast MRI Reconstruction, in *Computerized Medical Imaging and Graphics* (CMIG) (Under review).
2. **B. Murugesan** *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).
3. S. Ramanarayanan, **B. Murugesan** *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).

4. J. I. Orlando *et al.* REFUGE Challenge: A unified framework for evaluating automated methods for glaucoma assessment from fundus photographs, *Medical Image Analysis* (MedIA 2020).
5. **B. Murugesan** *et al.* A context based deep learning approach for unbalanced medical image segmentation, in *International Symposium on Biomedical Imaging* (ISBI 2020).
6. S. Ramanarayanan, **B. Murugesan** *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. **B. Murugesan** *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. **B. Murugesan** *et al.* Conv-MCD: A Plug-and-Play Multi-task Module for Medical Image Segmentation, in *Machine Learning in Medical Imaging* (MLMI 2019).
9. **B. Murugesan** *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. **B. Murugesan** *et al.* Deep detection and classification of mitotic figures, in *Medical Imaging: Digital Pathology* (SPIE 2018).

- **Biosignal analysis**:

1. S. Vijayarangan, V. Ravichandran, **B. Murugesan**. *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. S. Vijayarangan, **B. Murugesan**. *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. V. Ravichandran, **B. Murugesan**. *et al.* Deep Network for Capacitive ECG Denoising, in International Symposium on *Medical Measurements and Applications* (MeMeA 2019).
4. **B. Murugesan** *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)**: Developed a OMR recognition software in collaboration with Hashbytes Technology Solutions. The Govt. of Tamil Nadu and Karnataka used this tool and have processed 3.5 million sheets.
- **Platform for Glaucoma analysis** : Cup-to-disc ratio can be used to assess the progression of glaucoma. Developed an application to segment the fundus image to cup, disc and background.
- **Automatic Polyp detection in Colonoscopy videos**: Automatic Polyp detection increases the attentiveness of colonoscopists. Developed deep learning based algorithms to localize polyp in the colon image.
- **Face recognition – A tool for person verification**: Lynk conducted hackathon on Face Verification. Developed a deep network to localize and compare faces.
- **Course projects**: Image mosaicing, Camera trajectory to motion blur, Shape from Focus, Photometric Stereo, Stereo matching, Structure from Motion, Video background subtraction, Hand detection

Accomplishments

- **Reviewer**: ML4H 2019, CHIL 2020, MICCAI 2020, NeurIPS 2020, ML4H 2020
- **Medical imaging challenges**: Placed 3rd in glaucoma classification task in REFUGE challenge, MICCAI 2018. Placed 2nd in Polyp Localization task in EndoVis challenge, MICCAI 2018, Placed top 5% in MRI reconstruction in fastMRI.
- **Workshops**: Conducted two day workshop on Deep Learning, Deep Learning for Self driving Cars in Kurukshetra (International techno-management fest), CEG 2017 and 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.
- **Scholarships**: Recipient of Central sector scheme of scholarships and Tamil Nadu Educational Trust scholarships

Coursework

Fundamentals of Linear Optimization, Image Signal Processing, Geometry & Photometry-based Computer vision, Digital Video Processing and Deep Learning for Computer vision

Programming Skills

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