CURRICULUM VITAE

Lingchao Mao

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Research Interests

- Methodological developments in statistical machine learning:
  - Machine learning with limited supervision (knowledge-informed machine learning, weakly-supervised learning, self-supervised learning)
  - Multi-modal learning
  - Uncertainty quantification and active learning
- Application domains:
  - Precision medicine of brain cancer using MRI
  - Early prognosis and data-driven biomarker discovery of neurological diseases (e.g. post-traumatic headache, Alzheimer's Disease) using MRI, DTI, fMRI, mobile-collected speech signals
  - Medical image classification (CBCT), segmentation, and reconstruction (MRI)

Education

Ph.D. Machine Learning 2025 (expected)
Georgia Institute of Technology, Advisor: Dr. Jing Li

M.S. Computer Science 2023
Georgia Institute of Technology, specialization in Interactive Intelligence, GPA: 3.92/4.0

B.S. Statistics, B.S. Industrial and Systems Engineering 2020
North Carolina State University, GPA: 4.0/4.0

Awards

- **Best Student Paper Award**, Data Analytics and Information Systems Division, IISE Annual Conference, 2022.
- **Finalist for Best Student Paper Award**, INFORMS Conference of Service Science, 2021
- **Runners up for Best Poster Competition**, Quality and Productivity Research Conference, 2021
- **George Family Fellowship**, H. Milton Stewart School of Industrial & Systems Engineering, 2023
- **Williams S. Green Fellowship**, H. Milton Stewart School of Industrial & Systems Engineering, 2020-2022
- **NSF Travel Scholarship**, Quality and Productivity Research Conference, 2021
- **Stewart Fellowship**, H. Milton Stewart School of Industrial & Systems Engineering, 2020
- **Caldwell Fellowship**, North Carolina State University , 2015-2020
- **Edward P. Fitts Sholar**, North Carolina State University, 2019

Publications and Preprints

- **Mao L**, Wang L, Hu L, Eschbacher J, Leon GD, Singleton K, Curtin W, Urcuyo A, Sereduk J, Tran L, Hawkins A, Swanson K, Li J. Weakly supervised transfer learning with application in precision medicine. *IEEE Transactions on Automation Science and Engineering.* (in print)
- **Mao L**, Li J, Schwedt TJ, Berisha V, Nikjou D, Wu T, Dumkrieger G, Ross K, Chong CD. Questionnaire and structural imaging data accurately predict headache improvement in patients with acute post-traumatic headache attributed to mild traumatic brain injury. *Cephalalgia.* 2023;43(5). doi:10.1177/03331024231172736
- **Mao L**, Dumkrieger G, Ku D, Ross K, Berisha V, Wu T, Schwedt TJ, Li J, Chong CD. Developing multivariable models for predicting headache improvement in patients with acute post-traumatic headache attributed to mild traumatic brain injury: A preliminary study. *Headache: The Journal of Head and Face Pain 63(1).* doi:10.1111/head.14450
- **Mao L**, Chu E, Gu J, Hu T, Weyner B, Su Y. Measuring Topic-Specific Influence on Twitter: Development of Four-Dimensional Theoretical Framework and Usability Study of Dietary Sodium Tweets. *Journal of Medical Internet Research.* 2023. doi:10.2196/45897 http://dx.doi.org/10.2196/45897
- **Mao L**, Vahdat K, Shashaani S, Swann J. Personalized predictions for unplanned urinary rract infection hospitalizations with hierarchical clustering. *Proceedings of INFORMS International Conference on Service Science* (pp. 453-465)

Conference Presentations

- Predicting Headache Improvement in Patients with Acute Post-traumatic Headache Attributed to Mild Traumatic Brain Injury Using Imaging, Clinical, and Speech Data: a Multi-Modality Machine-Learning Study. *American Headache Society Annual Scientific Meeting*, June 15, 2023, Austin, TX (**oral presentation**).
- A Machine Learning Model Including Questionnaire and Structural Imaging Data Predicts Headache Improvement in Patients with Acute Post-traumatic Headache Attributed to Mild Traumatic Brain Injury. *American Academy of Neurology 2023 Annual Meeting*, April 25, 2023, Boston, MA (poster).
- Biomarker Signature to Predict the Persistence of Post-traumatic Headache. *Fourth Annual NIH HEAL Initiative Investigator Meeting*, February 21, 2023, Bethesda, Maryland (**oral presentation**)
- Predicting Headache Persistence in Patients with Acute Post-traumatic Headache Attributed to Mild Traumatic Brain Injury: a Preliminary Study. *American Headache Society Annual Scientific Meeting*, June 9, 2022, Denver, CO (poster)
- Weakly Supervised Transfer Learning with Application in Precision Medicine. *IISE Annual Conference*, May 21, 2022, Seattle, WA. (**Best student paper, DAIS Division**)
- Multivariate models for predicting headache improvement in patients with acute post-traumatic headache attributed to mild traumatic brain injury using baseline clinical data: a preliminary study. *Third Annual NIH HEAL Initiative Investigator Meeting*, April 11, 2022 (virtual poster).
- Weakly Supervised Transfer Learning with Application in Precision Medicine. *INFORMS Workshop on Data Mining and Decision Analytics*, October 23, 2021 (virtual poster).
- A Hybrid Regression-Ranking Model with Application in Personalized Radiomics. *Quality and Productivity research Conference*, 2021 July 27, virtual. (**Runners up of best student poster**)
- Personalized Predictions for Unplanned Urinary Tract Infection Hospitalizations with Hierarchical Clustering. *INFORMS Conference of Service Science*, 2020 December 20, virtual. (**Finalist of best student paper award**)

Research Experiences

Research Assistant, Georgia Institute of Technology, Atlanta, GA 2020 - present

- **Precision medicine of brain cancer**. This research aims to develop personalized machine learning models to predict regional tumor cell density from MRI. My methodological contribution include: 1) developing a novel weakly-supervised transfer learning (WS-TL) model that leverages domain knowledge about the tumor, which addresses the small sample problem and outperforms existing models, 2) an active sampling algorithm to select informative pairs of weakly labeled samples, 3) a GUI for non-technical users to run pre-operative and post-operative model to assist cancer treatment.

  This research is in collaboration with Drs. Kristin Swanson and Leland Hu at Mayo Clinic.

- **Prognosis of persistent post-traumatic headache.** This research develops predictive machine learning algorithms for the prognosis of post-traumatic headache based on neuroimaging (MRI, fMRI, DTI), clinical questionnaires, and mobile-collected speech data. My contributions include: 1) developed a dimension reduction and classification pipeline to predict patient's headache improvement from multi-modality data, and 2) used functional regression to analyze the temporal trajectory of headache evolution over time.

  This research is in collaboration with Drs. Catherine D. Chong and Todd Schwedt at Mayo Clinic.

- **Early prediction of Alzheimer's Disease.** This project benchmarks state-of-the-art machine learning algorithms for early prognosis of AD using incomplete multi-modality neuroimaging. My contribution include: 1) comparing state-of-the-art models on a benchmark dataset (ADNI), and 2) developing a supervised Structural Learning and Integrated DEcomposition (sSLIDE) model that can decompose multi-modality data into globally joint, locally joint, and individual components handling missing data.

- **Automated Detection and Diagnosis of Dental Lesion.** This project aims to develop an automated pipeline to detect, segment, and classify lesion from 3D CBCT dental volumes. I am developing a deep learning model that can combine local view and global views for accurate lesion classification.

Undergraduate Research Assistant, North Carolina State University, Raleigh, NC 2019 - 2020

- **Prediction of Unplanned Hospitalization of Medicare Patients**. This project developed machine learning models to predict unplanned hospitalization of eight types of common diseases and four type of adverse events by analyzing over 15M Medicare claims and various public datasets. My methodological contributions included co-developing a multi-layered feature selection and dynamic personalized scoring algorithm to predict monthly hospitalization risk for individual patients.

  Team selected top 25 out of 300+ teams into Stage I of the $1M CMS AI Health Outcomes Challenge.

- **Data Management in Additive Manufacturing**. This project aimed to build the data infrastructure for the Center for Additive Manufacturing and Logistics to enable real-time process monitoring. My contribution included literature review of process monitoring data types, mapping out the data workflow of 20+ machines in the lab, and proposing database solutions for the lab PI.

Academic Projects

- **MMTrip, a Personalized Multi-modal Routing Planner.** We developed a multi-modal trip planning application with the following capabilities: 1) Door-to-door routes considering all multimodal combinations of flights, public transit, driving, biking, and walking, 2) Personalization via user-defined trip details/preferences/constraints, 3) Accurate prediction of taxi fare via based on Uber's surge pricing model, and 4) Interactive map visualization of routes. (website under development)

- **Finding Influencers in Dietary Sodium Reduction on Twitter.** This project aims to quantify the influence of discussions about sodium intake, one of the risk factors of cardiovascular diseases, on social media. We proposed a novel four-dimensional framework to quantify influence on Twitter and used this framework to analyze 1M+ tweets from 33 stakeholder accounts. We also compiled a

database of national, state-level, and local sodium-reduction policies across the U.S. from 1965-2010 to correlate the policy data with social media patterns. Results revealed different dissemination strategies and areas of improvement for each stakeholder.

I served as mentor for a master and an undergraduate student in this one-year project.

- **Segmentation of Retinal Layers from OCT Images.** This research develops deep learning models to segment retinal nerve fiber layer from OCT images for eye disease diagnosis. My contribution involved implementation of a student-teacher architecture that makes use of unlabeled data via uncertainty-weighted pseudo-labels. Model achieved 0.86 DICE on a pre-clinical mouse dataset.

  This research uses data from Feola Lab from Wallace H. Coulter Dept. of Biomedical Engineering.

- **Self-supervised Reconstruction of MRI.** This research develops deep learning models that can reconstruct fully-sampled brain MRI from under-sampled, accelerated MRI. My contribution involve developing a self-supervised learning framework that can be trained with none or few paired fully-sampled images. The framework is model-agnostic and efficient to implement. Our model achieved similar performance as its supervised counterpart using only 20% of labeled samples on the IXI dataset using U-Net as backbone.

Grant Writing Experience

Helped Ph.D. advisor in preparation of the following grant applications. My involvement included literature review and participating in component section writing.

- NIH-NCI, "The Coordinating and Data Management Center for PDAC Stromal Reprogramming Research," unfunded, 7/1/2022 – 6/30/2027, $1,856,218 (GT share)

Teaching Experience

- Teaching assistant, Computer-Based Modeling for Engineers (undergraduate class at North Carolina State University)
- Level II Tutor (CRLA certified), Physics for Engineers and Scientists I & II (undergraduate classes at North Carolina State University)

Service

- Reviewer
  - IEEE Transactions on Automation Science and Engineering (IEEE-TASE)
  - INFORMS Journal on Computing
  - President's Undergraduate Research Awards (PURA), Georgia Institute of Technology
  - Caldwell Fellows, North Carolina State University
- Professional Memberships
  - **Treasurer**, Institute for Operations Research and the Management Sciences (INFORMS) Chapter at Georgia Tech, 2023 - present
  - **Advisory Committee**, Caldwell Fellows at North Carolina State University, 2023 - present
  - Member, Institute of Industrial and Systems Engineers (IISE)