

Pulkit Khandelwal

COMPUTER VISION · DEEP LEARNING · SHAPE ANALYSIS · MEDICAL IMAGING

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Education

University of Pennsylvania

Philadelphia, United States

PHD IN MEDICAL IMAGE ANALYSIS

Aug 2019 - Present

- Courses: Network Neuroscience, Theoretical Neuroscience, Systems Neuroscience, Advanced Image Applications
- Social, Affective and Cognitive Neuroscience, Advanced Linear Algebra and Optimization, Differential Geometry

McGill University

Montreal, Canada

MASTER'S IN COMPUTER SCIENCE

Sep 2016 - Aug 2019

- Courses: Computer Vision, Statistical Computer Vision, Advanced Medical Imaging, Deep Learning
- Natural Language Processing, Reinforcement Learning, Applied Machine Learning

Vellore Institute of Technology

Vellore, India

BACHELOR'S IN TECHNOLOGY IN ELECTRONICS AND COMMUNICATION ENGINEERING

July 2012 - May 2016

- Courses: Data Structures and Algorithms, Digital Image Processing, Digital Signal Processing
- Probability Theory and Random Process, Statistics, Calculus and Differential Equations, Information Theory and Coding

Research Experience

Penn Image Computing and Science Laboratory (PICSL), University of Pennsylvania

Philadelphia, United States

PHD STUDENT | SUPERVISOR: PAUL YUSHKEVICH

Aug 2019 - Present

- Few-shot Meta-learning based domain generalization for CT vertebrae segmentation
- Image synthesis, domain disentanglement, self-supervised learning for *ex vivo* 7T MRI cortical segmentation and registration
- Multi-atlas segmentation of human skull for craniofacial surgery in 3D Ultrashort Echo Time MRI
- Longitudinal network analysis of brain network measurements for early stage detection in Alzheimer's disease

Shape Analysis Group, McGill University

Montreal, Canada

GRADUATE RESEARCH ASSISTANT | SUPERVISORS: KALEEM SIDDIQI AND LOUIS COLLINS

Oct 2016 - Aug 2019

- Spine segmentation in computed tomography images using geometric flows and shape priors [[Link MSc. thesis](#)]
- Methods: Flux based Level-sets with shape priors, coherence and edge enhanced anisotropic diffusion filtering

Centre for Advanced Imaging, University of Queensland

Brisbane, Australia

SUMMER RESEARCH SCHOLAR | SUPERVISOR - STEFFEN BOLLMANN

Dec 2015 - Mar 2016

- Evaluated reliability and reproducibility of probabilistic and atlas based segmentation for Hippocampal subfields
- Performance evaluation of FreeSurfer and ASHS on 7T brain MRI volumes

Imaging, Media and Graphics Laboratory, University of Saskatchewan

Saskatoon, Canada

MITACS GLOBALINK RESEARCH INTERN | SUPERVISOR - MARK ERAMIAN

June 2015 - Aug 2015

- Evaluation of Reproducibility and Accuracy in Semi-automated Interactive Image Segmentation Algorithms
- Markov Random Fields and graph cuts based methods for Image Segmentation
- Focused on HCI and developed a web app to enhance usability research and analysis

Industrial Research Experience

Imagia Cybernetics

Montreal, Canada

COMPUTER VISION INTERN | SUPERVISOR - FLORIAN SOUDAN

May 2018 - Aug 2018

- Domain Adaptation via Adversarial Training to classify Polyp type in Colonoscopy data
- Meta-learning based Domain Generalization across multiple modalities for Brain Tumor Segmentation
- Interpretability of Deep Networks for medical imaging

Planet Labs

San Francisco, United States

INTERN | SUPERVISOR - KATHERINE SCOTT

Aug 2017 - Dec 2017

- Created Segmentation APIs for in-house Computer Vision, Machine Learning and GIS library
- Developed an open-source tool to query Open Street Maps data
- Developed deep semantic segmentation modules for building segmentation in Planet Satellite Imagery

Publications: Journals and Conferences

- **Pulkit Khandelwal**, and Paul A. Yushkevich. *Domain Generalizer: A Few-shot Meta Learning Framework for Domain Generalization in Medical Imaging*. Domain Adpation and Representation Transfer Workshop, International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI) 2020 [Link Conference Proceedings]
- **Pulkit Khandelwal**, Shokufeh Sadhagiani, Sadhana Ravikumar et al. *Gray Matter Segmentation in Ultra High Resolution 7 Tesla ex vivo MRI of human brain hemispheres*. [Under Review] [arXiv Link]
- **Pulkit Khandelwal**, Shokufeh Sadhagiani, Sadhana Ravikumar et al. *Three-dimensional Image Translation-based Diffeomorphic Image Registration using Contrastive learning and Generative Adversarial Networks: application to 7 Tesla ex vivo and 3 Tesla in vivo human brain hemispheres*. [In preparation]
- **Pulkit Khandelwal**, D. Louis Collins, Kaleem Siddiqi. *Spine and Individual Vertebrae Segmentation in Computed Tomography Images using Geometric Flows and Shape Priors*. Frontiers in Computer Science Journal 2021 [Link Journal]
- Zimmerman, Carrie E.***, **Pulkit Khandelwal*****, Long Xie, Hyunyeol Lee, Hee Kwon Song, Paul A. Yushkevich, Arastoo Vossough, Scott P. Bartlett, and Felix W. Wehrli. *Automatic Segmentation of Bone Selective MR Images for Visualization and Craniometry of the Cranial Vault*. Academic Radiology (2021). [Link Journal] ***Joint first authors
- Mark E., Christopher, Mingfang, Stephen R., **Pulkit Khandelwal**. *Benchmarking Human Performance in Semiautomated Image Segmentation*. Interacting with Computers Oxford University 2020 [Link Journal]
- Ahmed H. Aly, **Pulkit Khandelwal**, Abdullah H. Aly, Takayuki Kawashima, Kazuki Mori, Yoshiaki Saito, Judy Hung, Joseph H. Gorman III, Alison M. Pouch, Robert C. Gorman, and Paul A. Yushkevich. *Fully Automated 3D Segmentation and Diffeomorphic Medial Modeling of the Left Ventricle Mitral Valve Complex in Ischemic Mitral Regurgitation* [Under Review at Medical Image Analysis Journal]
- Long Xie, Laura E.M. Wisse, Jiancong Wang, Sadhana Ravikumar, **Pulkit Khandelwal**, Trevor Glenn, Anica Luther, Sydney Lim, David A. Wolk, and Paul A. Yushkevich. *Deep Label Fusion: A Generalizable Hybrid Multi-Atlas and Deep Convolutional Neural Network for Medical Image Segmentation* [Under Review at Medical Image Analysis Journal]

Publications: Abstracts and Posters

- **Pulkit Khandelwal**, Long Xie, Danielle S. Bassett, Robin de Flores, David A. Wolk, Paul A. Yushkevich, and Sandhitsu R. Das. *Longitudinal Network Connectivity Measurements in Medial Temporal Lobe Subregions Discriminate Preclinical Alzheimer's Disease Patients from Amyloid- β Negative Controls*. Alzheimer's Association International Conference (AAIC) 2020 [Link]
- Villavisanis Dillan, **Pulkit Khandelwal**, Zachary Zapatero, Connor Wagner, Blum Jessica D., Cheung Liana, Yushkevich Paul, Bartlett Scott. *Craniofacial Soft Tissue Anthropomorphic Database: MRI-Based Diffeomorphic Algorithmic Approach*. The International Society of Craniofacial Surgery 2021
- Zachary D. Zapatero, **Pulkit Khandelwal**, Connor S. Wagner, Mychajlo S. Kosyk, Christopher L. Kalmar, Paul A. Yushkevich, Bartlett P. Scott. *Generation of a Craniofacial Soft Tissue Anthropomorphic Database: Pilot Study*. Plastic Surgery The Meeting 2021
- **Pulkit Khandelwal**, C. E. Zimmerman, L. Xie, H. Lee, H. K. Song, S. P. Bartlett, P. A. Yushkevich, F. W. Wehrli. *Automated Segmentation of the Human Cranial Vault with Bone-Selective MRI as an alternative to radiative CT for Craniofacial Imaging*. European Society for Magnetic Resonance in Medicine and Biology (ESMRMB) 2020 [Lightning Talk Poster]
- Carrie E Zimmerman, **Pulkit Khandelwal**, Rosaline S Zhang, Long Xie, Hyunyeol Lee, Jesse A. Taylor, Jordan W Swanson, Paul Yushkevich, Felix W Wehrli, Scott Paul P Bartlett. *Bone-Selective MRI As a Non-radiative Alternative to CT for Cranial Vault Imaging: Concordance and Implementation of an Automated Segmentation Pipeline for Timely Image Processing*. Plastic Surgery the Meeting 2020 [Poster]
- **Pulkit Khandelwal**, Carrie E. Zimmerman, Long Xie, Hyunyeol Lee, Cheng-Chieh Cheng, Scott P. Bartlett, Paul Yushkevich, Felix W. Wehrli. *Automated Segmentation of Human Skull to plan Craniofacial Surgery using dual-Radiofrequency dual-Echo, 3D Ultrashort Echo Time MRI sequence*. International Society of Mag-

netic Resonance in Medicine (ISMRM), Paris, France 2020 [**Poster**]

- **P. Khandelwal**, M. Barth, S. Bollmann. *Performance evaluation for automated segmentation of Hippocampus Subfields: Preliminary Results using FreeSurfer and ASHS*. European Society for Magnetic Resonance in Medicine and Biology (ESMRMB), Vienna, Austria, September 2016 [Link](#) [**Lightning Talk Poster**]

Teaching

- University of Pennsylvania:
 - Machine Learning [CIS 520]: Fall 2019
 - Biomedical Image Analysis [CIS/BE 537]: Fall 2020, Fall 2021
 - Machine Learning [PHY 359]: Spring 2021
- McGill University:
 - Introduction to Computer Vision [COMP 558]: Fall 2018
 - Practical Machine Learning [YCBS 258]: Summer 2019
 - Introduction to Software Systems [COMP 206]: Fall 2016, Winter 2017, Winter 2018 and Winter 2019
 - Introduction to Computer Systems [COMP 273]: Winter 2019

Reviewer Duties and Services

- Organization of Human Brain Mapping (OHBM) 2020, 2021
- Medical Image Computing and Computer Assisted Intervention Society (MICCAI) 2020, 2021
- Medical Imaging with Deep Learning (MIDL) 2022
- Domain Adaptation and Representation Transfer (DART) Workshop at MICCAI 2021 (Program committee)
- Medical Imaging meets NeurIPS 2021 (Program committee)
- NeurIPS workshop on Machine Learning and the Physical Sciences 2021
- International Journal of Computer Assisted Radiology and Surgery
- Technical book reviewer: Packt Publishing **Applied Supervised Learning with R** [[Link to textbook](#)]

Software

- Reinforcement Learning Jupyter Notebooks (>1000 stars) [GitHub Link](#)
- Domain Generalizer: A Few-shot Meta Learning Framework for Domain Generalization in Medical Imaging [GitHub Link](#)
- Python Interface for Open Street Maps Queries [GitHub Link](#)
- PyTorch ecosystem: Kornia [Link](#)
- Level-set segmentation demos and code [Link](#)

Honors & Awards

2019-	School of Engineering and Applied Science , Graduate Fellowship (\$80,000 per year)	<i>Philadelphia, USA</i>
2016-19	NSERC CREATE-MIA , Graduate Fellowship (\$41,000)	<i>Montreal, Canada</i>
2016-17	Mitacs Globalink Graduate Fellowship , Graduate Fellowship (\$15,000)	<i>Montreal, Canada</i>
2015	University of Queensland Summer Research Program , Internship Scholarship (\$3,000)	<i>Brisbane, Australia</i>
2015	Mitacs Globalink Research Internship , Internship Scholarship (\$7,500)	<i>Saskatoon, Canada</i>

Talks

- Bioengineering Graduate Group Research Symposium, University of Pennsylvania 2021
- Medical Image Computing and Computer Assisted Interventions (MICCAI) 2020 [[Link](#)]
- Alzheimer's Association International Conference (AAIC) 2020 [[Link](#)]
- The European Society for Magnetic Resonance in Medicine and Biology 2020 [[Link](#)]
- Lightning talk for Product Engineering team, Planet Labs, San Francisco 2017 [[Link](#)]

Skills

- Languages: Python • C • C++ • R • Bash
- Libraries: scikit-learn • vlfeat • PIL • OpenCV • nltk • geoPandas • PyTorch • Keras
- Tools and Packages: Matlab • Mathematica • git • ITK • VTK • FreeSurfer • ASHS • Slicer

Media

- Podcast guest at **Abstract: The Future of Science**. [Listen here](#)