Shivesh Chaudhary

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EDUCATION

Georgia Institute of Technology, Atlanta, USA
Graduate Research Assistant, Chemical Engineering, Jan 2016 - current

Indian Institute of Technology (IIT), Kanpur, India
Master of Technology, Chemical Engineering, July 2008 - May 2013

Indian Institute of Technology (IIT), Kanpur, India
Bachelor of Technology, Chemical Engineering, July 2008 - May 2013

AWARDS AND DISTINCTIONS

- **2022 Suddath Award**, 3rd Place Prize - Department of Biomedical Engineering, Georgia Tech.
- NSF Student Award, MLSE 2019 - Machine Learning in BME track.
- The 2018 **Zeigler Award** for the Best Research Proposal (1 awarded in whole batch), Chemical and Biomolecular Engineering Department, Georgia Tech.
- 2018 **Petit Scholarship Mentor** - selected to mentor an undergrad student for a year to conduct biomedical research. Georgia Tech.
- SGA Conference Travel Fund. 2017, 2018, 2019. Georgia Tech.
- **MEXT Scholarship 2014**, awarded by Japan Government to pursue higher studies in University of Tokyo (Declined)
- All India Rank 13/11000, Graduate Aptitude Test for Engineering (GATE 2012) Chemical Engineering
- National Talent Search Examination (NTSE) Scholarship, NCERT, 2006
- All India Rank 91, National Science Talent Search Examination (NSTSE), 2006

RESEARCH EXPERIENCE

Graduate Research Assistant (PhD) Jan 2016 - current
Computer vision empowered *C. elegans* whole-brain calcium recording
Advisor: Prof. Hang Lu, Expected: Winter 2022

- **Conditional Random Fields based automatic cell identity annotation.**
  - developed a structured prediction method that minimizes Gromov-Wasserstein discrepancy between cell features in images and atlas. Demonstrated high accuracy and robustness to noise compared to other methods. [paper], [code]
- **Neuro Imaging Denoising with Deep Learning.**
  - developed UNet and Hourglass based efficient architectures to extract high quality neuron activity signal from noisy videos. Demonstrated high accuracy compared to CARE, RCAN, GANs while being 20-30X memory efficient and 3-4X faster inference speed. [slides], [code]
- **Multi object tracking benchmarking toolbox for biomedical images**
  - developed an easy to use MATLAB toolbox to optimize object tracking in real or synthetic data across 6 MOT accuracy metrics. Provided baseline implementation for 21 methods (7 registration based and 14 graph-matching based) across 3 different track linking strategies. [poster]
- **Hybrid graphical models for object tracking**
  - developed a method that combines Joint Point-Cloud Registration with Conditional Random Fields based constraints to improve correspondence estimation of objects across frames. [paper]

- **Whole Brain 3D cell segmentation**
  - a novel framework combining MaskRCNN based instance segmentation with optimal transport based spatial clustering for fast and accurate segmentation of dense cells in 3D image stacks. [code coming soon], [poster]
- **Microfluidics platforms for decoding signal represenation in brain**
  - Developed microfluidic experimental paradigms for precise chemosensory and mechanosensory stimulation to determine how sensory stimulus is encoded in brain. Performed dimensionality reduction, clustering, regression, mutual information etc. analysis to identify stimulus and behavior tuned cells.

Masters Thesis May 2012 - June 2013
Comprehensive modelling of water permeation across proton exchange membrane fuel cells as well as effects of inclusion of electro-osmotic pump
Advisor: Prof P. K. Bhattacharya, IIT Kanpur

- Developed a comprehensive 2-D, two phase, non-isothermal and transient model of PEM fuel cells using COMSOL Multiphysics and modelled two approaches of water uptake by membrane which account for Schroeder's Paradox. [paper]

JOURNAL PUBLICATIONS

1. Hyun Jee Lee, **Chaudhary S**, Lu H. Automated annotation of cell identities in multi-cell functional imaging videos." *in preparation*
2. **Chaudhary S**, Lu H. Deep learning combined with optimal transport based framework for fast 3D cell segmentation in whole-brain image stacks." *in preparation*
3. **Chaudhary S**, Lu H. Calcium activity recovery in volumetric functional imaging using deep learning." *in review at Nature Communications*
4. **Chaudhary S**, Lee SA, Li Y, Patel DS, Lu H. Graphical-model framework for automated annotation of cell identities in dense cellular images. Elife. 2021;10: e60321. doi:10.7554/eLife.60321
   Featured in - *Eureka Alert*, *Medical Express*, *Neuroscience News*
5. **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)
6. **Chaudhary S**, Sachan VK, Bhattacharya PK. Two dimensional modelling of water uptake in proton exchange membrane fuel cell. Int J Hydrogen Energy. 2014;39: 17802–17818

CONFERENCE PRESENTATION

Talks

1. Deep learning tools for dense fluorescent microscopic images and *C. elegans* whole-brain imaging. - 2021 AICHE, Boston, MA, USA
2. An objective method screening approach for optimizing cell tracking and identity annotation in dense fluorescent images. - 2021 AICHE, Boston, MA, USA
3. Graphical model framework for automated annotation of cell identities in dense cellular images - 2021 AICHE, Boston, MA, USA.
4. Deep learning based signal restoration enables high speed and long-term fluorescent imaging in microfluidics - 2021 microTAS, Palm Springs, CA, USA.
5. Deep learning based signal restoration enhances functional and whole-brain imaging - July 2021 Georgia Tech-Emory worm club, GA, USA.

6. A strategy for neuron identification in whole-brain videos. - 2019 MLSE ChemE and BME tracks, Georgia Tech, GA, USA.
7. A strategy for neuron identification in whole-brain videos. - July 2019 Georgia Tech-Emory worm club, GA, USA.
8. Automated tools for fast processing to investigate global brain dynamics. - 2018 Zeigler Seminar, Georgia Tech, GA, USA. [**Award Talk**]
9. Improving the interpretability of *C. elegans* whole-brain functional recordings. - 4th Year Symposium, Georgia Tech, GA, USA.
10. 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.

Posters

1. Whole-brain cell annotation framework combined with on-chip stimulation reveals stimulus encoding in brain. - 2021 microTAS, Palm Springs, CA, USA.
2. Deep learning toolbox for *C. elegans* whole-brain imaging. - 2021 International *C. elegans* Conference, Virtual.
3. A strategy for neuron identification in *C. elegans* whole-brain videos. - 2019 International *C. elegans* Conference, UCLA, CA, USA.
4. A strategy for neuron identification in *C. elegans* whole-brain videos. - 2019 GRC on Modulation of Neural Circuits and Behavior, Les Diablerets, CH.
5. Improving the interpretability of *C. elegans* whole-brain dynamics. - 2019 Southeast Center for Mathematics and Biology Symposium, Georgia Tech, GA, USA.
6. Improving the interpretability of *C. elegans* whole-brain dynamics. - 2019 Emory Biophysics workshop, Emory University, GA, USA.
7. Automatic neuron identity determination in *C. elegans* whole-brain videos. - MLSE 2018, Carnegie Mellon University, Pittsburgh, Pennsylvania, USA.
8. Fast and automatic processing of *C. elegans* whole-brain videos with probabilistic graphical models. - CRIDC 2018, Georgia Tech, GA, USA.
9. Point-set registration framework with Conditional Random Fields for automatic tracking of neurons in *C. elegans* whole-brain videos. - NIPS Workshop on Worm's Neural Information Processing 2017, Long Beach, CA, USA. [**Poster and Short Paper**]
10. Automatic cell identification, tracking and annotation in whole brain functional recording videos of [*C. elegans*]. - Emerging Tools for Acquisition and Interpretation of Whole-Brain Functional Data 2017, Janelia Research Farms, Virgina, USA.

Skills

ML/CV - Probabilistic Graphical Models, Convex Optimization, Optimal Transport, CPLEX, Inverse Problems, Object detection, Object tracking, Image Registration, Gaussian Processes
Deep Learning - CNN, VAEs, GANs, ViT
Coding - Python, MATLAB, Github, Tensorflow, Keras, Pytorch, Jupyter
Neurobiology - C. elegans, Genetics, Behavior Recording, Microfluidics automation, Functional Imaging, Fluorescence Microscopy
Molecular Biology - PCR, Gel Extraction, Transgenics, Transformation, Cloning

TEACHING ASSISTANT

- CHBE2130, Thermodynamics, Spring 2019, Georgia Tech
- CHBE3200, Transport Phenomena 1, Summer 2018, Georgia Tech
- CHBE3200, Transport Phenomena 1, Summer 2017, Georgia Tech
- CHE453, Chemical Engineering Design, Spring 2013, IIT Kanpur
- CHE674, Introduction to Nanoscience and Nanotechnology, Fall 2012, IIT Kanpur

PROFESSIONAL SERVICE

Undergraduates Mentored

- Yueyi Li, Mentored 2017 - 2019, Petit Scholar
- Rebecca K Xiao, Mentored 2019
- Stutee Acharya, Mentored 2019

Peer reviewing for journals

- Lab On Chip, Food and Function

Volunteer

- Microfluidics demonstration with Lu Lab at 2019 Science Night - Morningside Elementary School, Atlanta, Georgia, USA

WORK EXPERIENCE

Senior Consultant - Analytics, EXL Service July 2015 - December 2015

Head of Assurant's Strategy Team for T-Mobile's JUMP program.

- Conducted sales analytics, developed statistical models to forecast used cellphone prices, and designed profitability analysis of JUMP program.
- Developed an end-to-end optimization strategy to rank various B2B aggregators based on demand and profit.
- Automated weekly data aggregation using SAS, MySQL and ExcelVBA scripts. Developed ExcelVBA and Tableau based containerized dashboards for visualization profitability analyses.

Consultant - Analytics, EXL Service July 2013 - June 2015

Project - Improved First Call Resolution rate for one of the largest US based health insurance provider

- Developed NLP and text mining methods to automatically mine grievance call data for resolution complaints.
- Developed geography and category based strategies based on identified reasons for automatic and fast first-call resolution.
- Developed a SAS based framework to gauge the performance of sites on timely basis.

Project - Identified individual and institutional non-compliant users misusing the services of a global health information provider

- Segmented individual and institutional access data and developed decision rules to automatically identify non-compliant users.
- Collated large-scale events data from webpages and automated non-complian users identification using SAS scripts

Skills - SAS, ExcelVBA, SQL, Tableau, Dashboards, Data analysis, Predictive Modelling, Statistial analysis