

# TIANFENG LU

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## EDUCATION

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**Zhejiang University, *Chu Kochen* Honors College**

B.S. in Biology Science *cum laude* (major)

Information and Computing Science (minor)

**August 2019-June 2023**

*Major GPA: 3.97/4.00, 1st in the major*

*Overall GPA: 3.89/4.00, 1st in the major*

## INTERNSHIP AND WORK

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**Washington University in St. Louis**

Departments of Developmental Biology & Neuroscience, *Visiting Researcher*

**August 2023-present**

**Tsinghua University**

IDG/McGovern institute, *Visiting Student (for dissertation)*

**July 2022-July 2023**

**Zhejiang University**

Department of Cell Biology, School of Medicine, *Undergraduate Student Intern*

**August 2020-July 2023**

**Zhejiang University**

Life Sciences Institute, *Undergraduate Student Intern*

**June 2020-August 2020**

## MANUSCRIPTS AND PUBLICATIONS

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1. **T. Lu**, S. Zhu, R. Wong, G.J. Goodhill, Neuronal coordination structure in a visuomotor transformation, *submitted to COSYNE 2024*.
2. Y. Li, **T. Lu**<sup>#</sup>, P. Dong, J. Chen, Q. Zhao, Y. Wang, T. Xiao, H. Wu, Q. Zhao and H. Huang. A single-cell atlas of *Drosophila* trachea reveals glycosylation-mediated Notch signaling in cell fate specification. *in revision for Nature Communications*.
3. Y. Li, P. Dong, Y. Yang, T. Guo, Q. Zhao, D. Miao, H. Li, **T. Lu**, F. Xia, J. Lyu, J. Ma, T. B. Kornberg, Q. Zhang and H. Huang (2022). Metabolic control of progenitor cell propagation during *Drosophila* tracheal remodeling. *Nature Communications*, **13**: 2817. <https://doi.org/10.1038/s41467-022-30492-4>

## MAJOR COURSEWORK

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- Molecular Biology(99)
- Cell Biology(94)
- Neurobiology(88)
- Genetics(92)

## MINOR COURSEWORK

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- Data Structures and Algorithms(98)
- Point Set Topology/Algebraic Topology(93/94)
- Ordinary Differential Equations(89)
- Probability Theory/Mathematical Statistics(95/97)
- Algebra II/Algebra III(85/78)
- Numerical Algebra(92)
- Differential Manifolds(86)
- Commutative Algebras and Algebraic Geometry(97)

## RESEARCH INTERESTS

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Computational Biology, Gene Regulation Networks, Systems Neuroscience, Neural Networks

AI for Science, Deep Generative Models, Statistical Learning

## SKILLS

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- Advanced programming in R, Python, C/C++
- Expertise in modern Geometry, Algebra and Statistics
- Analysis of high dimensional data
  - ChIP-seq, scRNA-seq, scATAC-seq data
  - Widefield/volume imaging  $\text{Ca}^{2+}$  recordings for thousands of neurons
  - High-speed behavior videos
- Use PyTorch to implement deep learning models (VAE, DDPM, latent diffusion, cross-attention)

## RESEARCH EXPERIENCE

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### Inter-area Information Flow in Zebrafish Larva Brain

August 2023-present

*Mentored by Dr. Geoffrey Goodhill*

*School of Medicine, Washington University in St. Louis*

- I am analyzing 2-photo and lightsheet imaging  $\text{Ca}^{2+}$  recordings for zebrafish larva brain undertaking visual stimuli. I am particularly interested in how sensory stimulus mingles with other experimental-design-irrelevant information in brain regions, resulting variant behavior outcome in the end of sensorimotor transformation.
- Our result will also provide a novel paradigm to study brain information flow via treating brain region neural dynamics as state-space models and estimating causality for time sequences of latent variables.

### Cell classification in cardiovascular disease

February 2022-July 2023

*Mentored by Dr. Hai Huang*

*School of Medicine, Zhejiang University*

- We utilize scRNA-seq and scATAC-seq to study gene regulation networks in human cardiovascular disease. Coronary endothelial dysfunction undertakes a profound change in metabolism, immunity and cell identity.
- A universal theory framework for cell type identification among multiple single cell RNA-seq samples, including SOTA methods as scran-MNN, CCA, harmony, scmap, Symphony, scArches, CaSTLe, etc.

### A Single-cell Atlas of Drosophila Larva Trachea

May 2021-June 2023

*Mentored by Dr. Hai Huang*

*School of Medicine, Zhejiang University*

- A single cell atlas depicts heterogeneity of tracheal cells during morphogenesis. Innovated bioinformatic analyses further resolve cell fate plasticity of tracheoblasts across metabolic conditions.
- Evidence *in silico* reveals key regulators that control tracheal cell identities and developmental trajectory.
- Reacting to high sugar diet induced glycosylation, aberrancy in Notch signaling perturbs cell fate determination in tracheal development.

### Neural Dynamics in Awake-Sleep/Anesthesia Transitions

July 2022-July 2023

*Mentored by Dr. Zengcai Guo*

*School of Medicine, Tsinghua University*

- We use widefield microscope to capture cortex-wide neural dynamics during invertible loss of consciousness in sleep or anesthesia process and identify key signature for the transition.
- Machine learning methods are exploited to analyze high dimensional neural recordings. Statistical properties of complicated networks are highlighted for identification of key characteristics in the transition. Relationship among neural representation, behavior and EEG during such transition is also discussed.
- Deep probabilistic generative models, such as VAE and DDPM, are established and optimized for long time sequences, enhancing inference of behavior evidence and underlying neural dynamics.

### Metabolic control of Drosophila trachea stem cell

August 2020-March 2022

*Mentored by Dr. Hai Huang*

*School of Medicine, Zhejiang University*

- A bioinformatics analysis pipeline for bulk RNA-seq and ChIP-seq data is established to resolve the transcription response towards metabolic change in progenitor cells during tracheal remodeling.
- Our result reveals a series of potential regulation targets of transcription cofactor Yki, building a bridge among metabolic state, signal transduction and development.

### Scientific research training I

June 2020-August 2020

*Mentored by Dr. Cunqi Ye*

*Life Sciences Institute, Zhejiang University*

- I constructed plasmids, cloned target gene sequences and transformed *S. cerevisiae* to express fusion proteins (NLS-GST-GFP). The location change of this enzyme had a significant impact on their survival in adversity.

## SELECTED AWARDS AND HONORS

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Yongping Scholarship

2022

First Class Scholarship for Top talents in Basic Sciences

2021, 2022

Academic Excellence Award & Zhejiang University Scholarship

2020, 2021, 2022

Second Class Prize in China High School Biology Olympiad

2018