Yuta Hozumi

yhozumi3@gatech.edu | [Google Scholar](#) | [Website](#)

EMPLOYMENT HISTORY

Georgia Institute of Technology   Atlanta, GA
Hale Visiting Assistant Professor, School of Mathematics   08/2024 - Current

EDUCATION

Michigan State University   East Lansing, MI
Ph.D. candidate, Department of Mathematics   September 2018 - May 2024
Advisor: Prof. Guo-Wei Wei
Dissertation title: Topological representation and dimensionality reduction of single cell RNA sequencing and phylogenetic data **Case**
Western Reserve University   Cleveland, OH
B.Sc. Applied Mathematics   September 2014 - June 2018

RESEARCH EXPERIENCE

Michigan State University   East Lansing, MI
Research Assistant, Department of Mathematics   January 2018 - current
Case Western Reserve University   East Lansing, MI
Undergraduate Researcher, Department of Mathematics   January 2016 - 2018
Case Western Reserve University   East Lansing, MI
Undergraduate Researcher, Department of Physics   January 2016 - 2018

NONACADEMIC EMPLOYMENT HISTORY

Mercy Ambulance   East Lansing, MI
Emergency medical technician, Dispatcher, COVID response team (2020-2021)   January 2019 - May 2024
Physicians Ambulance Service   Warren, OH
Emergency medical technician   May 2017 - May 2018
Case Western Reserve University Ambulance Service   Cleveland, OH
Emergency medical technician   January 2015 - May 2018

RESEARCH INTERESTS

- **Single Cell RNA Sequencing Data**
  Downstream analysis, Differential Gene Expression (DGE), Cell-Cell Communication, Spatial-Temporal analysis, Multi-omics analysis, Clustering and Visualization

- **Dimensionality Reduction**
  Correlated Clustering and Projection (CCP), Nonnegative matrix factorization (NMF), Principle Components Analysis, Deep-learning based dimensionality reduction (Transformers, Convolutional Neural Network), UMAP, t-SNE

- **Data Visualization**
  Residue Similarity Plots, Vector Field Analysis, Anisotropic Motion, 3D molecular visualization

- **Computational Topology and Geometry**
  Persistent Spectral Graph, Hessian Analysis, Curvature, Differential Geometry

- **Machine and Deep Learning**
  Convolution neural network(CNN); U-Net; Long Short Term Memory network (LSTM); Gated Recurrent Units (GRU); Multi-task learning; Transfer learning; AutoEncoder; Generative Adversarial Network (GAN); Clustering

SKILLS

- **Data Analysis**
  DNA/RNA-Alignment, Single Cell RNA Sequencing, Spatial Omics Data, Multimodal Single Cell Omics data integration, Protein Data Bank

- **Programming Languages**
  Python, R, MATLAB, C++

- **Machine Learning Libraries**
  Scanpy, NumPy, Pandas, Scipy, Scikit-learn, Biopython, Pytorch, Tensorflow, Keras, Matplotlib, Seaborn, Plotly

- **Molecular Visualization and Computer Graphics Software**
  VMD, PyMOL, ChimeraX

AWARDS AND SCHOLARSHIPS

- **College of Natural Science Completion Fellowship**   January 2023 - May 2023
  Michigan State University
- **Women in Mathematics Travel Award**   October 2022
  Florida State University
- **Hertert T. Graham Scholarship Award**   April 2020
  Michigan State University
- **SOURCE Summer Research Grant**   Summer 2017
  Case Western Reserve University
- **Research Education for Undergraduate (REU)**   Summer 2017
  Case Western Reserve University

WEBSITE DEVELOPED

- **Mutation Tracker**
  An interactive website for tracking SARS-CoV-2 mutations.
- **Mutation Analyzer**
  An interactive website for analyzing Spike protein RBD mutations.

PUBLICATIONS

11. **Hozumi, Yuta**, Kiyoto Aramis Tanemura, and Guo-Wei Wei. "Preprocessing of Single Cell RNA Sequencing Data Using Correlated Clustering and Projection." Journal of Chemical Information and Modeling (2023).

10. Chen, Jiahui, Rui Wang, **Yuta Hozumi**, Gengzhuo Liu, Yuchi Qiu, Xiaoqi Wei, and Guo-Wei Wei. "Emerging dominant SARS-CoV-2 variants." Journal of Chemical Information and Modeling 63, no. 1 (2022): 335-342.

9. Gao, Kaifu, Rui Wang, Jiahui Chen, Limei Cheng, Jaclyn Frishcosy, **Yuta Huzumi**, Yuchi Qiu, Tom Schluckbier, Xiaoqi Wei, and Guo-Wei Wei. "Methodology-centered review of molecular modeling, simulation, and prediction of SARS-CoV-2." Chemical Reviews 122, no. 13 (2022): 11287-11368.

8. Wang, Rui, Jiahui Chen, **Yuta Hozumi**, Changchuan Yin, and Guo-Wei Wei. "Emerging vaccine-breakthrough SARS-CoV-2 variants." ACS infectious diseases 8, no. 3 (2022): 546-556.

7. **Hozumi, Yuta**, Rui Wang, Changchuan Yin, and Guo-Wei Wei. "UMAP-assisted K-means clustering of large-scale SARS-CoV-2 mutation datasets." Computers in biology and medicine 131 (2021): 104264.

6. Wang, Rui, Jiahui Chen, Kaifu Gao, **Yuta Hozumi**, Changchuan Yin, and Guo-Wei Wei. "Analysis of SARS-CoV-2 mutations in the United States suggests presence of four substrains and novel variants." Communications biology 4, no. 1 (2021): 228.

5. Wang, Rui, Jiahui Chen, **Yuta Hozumi**, Changchuan Yin, and Guo-Wei Wei. "Decoding asymptomatic COVID-19 infection and transmission." The journal of physical chemistry letters 11, no. 23 (2020): 10007-10015.

4. Wang, Rui, **Yuta Hozumi**, Yong-Hui Zheng, Changchuan Yin, and Guo-Wei Wei. "Host immune response driving SARS-CoV-2 evolution." Viruses 12, no. 10 (2020): 1095.

3. Wang, Rui, **Yuta Hozumi**, Changchuan Yin, and Guo-Wei Wei. "Mutations on COVID-19 diagnostic targets." Genomics 112, no. 6 (2020): 5204-5213.

2. Wang, Rui, Jiahui Chen, Kaifu Gao, **Yuta Hozumi**, Changchuan Yin, and Guo-Wei Wei. "Characterizing SARS-CoV-2 mutations in the United States." Research square (2020).

1. Wang, Rui, **Yuta Hozumi**, Changchuan Yin, and Guo-Wei Wei. "Decoding SARS-CoV-2 transmission and evolution and ramifications for COVID-19 diagnosis, vaccine, and medicine." Journal of chemical information and modeling 60, no. 12 (2020): 5853-5865.

SUBMITTED PREPRINTS

4. **Hozumi, Yuta** and Wei, Guo-Wei. "Analyzing Single Cell RNA Sequencing with Topological Nonnegative Matrix Factorization", arXiv preprint arXiv:2310.15744, submitted to Journal of Computational and Applied Mathematics.

3. Cottrell, Sean, **Hozumi, Yuta** and Wei, Guo-Wei. "K-Nearest-Neighbors Induced Topological PCA for scRNA Sequence Data Analysis", arXiv preprint arXiv:2310.14521 (2023) submitted.

2. **Hozumi, Yuta**, and Guo-Wei Wei. "Analyzing scRNA-seq data by CCP-assisted UMAP and t-SNE." arXiv preprint arXiv:2306.13750 (2023). Briefings in Bioinformatics, revised.

1. **Hozumi, Yuta**, Rui Wang, and Guo-Wei Wei. "CCP: correlated clustering and projection for dimensionality reduction." arXiv preprint arXiv:2206.04189 (2022). IEEE TPAMI, under review.

IN PREPARATION

1. **Hozumi, Yuta**, Cottrell, Sean, Feng, Hongsong and Wei, Guo-Wei, "Differential geometry and algebraic topology of single cell RNA sequencing data", in preparation

CONFERENCES AND PRESENTATIONS

- **Hozumi, Y.**, Minisymposium titled Mathematical Modeling and Analysis of Single Cell Omics Data, 2023 SIAM Great Lakes Section Annual Meeting (GLSIAM) (Organizer)
- **Hozumi, Y.**, Minisymposium titled Mathematical Modeling of Biomolecular data, 2023 SIAM Great Lakes Section Annual Meeting (GLSIAM) (Organizer)
- **Hozumi, Y.**, Recent Advances in Mathematical Modeling of Single Cell RNA Sequencing, Applied Mathematics Seminar at Michigan State University, November 10, 2022
- **Hozumi, Y.**, Correlated Clustering and Projection for Single Cell RNA Sequencing Data (Poster), Women in Scientific Computing on Complex Physical and Biological Systems at University of Florida, Oct 24 - Oct 26, 2022
- **Hozumi, Y.** Application of Spectral Graph Theory on Biomolecular data, Calvin University Colloquium, Feb 02, 2023
- **Hozumi, Y.**, Correlated Clustering and Projection for Dimensionality Reduction, 2022 SIAM Great Lakes Section Annual Meeting (GLSIAM)
- **Hozumi, Y.** Correlated Clustering and Projection for Dimensionality Reduction, Computational Biology Forum at Michigan State University, March 15, 2021
- **Hozumi, Y.** UMAP-assised k-Means Clustering of SARS-CoV-2, Computational Biology Forum at Michigan State University, October 10, 2020

TEACHING EXPERIENCES AND MENTEES

- **Instructor**
  - MTH 124, Survey of Calculus I   Michigan State University
    Lecture Instructor   January 2020 - May 20020
  - MTH 124, Survey of Calculus I   Michigan State University
    Lecture Instructor   August 2019 - December 2019
  - MTH 124, Survey of Calculus I   Michigan State University
    Lecture Instructor   May 2019 - July 2019
  - Math Learning Center (MLC)   Michigan State University
    Tutor   September 2018 - May 2020
- **Undergraduate Research Mentoring**
  - Discovring America Research Project Spring 2024 (MSU)   January 2024 - May 2024
    * Mrs. Areebah Mahdia, Mr. Minh Nguyen, Mr. Bora Uner, Mr. Robert Cesario, Mr. Jiachen Liu
  - Mr. Sean Cottrell (Undergraduate Student, MSU)   May 2023 - Present
- **Graduate Teaching Assistant**
  - MTH 309, Linear Algebra   Michigan State University
    Recitation, office hours, grading   January 2021 - May 2021
  - MTH 309, Linear Algebra   Michigan State University
    Recitation, office hours, grading   January 2020 - May 2020

- MTH 451, Numerical Analysis — Michigan State University
  Recitation, office hours, grading — September 2019 - December 2019
- Math Learning Center (MLC) — Michigan State University
  Tutor — September 2018 - May 2020
- **Japanese School Instructor**
  - High School Japanese Math III (equivalent to AP Calc BC) — Japanese School of Detroit
    Lecture Instructor — April 2020 - October 2022
  - High School Japanese Math AB (equivalent to discrete math and proofs) — Japanese School of Detroit
    Lecture Instructor — April 2020 - October 2022
  - 7th Grade Japanese Math — September 2019 - April 2020
    Lecture Instructor — Japanese School of Detroit
  - Math, English and Science Instrctor — Japanese School of Detroit
    Substitute Lecture Instructor — September 2020 - current

PROFESSIONAL SERVICES

- **Journal Reviewer**
  - Journal of Chemical Information and Modeling

MAJOR MEDIA COVERAGE

- Matt Davenport, MSU researchers use AI to stay ahead of COVID-19 and other diseases, MSUTODAY, 27 June 2022.
- Kim Ward, Using AI to fight Coronavirus, MSUTODAY, 15 Feb 2022.
- Susha Cheriyedath, SARS-CoV-2 Mutations Strengthen RBD-ACE2 Binding, Making the Virus More Infectious, News-Medical.Net, 23 May 2021.
- Sally Robertson, A Host of Mutations Could Compromise COVID-19 Vaccines and Antibody Therapies, News-Medical.Net, 14 Apr 2021.
- Merogenomics,Vaccines and virus evolution - COVID-19 mRNA vaccines update 25, Third party YouTube video about our work on SARS-CoV-2, 01 Jan 2021
- Matt Davenport, "Machine learning helps hunt for COVID-19 therapies", MSUTODAY, 27 Oct 2020.
- Molly Glick, "How COVID-19 Variants Could Outsmart Vaccines", Discovery Magazine, 29 Sep 2021.
- Adrian de Novato, Machine learning model finds SARS-CoV-2 growing more infectious, MSUTODAY, 19 Aug 2020.