Yunpu Zeng

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Educational Background

Georgia Institute of Technology (Georgia Tech) **Atlanta, GA**
Ph.D in Industrial Engineering, *01/2025 – now*

Georgia Institute of Technology (Georgia Tech) **Atlanta, GA**
Master of Science in Industrial Engineering, *08/2023 – 12/2024*

Sichuan University (SCU) **Chengdu, China**
Bachelor of Science in Industrial Engineering, *09/2019 – 06/2023*

Publications

- Kunpeng Wang, **Yunpu Zeng**, Zhichun Ye, Zheng Yang, Sai Cheong Fok. "Intra-Subject Respiratory Motion Modeling Based on 4D CT Images via Diffeomorphic Approach." In *Advances in Information and Communication*, Lecture Notes in Networks and Systems, vol. 2025, pp. 287–299. Springer, March 2025. DOI: 10.1007/978-3-031-84460-7_19.
- Kunpeng Wang, Yuexi Dong, **Yunpu Zeng**, Zhichun Ye, Yangzhe Wang. "A CT-Based Airway Segmentation Using U^2-net Trained by the Dice Loss Function." *arXiv preprint arXiv:2209.10796*, September 2022.

Invention Patent

"A Novel Paradigm for Modeling Human Lung Motion and Its Corresponding Biopsy Device".

Research Experience

Modeling Long COVID Progression Using a Multi-Phase State-Transition Framework **Atlanta, GA**
Research Assistant, Supervised by Asst. Prof. Jovan Julien (Georgia Tech) *07/2025 – Present*

- Developed a multi-phase state-transition framework to model Long COVID progression by linking acute COVID-19 infection dynamics with post-acute symptom trajectories and chronic disease burden.
- Constructed a discrete-time simulation model capturing transitions across acute infection, recovery, Long COVID onset, heterogeneous symptom-severity trajectories, and mortality, informed by RECOVER-based clinical profiles.
- Integrated population-level COVID-19 infection and recovery data with individual-level trajectory simulation to estimate Long COVID incidence, prevalence, and symptom burden over calendar time.
- Extended the framework using score-based Long COVID symptom profiles across follow-up months to evaluate persistent disease burden and support long-term healthcare resource planning.

Drinking-Behavior-Driven Microsimulation for Alcohol-Related Disease Progression **Atlanta, GA**
Research Assistant, Supervised by Asst. Prof. Jovan Julien (Georgia Tech) *07/2024 – Present*

- Developed an individual-level microsimulation framework to model the impact of heterogeneous drinking behaviors on alcohol-related disease progression and intervention outcomes across U.S. birth cohorts. The framework primarily focuses on cirrhosis progression and liver-related outcomes, while incorporating broader alcohol-attributable mortality risks and extending to other alcohol-related diseases.
- **Cirrhosis Progression and Alcohol-Related Mortality** *(01/2025 – 03/2026):* Built a natural history state-transition model for alcohol-related cirrhosis progression, incorporating drinking-risk states and liver disease progression pathways. Extended the model by adding major alcohol-attributable causes of death, including cancer, cardiovascular disease, unintentional injuries, and other competing mortality risks, to better capture the overall disease burden associated with alcohol use.
- **Esophageal Cancer Progression** *(01/2025 – 07/2025):* Adapted the drinking-behavior-driven microsimulation framework to esophageal cancer by modeling alcohol-related disease progression pathways, including normal tissue, dysplasia, early- and late-stage esophageal squamous cell carcinoma, and mortality. Evaluated long-term cancer incidence and mortality across U.S. birth cohorts.
- **Intervention Evaluation for Alcohol Use Reduction** *(04/2026 – Present):* Extended the framework to evaluate interventions targeting alcohol use and related health outcomes, including mindfulness-based interventions and semaglutide

for alcohol use disorder. Modeled intervention effects by modifying transitions across drinking-risk states and assessed long-term impacts on alcohol-related disease burden and mortality under different treatment-duration assumptions.

Forecasting Flu Hospitalizations with Google Search Trends Using a Compartmental Model **Atlanta, GA**
Research Member, Supervised by Asst. Prof. Shihao Yang (Georgia Tech) *01/2024 – 12/2024*

- This project, in cooperation with Northeastern University, focuses on probabilistic forecasting of flu hospitalizations using Google search trends. By sampling predictions within the model structure, various methods such as naive strategies, compartmental models, machine learning, statistical time series, temporal deep learning, and advanced multivariable temporal models are employed to enhance prediction accuracy and timeliness.
- Demonstrated a compartmental SIRS model combined with an Extended Kalman Filter (EKF) to accurately predict seasonal flu hospitalizations, leveraging the EKF for state estimation and noise reduction in real-time data assimilation.
- Generated revised rates of corrected data for the CDC (Centers for Disease Control and Prevention), ensuring accuracy and reliability in reported flu hospitalization statistics and facilitating better public health responses.

Intra-Subject Respiratory Motion Modeling Using a Diffeomorphic Approach **Chengdu, China**
Project Leader, Supervised by Asst. Prof. Kunpeng Wang and Prof. Sai Cheong Fok (SCU) *03/2022 – 08/2023*

- I constructed a novel paradigm for deriving human lung motions using affine transformations, enhancing the precision of respiratory motion understanding, facilitating the lung biopsy surgery.
- To optimize lung motion predictions, I employed both linear and non-linear least squares methods to fit the correspondence model. DVFs are developed to characterize respiratory motion, using point cloud data extracted from 4D CT images and manually identified landmarks with semi-automatic tools to reduce errors and improve model reliability.
- I acquired ground truth deformable vector fields (DVFs) for subjects to enable supervised image registration and ensure accurate motion modeling.

Airway Tree Segmentation Using U^2-net and Dice Loss Function **Chengdu, China**
Key Project Member, Supervised by Asst. Prof. Kunpeng Wang (SCU) *05/2022 – 08/2022*

- The Airway Tree Modeling Challenge organized by MICCAI focuses on the crucial task of airway tree segmentation in CT scans. We normalized voxel values to enhance computational efficiency during network training.
- Our training process employed the U^2-net architecture, featuring a two-level nested U-structure for airway tree segmentation. The U^2-net was trained end-to-end using the Dice loss function defined as the weighted sum of the side and final output saliency probability maps.
- To refine the segmented results, we removed distinguishable large non-airway regions by assigning different labels to separate regions and extracting the airway regions. We then implemented segmentation visualization using 3D Slicer and ITK-SNAP for detailed and accurate analysis.

Teaching Experience

- Teaching Assistant, "Analytic Geometry and Calculus I", Sichuan University, 02/2023-06/2023.
- Teaching Assistant, "Analytic Geometry and Calculus III", Sichuan University, 09/2022-01/2023.
- Teaching Assistant, "Physics II", Sichuan University, 09/2021-01/2022.

Leadership Experience

President of the Student Council, 09/2021-06/2022.

Honors and Awards

- Outstanding Capstone Project & Outstanding Graduating Student, 2023.
- National Scholarship, 2022 & 2021.
- Outstanding Student Leader, 2021.

Skills

Languages: Fluent in English; Native in Mandarin.
IT Skills: Proficient in R, Matlab, Python, SIMUL8, SQL, Tableau, ITK-SNAP, Slicer.