Karthik Gopinath

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Research Interest

Image analysis (Medical Imaging, Computer Vision) & Machine Learning (Deep Learning, Geometric Deep Learning).

Education

Ph.D., Computer Engineering Sep. 2017 – Dec. 2021
École de technologie supérieure *Montreal, Canada*

- **Thesis**: Geometric Learning for Brain Surface Analysis
- **Advisors**: Prof. Herve Lombaert & Prof. Christian Desrosiers

M.S. by Research, Electronics and Communication Engineering Jan. 2015 – July 2017
International Institute of Information Technology - Hyderabad (IIIT-H) *Hyderabad, India*

- **Thesis**: A design for an automated Optical Coherence Tomography analysis system
- **Advisor**: Prof. Jayanthi Sivaswamy

B.E., Electronics and Communication Engineering Aug. 2010 – July 2014
Visvesvaraya Technological University (VTU) *Bengaluru, India*

- **Thesis**: Automatic decision support system for Retinopathy of Prematurity
- **Advisors**: Prof. Vanishree P & Dr. Subba Krishna Rao

Research Experience

Harvard Medical School & Massachusetts General Hospital. Mar. 2022 – Present
Research Fellow (PostDoc) *Boston, USA*

- **PI**: Prof. Juan Eugenio Iglesias
- Working on brain surface reconstruction, registration and labelling heterogeneous clinical MRI scans.
- Lead to 5 conference/workshop publications and 2 Journal publications.
- Mentored 9 graduate level students and 1 high-school student

ETS Montreal Sept. 2017 – Dec. 2021
Graduate Research Assistant *Montreal, Canada*

- Worked on geometric deep learning for brain surface analysis.
- Led to 11 publications including 9 first-author papers.
- Mentored 3 summer interns.

International Institute of Information Technology - Hyderabad (IIIT-H) Jan. 2015 – July 2017
Graduate Research Assistant *Hyderabad, India*

- Worked on machine learning techniques for retinal image analysis.
- Led to 5 publications including 4 first-author papers.
- Mentored 1 bachelor student.

International Institute of Information Technology - Hyderabad (IIIT-H) Oct. 2014 – Dec. 2014
Research Intern *Hyderabad, India*

- **Supervisor**: Prof. Jayanthi Sivaswamy
- Developed robust retinal image analysis CAD algorithm for different ethnicity.

Awards

Best Thesis Award

- Canada Governor General's Academic Gold Medal. (Best Graduate Thesis in the University)
- Best thesis award for Computer Engineering Department of Ecole de Technologie Superieure (ETS).

Academics

- Best paper runner-up paper award at GRAIL workshop MICCAI-2020.
- Outstanding Reviewer Honorable Award at MICCAI 2022 – One of 118 (top 10%) review awardees out of a total of 1242 reviewers.

Scholarships

- ETS Montreal - Prix d'excellence du conseil d'administration.
- FQRNT Scholarship awarded among the top doctoral students in Quebec. (Ranked 3rd in Quebec Province)
- Foreign tuition Fee Exemption scholarship by ETS Montreal, Canada. (Selective)
- Travel Award from Quebec Bio-imaging Network (RBIQ) for IPMI-2019 conference. (Selective)
- Financial Aid for research assistantship at IIIT-Hyderabad.

Publications (🎓):

– Published in the top Journals (TPAMI (IF: 24.31), MedIA (IF: 13.83) and TMI(11.03)) and top Tier-1 Conferences (IPMI, MICCAI, and ISBI).
– Total articles published: **20+** in 10 years of research in Machine Learning and Medical Image Analysis.
– Total Citations: **1000+** with H-Index: 13

Under Submission

1. A. Fawaz, L. Z. J. Williams, ..., **K. Gopinath**, ..., C. Desrosiers, H. Lombaert, ..., E. C. Robinson..
Benchmarking Geometric Deep Learning for Cortical Segmentation and Neurodevelopmental Phenotype Prediction
Machine Learning for Biomedical Imaging (MELBA) Journal.

2. **K. Gopinath**, D. N. Greve, C. Magdamo, S. Arnold, S. Das, O. Puonti, J. E. Iglesias.
Recon-all-clinical: Cortical surface reconstruction and analysis of heterogeneous clinical brain MRI
Medical Image Analysis (MedIA) Journal.

Peer Reviewed Journals Publications

1. **K. Gopinath**, B. Billot, A. Hoops, ..., A. Dalce, B. Fischle, J. E. Iglesias.
Synthetic data in generalizable, learning-based neuroimaging.
Imaging Neuroscience Journal, 2024.

2. **K. Gopinath**, C. Desrosiers, H. Lombaert.
Learning joint surface reconstruction and segmentation, from brain images to cortical surface parcellation
Medical Image Analysis Journal (MedIA), 2023. (IF: 10.9)

3. **K. Gopinath**, C. Desrosiers, H. Lombaert.
Learnable Pooling in Graph Convolution Networks for Brain Surface Analysis
IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI), 2021. (IF: 23.6)

4. **K. Gopinath**, C. Desrosiers, H. Lombaert.
Graph Convolutions on Spectral Embeddings for Cortical Surface Parcellation
Medical Image Analysis Journal (MedIA), 2019. (IF: 10.9)

5. H. Bogunovic, ..., **K. Gopinath**, ..., J. Sivaswamy, ..., U. Schmidt-Erfurth.
RETOUCH-The Retinal OCT Fluid Detection and Segmentation Benchmark and Challenge
IEEE Transactions on Medical Imaging (TMI), 2019.. (IF: 10.6)

6. J. Dolz, **K. Gopinath**, J. Yuan, H. Lombaert, C. Desrosiers, I. Ben Ayed
HyperDense-Net: A hyper-densely connected CNN for multi-modal image segmentation.
IEEE Transactions on Medical Imaging (TMI), 2018.(IF: 10.6).

7. **K. Gopinath**, J. Sivaswamy.
Segmentation of retinal cysts from Optical Coherence Tomography volumes via selective enhancement.
IEEE Journal of Biomedical and Health Informatics (JBHI), 2018. (IF: 7.0)

Peer Reviewed Conferences Publications

1. **K. Gopinath**, D. N. Greve, S. Das, S. Arnold, C. Magdamo, J. E. Iglesias.
Cortical analysis of heterogeneous clinical brain MRI scans for large-scale neuroimaging studies
Medical Image Computing and Computer Assisted Intervention (MICCAI) conference 2023.
(Early Acceptance - Top 15%)

2. **K. Gopinath**, C. Desrosiers, H. Lombaert.
SegRecon: Learning Joint Brain Surface Reconstruction and Segmentation from Images
Medical Image Computing and Computer Assisted Intervention (MICCAI) conference 2021.

3. **K. Gopinath***, H. Ran*, C. Desrosiers, H. Lombaert.
Spectral Graph Transformer Networks for Brain Surface Parcellation.
IEEE International Symposium on Biomedical Imaging (ISBI) 2020.
(Oral Presentation)

4. **K. Gopinath**, C. Desrosiers, H. Lombaert.
Adaptive Graph Convolution Pooling for Brain Surface Analysis
Information Processing in Medical Imaging (IPMI) 2019.
(Oral Presentation) - Top 10%

5. **K. Gopinath**, C. Desrosiers, H. Lombaert.
Cortical Parcellation via Spectral Graph Convolutions
Medical Imaging and Deep Learning (MIDL) conference 2019.
(Short Paper Presentation)

6. C. Reddy, **K. Gopinath**, H. Lombaert.
Brain Tumor Segmentation using Topological Loss in Convolutional Networks
Medical Imaging and Deep Learning (MIDL) conference 2019.
(Short Paper Presentation)

7. **K. Gopinath**, S. Rangrej, J. Sivaswamy.
Automatic layer segmentation from OCT volumes using Deep learning.
Asian Conference on Pattern Recognition (ACPR) 2017.

8. **K. Gopinath**, J. Sivaswamy, T. Mansoori.
Automatic Glaucoma Assessment from Angio-OCT Images.
IEEE International Symposium on Biomedical Imaging (ISBI) 2016

Peer Reviewed Workshops Publications

1. **K. Gopinath***, X. Hu*, M. Hoffmann, O. Puonti, J. E. Iglesias.
   Registration by Regression (RbR): a framework for interpretable and flexible atlas registration
   Workshop on Biomedical Image Registration (WBIR)
   Medical Image Computing and Computer Assisted Intervention (MICCAI) conference 2024.

2. **K. Gopinath***, P.B. Fernandez*, W. J. Williams, R. Herisse, L. J. Deden-Binder, D. Zemlyanker, T. Connors, L. Kozanno, D. Oakley, B, Hyman, S.I. Young, J. E. Iglesias.
   Pseudo-Rendering for Resolution and Topology-Invariant Cortical Parcellation
   Workshop on Machine Learning for Medical Imaging (MLMI)
   Medical Image Computing and Computer Assisted Intervention (MICCAI) conference 2024.

3. **K. Gopinath**, C. Desrosiers, H. Lombaert.
   Graph Domain Adaptation for Alignment-Invariant Brain Surface Segmentation
   Workshop on GRaphs in biomedicAl Image anaLysis (GRAIL)
   Medical Image Computing and Computer Assisted Intervention (MICCAI) conference 2020.
   (Best paper runner-up award) – Oral Presentation

International Conference Challenge (Benchmarks) Proceedings

1. S. Yadav, **K. Gopinath**, J. Sivaswamy.
   A Generalized Motion Pattern and FCN based approach for retinal fluid detection and segmentation
   Retinal OCT Fluid (RETOUCH) Challenge 2017
   Medical Image Computing and Computer Assisted Intervention (MICCAI) conference 2017

2. **K. Gopinath**, J. Sivaswamy.
   A Generalized Motion Pattern and FCN based approach for retinal fluid detection and segmentation
   Ophthalmic Image Analysis (OPTIMA) Challenge 2015
   Medical Image Computing and Computer Assisted Intervention (MICCAI) conference 2015

Refereed Short Paper Contributions

1. Y. Cheng, **K. Gopinath**, B. Billot, J. E. Iglesias, A. Touroutoglou, P. Kivisäkk, C.-Y. Wu, H. H. Dodge, B. T. T. Hyman, S. E. Arnold.
   Association of brain MRI signatures with Alzheimer Disease CSF biomarkers
   Alzheimer's Association International Conference (AAIC), 2024.

2. **K. Gopinath**, O. Puonti, D. Greve, A. Sorby-Adams, J. Guo, S. Das, S. Arnold, C. Magdamo, M. Montine, C. Latimer, C. Mac Donald, C. D. Keene, W. T. Kimberly, J. E. Iglesias
   Recon-any: A FreeSurfer-based cortical reconstruction tool for any MRI
   Organization of Human Brain Mapping (OHBM), 2024.

3. **K. Gopinath**, C. Desrosiers, H. Lombaert.
   Graph Convolutions on Spectral Embeddings: Learning of Cortical Surface Data
   Workshop on Medical Imaging meets NeurIPS (Med-NeurIPS) – NeurIPS 2018.
   (Oral Presentation) – Top 10%

Invited Talks

- *Machine Learning of Brain Surface Data* Nov. 2023
  insitro, South San Francisco, California, USA. Invited By: Dr. Chris Probert

- *Recon-all-clinical: Cortical analysis of heterogeneous clinical brain MRI scans* Aug. 2023
  Department of Computational and Data Sciences (CDS), Indian Institute of Science (IISc), Karnataka, Bangalore, India. Invited By: Dr. Vaanathi Sundaresan

- *Recon-all-clinical: Cortical analysis of heterogeneous clinical brain MRI scans* July 2023
  Montreal Neurological Institute (MNI), McGill University, Montreal, Canada. Invited By: Prof. Tal Arbel

- *Cortical analysis of heterogeneous clinical brain MRI scans for large-scale neuroimaging studies* June 2023
  Center for Machine Learning, A.A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, USA. Invited By: Prof. Matthew Rosen

- *Geometric Deep Learning for Brain Surface Analysis* May 2022
  CNS Lab, Stanford University, Palo Alto, California, USA. Invited By: Prof. Kilian Pohl

- *Geometric Deep Learning for Brain Surface Analysis* Mar. 2021
  A.A. Martinos Center for Biomedical Imaging, Massachusetts General Hospital, Harvard Medical School, Boston, MA, USA. Invited By: Prof. J. E. Iglesias

- *Graph Convolution Networks for Brain Surface Analysis* Feb. 2020
  Center for Visual Information Technology (CVIT), International Institute of Information Technology Hyderabad (IIIT-H), Hyderabad, Telangana, India. Invited By: Prof. Jayanthi Sivaswamy

- *Learning of Surface Data with application to neuroimaging* Oct. 2018
  Imaging, Vision and Artificial Intelligence Laboratory (LIVIA), École de technologie supérieure (ETS), Montreal, Quebec, Canada. Invited By: Prof. Éric Grange

Academic Service and Leadership

Organizing Committee

- Boston Medical Imaging Workshop 2023.
- Deep Learning in Neuroimaging Seminar, ETS Montreal.
- Imaging, Vision and Artificial Intelligence Laboratory (LIVIA) seminar series, ETS Montreal.
- Student Organization Team - International Conference on Image Processing Theory, Tools, & Application (IPTA) 2017.

Technical Reviewer

- MedIA: Medical Image Analysis Journal 2021-2024
- TMI: Transactions on Medical Imaging 2019-2024
- NeuroComputing Journal 2020-2022
- MIDL: Medical Imaging and Deep Learning conference 2018-2021
- MICCAI: Medical Imaging Computing and Computer Assisted Intervention conference 2019-2024
- IPMI: Information Processing in Medical Imaging 2020-2024
- GRAIL-MICCAI: GRaphs in biomedicAl Image anaLysis - MICCAI 2022-2024
- Med-NeurIPS: Medical Imaging meets Neural Information Processing Systems 2018-2019

Teaching

- Co-lectured "Introduction to FreeSurfer" course at MGH and Harvard Medical school, 2024.

Open Source Software Release:

- Recon-all-clinical: the first out-of-the-box cortical surface reconstruction and analysis of brain MRI scans of any modality, contrast and resolution without retraining and fine-tuning. Freesurfer - (link).
- ReconAny: A deep learning-enabled version of "Recon-all-like" stream that can handle any adult 3D imaging volumes of arbitrary orientation/resolution/contrast (including low-fied/portable MRI scans and 3D reconstructions of dissection photographs). Freesurfer - (link).

Student Mentorship

Massachusetts Institute of Technology (MIT) 2023 – Present
Summer Geometry Initiative

Cortical mesh parcellation as a 2D segmentation *July 2024 – Aug. 2024*

- *Nicolas Pigadas*, Intern
- *Mutiraj Laksanawisit*, Intern
- *Sergius Justus Nyah*, Intern
- *Kyle Onghai*, Intern

Exvivo surface mesh reconstruction from in-vivo FreeSurfer meshes *July 2023 – Aug. 2023*

- *Tewodros Tassew*, Intern
- *Shanthika Naik*, Intern
- *Sanjana Adapala*, Intern
- *João Teixeira*, Intern

Harvard Medical School 2024 – Present
co-supervised with Prof. Juan Eugenio Iglesias

- *Pablo Fernandez*, Intern Jan. 2024 – Apr. 2024
  - Published at MICCAI MLMI 2024 workshop

Ecole de Technologie Superieure (ETS) 2018 – 2020
co-supervised with Prof. Herve Lombaert

- *Karthik Pullalarevu*, Summer Intern May 2020 – Sep. 2020
  - Worked on Robust Graph spectral alignment.
- *He Ran*, Summer Intern May 2019 – Sep. 2019
  - Published at ISBI 2020 conference.
- *Charan Reddy*, Summer Intern May. 2018 – Sep. 2018
  - Published at the MIDL 2019.

International Institute of Information Technology - Hyderabad (IIIT-H) 2017
co-supervised with Prof. Jayanthi Sivaswamy

- *Shivin Yadav*, Intern Jan. 2017 – July 2017
  - Published at MICCAI RETOUCH 2017 challenge.

Technical Skills

Programming/scripting Languages: Python, MATLAB , Bash, LaTeX
ML Libraries: PyTorch, Tensorflow, OpenCV, scikit-learn, NumPy, SciPy, Pandas, sklearn
Medical Imaging: FSL, Freesurfur