Shivesh Chaudhary

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Education

Georgia Institute of Technology, PhD Atlanta, GA
PhD, Chemical Engineering (GPA 3.6/4.0) (01/16 - 12/16)
- Neural Information Processing in Neural Systems, Convex Optimization, Biomedical Optics, Probabilistic Graphical Models

Indian Institute of Technology - Kanpur (IITK), BS - MS Kanpur, India
Dual Degree, Chemical Engineering, (GPA 8.6/10 & 10/10) (07/08 - 06/13)
- 1st author paper published in *International Journal of Hydrogen Energy*, Overall rank 5th in Department

Awards and Distinctions

- 2022 Suddath Award, 3rd Place Prize, Department of Biomedical Engineering, Georgia Tech
- NSF Student Awards, Machine Learning in Science and Engineering (MLSE) 2019, BME Track
- 2018 Zeigler Award for Best Research Proposal (1 awarded in batch), Chemical & Biomolecular Engineering, Georgia Tech
- 2018 Petit Scholarship Mentor – selected to mentor research of an undergraduate student for 1 year, Georgia Tech
- SGA Conference travel awards 2017, 2018, 2019, Georgia Tech
- MEXT Scholarship 2014, all expenses paid to conduct PhD studies in U. of Tokyo, Japanese Government (declined)
- 2006 National Talent Search Examination Scholarship (NTSE), Govt. of India, 500 awarded in all India
- All India Rank 91, National Science Talent Search Examination 2006, Govt. of India

Research Experience

Georgia Institute of Technology, PhD Atlanta, GA
Computer Vision tools for fast and automated processing of C. elegans whole-brain functional imaging (01/16 – Present)

- ***Conditional Random Fields model for automatic cell identity annotation in images, [paper], [code]***
  - Developed a structured prediction framework that minimizes Gromov-Wasserstein discrepancy between images
  - Showed CRF model is more accurate and robust to common noises in data compared to previous methods
- ***Neuro Imaging Denoising with Deep Learning (NIDDL), [paper], [code]***
  - Developed UNet and Hourglass based efficient architectures to extract high SNR calcium traces from noisy videos
  - NIDDL is highly accurate while requiring 10X lower amount of training data compared to previous methods
  - Experimented with Pix2Pix GANs, ViTs and designed networks 20-30X memory efficient and 3-4X faster inference
- ***Multi object tracking benchmarking toolbox for biomedical images***
  - Built and easy-to-use MATLAB toolbox to optimize and compare object tracking in videos across 6 MOT metrics
  - Toolbox provides APIs to implement and test 21 methods (7 registration based and 14 graph matching based) across 3 different track linking strategies
- ***Hybrid graphical models for object tracking, [paper]***
  - New method that combines Joint Point Cloud Registration with Conditional Random Fields based constraints.
- ***Whole brain 3D cell segmentation***
  - Developed a new framework combining MaskRCNN based instance segmentation with optimal transport based spatial clustering for fast, accurate segmentation of densely packed cells in 3D image stacks

Indian Institute of Technology – Kanpur, Masters Kanpur, India
Comprehensive modeling of water permeation across proton exchange membrane fuel cells (07/12 – 06/13)

- ***Numerical multi-physics simulation of water uptake in PEM fuel cells an effect of Schroder's paradox, [paper]***
  - Developed a comprehensive FEM model of PEM fuel cells and compared two implications of Schroders' paradox

Machine Learning and Computer Vision Projects

- ***SinGAN****. Built using native tensorflow. Modified generative sampling to preserve long scale structures in images*
- ***CutGAN****. Explored contrastive losses for unpaired style transfer between images. Developed in native tensorflow*
- ***Vision Transformer*** *based image classifier. Built native tensorflow and Keras implementations for educational use*
- ***Sentiment analysis*** *Built SVM, Naïve Bayes, Logistic, GBM etc. based classifiers on Zomato user reviews*

Work Experience

EXL Services Gurugram, India
Senior Consultant, Analytics (07/12 – 06/15)

- ***Managed T-Mobile's strategy team for JUMP Program***
  - Managed weekly sales analytics for **$350,000**, developed **statistical models** to predict used cellphone prices
  - Developed **optimization strategy** to rank various B2B aggregators based on demand, designed profitability of JUMP2
  - Automated weekly analysis using **SAS, SQL** based pipelines, and **Excel VBA and Tableau** dashboards
  - Built **unsupervised methods to automatically segment** non-compliant users for US based health information provider
  - Implemented **text mining and NLP methods** to identify top grievance reasons and improve first-call resolution rate

Publications

- Hyun Jee Lee, **Chaudhary S**, Lu H. Automated annotation of cell identities in multi-cell functional imaging videos. *In preparation*
- **Chaudhary S**, Lu H. deep learning combined with optimal transport based framework for fast 3D cell segmentation in whole-brain image stacks. *In preparation*
- **Chaudhary S**, Moon Sihoon, Lu H. Fast, accurate, calcium imaging denoising via deep learning. *In revision Nature Comm.*
- **Chaudhary S**, Lee SA, Li Y, Patel DS, Lu H. Graphical-model framework for automated annotation of cell identities in dense cellular images. Elife. Featured in - *Eureka Alert*, *Medical Express*, *Neuroscience News*
- **Chaudhary S**, Lu H. Point-set registration framework with Conditional Random Fields for automatic tracking of neurons in *C. elegans* whole-brain videos. Workshop on Worm's Neural Information Processing (WNIP), 31st Conference on Neural Information Processing Systems (NIPS 2017)
- **Chaudhary S**, Sachan VK, Bhattacharya PK. Two dimensional modelling of water uptake in proton exchange membrane fuel cell. Int J Hydrogen Energy. 2014

Talks

- Deep learning tools for dense fluorescent microscopic images and *C. elegans* whole-brain imaging. - 2021 AICHE, Boston, MA
- An objective method screening approach for optimizing cell tracking and identity annotation - 2021 AICHE, Boston, MA, USA
- Graphical model framework for automated annotation of cell identities in dense cellular images - 2021 AICHE, Boston, MA
- Deep learning based signal restoration enables high speed and long-term fluorescent imaging in microfluidics - 2021 microTAS
- Deep learning based signal restoration enhances functional and whole-brain imaging - July 2021 Georgia Tech-Emory
- A strategy for neuron identification in whole-brain videos. - 2019 MLSE ChemE and BME tracks, Georgia Tech, GA, USA.
- A strategy for neuron identification in whole-brain videos. - July 2019 Georgia Tech-Emory worm club, GA, USA.
- Automated tools for fast processing to investigate global brain dynamics. - 2018 Zeigler Seminar, Georgia Tech, GA. **Award Talk**
- Improving the interpretability of \textit{C. elegans} whole-brain functional recordings. - 4th Year Symposium, Georgia Tech, GA
- Comprehensive modelling of water permeation across proton exchange membrane fuel cells as well as effects of inclusion of electro-osmotic pump" in 37th Annual Review Meeting, Vikram Sarabhai Space Center, Kerala, India, Nov 2013.

Others

Undergraduates Mentorship

- Yueyi Le – 2018 – 2019, Petit Scholar, Current PhD student at Northwestern University
- Travis Gibson – Spring - Summer 2019, Current PhD student at U. of Wisconsin Madison
- Rebecca K Xiao – Fall 2019
- Stuti Acharya – Spring 2020, Fall 2020

Reviewing work

- Lab on Chip
- Food and Function

Volunteer, Science Night at Morning Side Elementary

- Designed multiple microfluidic demonstrations to demonstrate fluid phenomena at small scale.

Teaching Assistant, Georgia Tech

- CHBE 2130 Chemical Engineering Thermodynamics
- CHBE 3200 Transport Phenomena 1

Southeast Center for Mathematics & Biology (SCMB) – NSF-Simons research center

- Regularly presented posters, talks at SCMB meetings.

Skills

Machine Learning/Computer Vision – Probabilistic Graphical Models, Convex Optimization, Optimal Transport, CPLEX, Inverse Problems, Image registration, Gaussian Process, ADMM, AH, Primal-Dual algorithms
Deep Learning – CNN, VAEs, GANs, ViT, Object Detection, Pose estimation, Image Denoising

Neurobiology – C. elegans, Genetics, Behavior Recording, Microfluidics automations, Fluorescence Microscopy, Molecular Biology, PCR, Gel extraction, Transgenics, Transformation, Gibbs Assembly, cloning
Coding – Python, MATLAB, Tensorflow, Keras, Pytorch, Jupyter, Github, SAS, MySQL, ExcelVBA