

# Balamurali Murugesan

Website: <https://bala93.github.io/>

LinkedIn: <https://www.linkedin.com/in/balamurali-murugesan/>

Email : [balamuralim1993@gmail.com](mailto:balamuralim1993@gmail.com)

Mobile : +91-9360493626

GitHub : <https://github.com/Bala93>

## RESEARCH INTERESTS

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

## EDUCATION

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- **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

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- **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

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- **Medical Image analysis:**
  1. **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).
  2. 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).

3. S. Ramanarayanan, **B. Murugesan** *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. 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.* RespNet: A deep learning model for extraction of respiration from photoplethysmogram, in International Conference of *Engineering in Medicine and Biology Society* (EMBC 2019).
4. V. Ravichandran, **B. Murugesan** *et al.* Deep Network for Capacitive ECG Denoising, in International Symposium on *Medical Measurements and Applications* (MeMeA 2019).
5. **B. Murugesan** *et al.* ECGNet: Deep Network for Arrhythmia Classification, in International Symposium on *Medical Measurements and Applications* (MeMeA 2018).

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#### 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.

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#### 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.

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#### COURSEWORK

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

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#### PROGRAMMING SKILLS

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