Aiying Zhang

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Mental Health Data Science Division

New York State Psychiatric Institute

Columbia University Irving Medical Center

EDUCATION

Columbia University	EXPECTED JULY 2023

Postdoc Training in Cliniacal Biostatistics and Psychiatry, COLUMBIA UNIVERSITY IRVING MEDICAL CENTER

Tulane University	MAY 2021

Ph.D. in Biomedical Engineering, SCHOOL OF SCIENCE AND ENGINEERING — **GPA 3.81/4.0**

Dissertation: *Study brain functional connectivity using graphical models*

Committee members: Yu-Ping Wang (Chair), Donald P. Gaver, Department of Biomedical Engineering

Jihun Hamm, Department of Computer Science

Hongwen Deng, Department of Biostatistics and Data Science

Research Field: Brain imaging, Imaging (epi)genetics

Concentration: Network analysis, Probabilistic graphical models (directed/ undirected)

University of Science and Technology of China (USTC)	JUN 2014

B.Sc. in Statistics, SCHOOL FOR THE GIFTED YOUNG — **GPA 3.63/4.0**

PUBLICATIONS

First Author

Zhang, A., Cai, B., Hu, W., Jia, B., Liang, F., Wilson, T. W., Stephen, J. M., Calhoun, V. D. and Wang, Y.-P. (2020). Joint Bayesian-incorporating estimation of multiple Gaussian graphical models to study brain connectivity development in adolescence. IEEE transactions on medical imaging. vol. 39, no. 2, pp. 357-365.

Zhang, A., Fang, J., Hu, W., Calhoun, V. D., and Wang, Y.-P. (2019). A Latent Gaussian Copula Model for Mixed Data Analysis in Brain Imaging Genetics. IEEE/ACM transactions on computational biology and bioinformatics. vol. 18, no. 4, pp. 1350-1360.

Zhang, A., Fang, J., Liang, F., Calhoun, V. D. and Wang, Y.-P.(2019). Aberrant Brain Connectivity in Schizophrenia Detected via a Fast Gaussian Graphical Model. IEEE journal of biomedical and health informatics. vol. 23, no. 4, pp. 1479-1489.

Zhang, A., Zhang, G., Calhoun, V. D. and Wang, Y.-P. (2020, March). Causal brain network in schizophrenia by a two-step Bayesian network analysis. In Medical Imaging 2020: Imaging Informatics for Healthcare, Research, and Applications (Vol. 11318, p. 1131817). International Society for Optics and Photonics.

Zhang, A., Calhoun, V. D. and Wang, Y.-P. (2019, March). Joint Gaussian copula model for mixed data with application to imaging epigenetics study of schizophrenia. In Medical Imaging 2019: Imaging Informatics for Healthcare, Research, and Applications (Vol. 10954, p. 109540R). International Society for Optics and Photonics.

Zhang, A., Fang, J., Calhoun, V. D. and Wang, Y.-P. (2018, April). High dimensional latent Gaussian copula model for mixed data in imaging genetics. In 2018 IEEE 15th International Symposium on Biomedical Imaging (ISBI 2018) (pp. 105-109).

Zhang, A., Jia, B. and Wang, Y.-P. (2018, March). Tracking the development of brain connectivity in adolescence through a fast Bayesian integrative method. In Medical Imaging 2018: Imaging Informatics for Healthcare, Research, and Applications (Vol. 10579, p. 105790O). International Society for Optics and Photonics.

Co-Author

Zhang, G., Cai, B., **Zhang, A.**, Tu, Z., Xiao, L., Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y. P. (2022). Detecting abnormal connectivity in schizophrenia via a joint directed acyclic graph estimation model. NeuroImage, 260, 119451.

Cai, B., Zhou, Z., **Zhang, A.**, Zhang, G., Xiao, L., J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2022) Functional connectomes incorporing phase synchronization for the characterization and prediction of individual differences. Journal of Neuroscience Methods, 372, 109539.

Cai, B., Zhang, G., **Zhang, A.**, Xiao, L., Hu, W., Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2021) Functional connectome fingerprinting: Identifying individuals and predicting cognitive functions using refined brain connectivity. Human Brain Mapping 42.9, 2691-2705.

Hu, W., Meng, X., Bai, Y., **Zhang, A.**, Cai, B., Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2021) Interpretable multimodal fusion networks reveal mechanisms of brain cognition. IEEE Transactions on Medical Imaging, vol. 40, no. 5, pp. 1474-1483.

Xiao, L., **Zhang, A.**, Cai, B., Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2021) Correlation Guided Graph Learning to Estimate Functional Connectivity Networks from fMRI Data. IEEE Transactions on Biomedical Engineering, vol. 68, no. 4, pp. 1154-1165.

Zhou Z., Cai, B., Zhang, G., **Zhang, A.**, Calhoun, V. D. and Wang, Y.-P. (2021) Prediction and classification of sleep quality based on phase synchronization related whole-brain dynamic connectivity using resting state fMRI. NeuroImage, 221, 117-190.

Cai, B., Zhang, G., **Zhang, A.**, Hu, W., Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2020). A GICA-TVGL framework to study sex differences in resting state fMRI dynamic connectivity. Journal of Neuroscience Methods, 332, p.108531.

Cai, B., Zhang, G., Hu, W., **Zhang, A.**, Zille, P., Zhang, Y., Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2019). Refined measure of functional connectomes for improved identifiability and prediction. Human brain mapping, 40(16), pp.4843-4858.

Zhang, G., Cai, B., **Zhang, A.**, Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2020). Estimating Dynamic Functional Brain Connectivity with a Sparse Hidden Markov Model. IEEE transactions on medical imaging, vol. 39, no. 2, pp. 488-498.

Hu, W., **Zhang, A.**, Cai, B., Calhoun, V. D. and Wang, Y.-P. (2019). Distance canonical correlation analysis with application to an imaging-genetic study. Journal of Medical Imaging, 6(2), 026501.

Hu, W., Cai, B., **Zhang, A.**, Calhoun, V. D. and Wang, Y.-P. (2019). Deep collaborative learning with application to multimodal brain development study. IEEE Transactions on Biomedical Engineering, 66(12), 3346-3359.

Cai, B., Zhang, G., **Zhang, A.**, Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. (2018). Capturing dynamic connectivity from resting state fMRI using time-varying graphical LASSO. IEEE Transactions on Biomedical Engineering, 66(7), 1852-1862.

Zhang, G., **Zhang, A.**, Calhoun, V. D. and Wang, Y.-P. (2020, February). A causal brain network estimation method leveraging Bayesian analysis and the PC algorithm. In Medical Imaging 2020: Biomedical Applications in Molecular, Structural, and Functional Imaging (Vol. 11317, p. 113170X). International Society for Optics and Photonics.

Under Review

Sun, L., **Zhang, A.**, Liang, F. Consistent Dynamic Bayesian Network Learning for a fMRI Study of Emotion Processing. Submitted to Journal of the American Statistical Association.

Zhang, A., Pagliacciob, D., Marsha, R., Lee, S. Decoding Age-specific Changes in Brain Functional Connectivity Using a Sliding-window Based Clustering Method. Submitted to Nature Communications.

Under Preparation

Zhang, A., Zhang, G., Cai, B., Xiao, L., Hu, W., Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. ψ-Learning Incorporated Linear non-Gaussian Acyclic Model (ψ-LiNGAM) for causal inference of brain connectivity from fMRI.

Zhang, A., Zhang, G., Cai,B., Stephen, J. M., Wilson, T. W., Calhoun, V. D. and Wang, Y.-P. A Bayesian incorporated linear non-Gaussian acyclic model for multiple directed graph estimation to study brain emotion circuit development in adolescence.

Zhang, A., Wrengler, K., Horga, G., Goldberg, T., Lee, S. Distinct hierarchical alterations of intrinsic neural timescales account for mild cognitve impairment (MCI) to Dementia.

Research Experience

Research Scientist II	New York State Psychiatric Institute

Mental Health Data Science Division   July 2021 –

- Description: develop data-driven methods to understand typical and atypical brain across lifespan by leveraging large scale public data including ABCD, HCP-D, PNC, ADNI.

   1. Form the basis for developing a new line of statistical methods to identify age-related changes in functional connectivity and examine the role of brain structure and genetics in function development.

   2. Generate new hypotheses regarding the neural bases of developmentally based psychopathologies, and accurate identification of functional development abnormalities and their mechanisms.

Research Assistant, Department of Biomedical Engineering	Tulane University

Statistical Methods for Brain Functional Connectivity Studies   Jan 2016 – May 2021

- Laboratory: The Multiscale Bioimaging and Bioinformatics Laboratory (MBB)
- Description: Develop solid statistical graphical models for the FC estimation under various situations.

   1. Develop a systematic framework of undirected graph estimation under various circumstances. Specifically, we consider cases of high dimensionality, mixed data types, joint estimation for multiple graph, and time-series data.

   2. Address current difficulties in directed graph estimation, specifically for small sample size problems.

Developmental Chronnecto-Genomics (Dev-CoG)

- Collaborator: the Mind Research Network (MRN), the University of Nebraska Medical Center (UNMC), and the Center for Translational Research in Neuroimaging and Data Science (TReNDS)
- Description: Leverage advanced brain imaging and omics data, for biomarkers that can help address relevant areas of brain health and disease.

   1. Deepen the understanding of the neural /neurogenetic mechanism of schizophrenia (SZ) using fMRI, genomic and epigenomic profiles and Identify new and reliable biomarkers for precise diagnosis.

   2. Study the brain emotion circuit development to explain the emotional sensitivity and specialty of adolescence.

   3. Analyze the dynamic functional connectivity and individual variability.

Multi-omics data integration for biomarkers identification in osteoporosis

- Collaborator: Tulane Center for Bioinformatics and Genomics
- Description: Integrate multi-omics data include SNP, DNA methylation, DNA expression, RNA transcription, metabolomics for biomarkers identification and their biological interactions and causal mechanisms of osteoporosis.

Research Assistant, Department of Biostatistics	University of Florida

Research of Early Detection of Infectious Disease Outbreaks Aug 2014 – Dec 2015
- Description: Built an effective and flexible spatial-temporal monitoring system for disease surveillance and early detection.
  1. Statistical model: developed nonparametric spatial-temporal statistical models for estimating the incidence rate and proposed a method coping with irregular spatial-temporal data with measurement error in sensor network.
  2. Compared with the well-received Hierarchical Bayesian Model, Conditional Autoregressive Model and Log-Gaussian Cox Process Model.

Teaching Experience

Advisor of Undergraduate Research, Department of Biomedical Engineering	Tulane University

Student: Jason Dent Jan 2018 – Dec 2018

Thesis: Using a Multilayer Perceptron to Categorize fMRI Data

Teaching Assistant, Department of Biostatistics	University of Florida

Biostatistical Computing with SAS Sep 2015 - Dec 2015
- Prepared lectures for lab sessions using SAS and conducted discussions with students
- Graded, provided correct homework solutions, provided office hours

Advanced Biostatistical Methods Sep 2015 - Dec 2015
- Conducted homework discussions with students weekly
- Graded, provided correct homework solutions, provided office hours

Presentations

Invited Talk

ENAR 2023, March 19 - 22, 2023, Nashville, TN. (scheduled)

Department of Statistics at University of Kentucky, Nov 18, 2022, Lexington, KY (scheduled)

Department of Psychiatry at University of Pittsburgh, Virtual Presentation, Mar 17, 2021.
  Study Brain Functional Connectivity Using Graphical Models

Department of Electrical and Computer Engineering at Rice University, Virtual Presentation, Jan 12, 2021.
  Study Brain Functional Connectivity Using Graphical Models

Mental Health Data Science at Coulumbia University, Virtual Presentation, Jan 8, 2021.
  Study Brain Functional Connectivity Development in Adolescence Using Graphical Models

Department of Biostatistics at Coulumbia University, Virtual Presentation, Dec 3, 2020.
  A Latent Gaussian Copula Model for Data Integration and Its Application in Imaging Genetics

The Cole Neurocognition Lab at Rutgers University, Virtual Presentation, Nov 23, 2020.
  Study Brain Functional Connectivity Using Graphical Models

Conference Presentations

OHBM Annual Meeting, Virtual Presentation, Jun 6 - 7, 2022

Decoding Age-specific Changes in Brain Functional Connectivity Using a Sliding-window Based Clustering Method

9th Annual Tom R. Ten have Symposium on Statistics in Mental Health, Jun 3, 2022, New York, NY, USA.

New Adcances in Statistics and Data Science, May 25, 2022, Honolulu, HI, USA.

A Sliding-window based Clustering Method to Decode Age-Specific Changes in Brain Functional Connectivity

Joint Statistical Meetings (JSM), Virtual Presentation, August 4th, 2020.

A Bayesian Incorporated Linear Non-Gaussian Acyclic Model (BiLiNGAM) for Multiple Directed Acyclic Graph Estimation with application to causal brain connectivity using fMRI (#313970)

OHBM Annual Meeting, Virtual Presentation, June 23 - July 3, 2020.

Causal functional brain network: An advanced approach to study brain cognitive variance (#1068)

SPIE Medical Imaging, Feb 17, 2020, Houston, TX, USA.

Estimation of a causal brain network in schizophrenia via a two-step Bayesian network analysis (#11318-40)

SPIE Medical Imaging, Feb 18, 2019, San Diego, CA, USA

Joint Gaussian copula model for mixed data with application to imaging epigenetics study of schizophrenia (#10954-26)

IEEE ISBI 2018, Apr 5, 2018, Washington, D.C., USA

High dimensional latent Gaussian copula model for mixed data in imaging genetics (#551)

SPIE Medical Imaging, Feb 14, 2018, Houston, TX, USA

Tracking the development of brain connectivity in adolescence through a fast Bayesian integrative method (#10579-20)

OHBM Annual Meeting, June 28, 2017, Vancouver, BC, CA.

Discovery of aberrant brain connectivity networks associated with Schizophrenia using a high-dimensional Gaussian Graphical Model (#4028)

Campus Presentations

School of Science and Engineering (SSE) Research Day, April 11, 2019

High Dimensional Latent Gaussian Copula Model for Mixed Data in Imaging Genetics

Tulane Health Sciences Research Days (HSRD), Feb 20-21, 2017

Discovery of Aberrant Brain Connectivity in Schizophrenia using Gaussian Graphical Models

SSE Research Day, April 6, 2017

Discovery of Aberrant Brain Connectivity in Schizophrenia using Gaussian Graphical Models

SERVICE TO PROFESSION

Editorial Coordinator of Technometrics, American Statistician Association (ASA).	2014 – 2015
Volunteer of K-12 STEM Education Outreach	2017 – 2021
Abstract Triage for the Neuromatch Conference	2020
Reviewer for Medical Image Analysis (MedIA)	
Reviewer for IEEE transactions on Medical Imgaing (TMI)	
Reviewer for IEEE transactions on Network Sience and Engineering (TNSE)	
Reviewer for IEEE transactions on Pattern Analysis and Machine Intelligence (PAMI)	
Reviewer for IEEE/ACM transactions on Computational Biology and Bioinformatics (TCBB)	

RELATED TRAINING

SHARP Traing Program: Skills for Health and Research Professionals   AUG 11-12, 2022

  Organization: Columbia University Mailman School of Public Health

  Certification: Mendelian Randomization Boot Camp: A Practical Guide to Study Design and Implementation

Woman in Neuroscience   JULY 8-10, 2019

  Organization: Brown University, Dartmouth College, Montana State University and University of Nevada at Reno

  Content: Elevator Pitch Talk Training

Deep Learning by deeplearning.ai   MARCH 22, 2019

  Platform: Coursera

  Certification: Completion of five interconnected courses, which are *Neural Networks and Deep Learning*, *Improving Deep Neural Networks: Hyperparameter tuning, Regularization and Optimization*, *Structuring Machine Learning Projects*, *Convolutional Neural Networks*, and *Sequence Models*.

Biostatistics Summer Institutes in Statistical Genetics (SISG) and Statistics in Big Data (SISBID)   JULY 11-29, 2016

  Organization: University of Washington, Seattle

  Certification: Completion of *Quantitative Genetics* and *Supervised Methods for Statistical Machine Learning*

CCNS: Computational Neuroscience Summer School   JULY 27-31, 2015

  Organization: The Statistical and Applied Mathematical Sciences Institute (SAMSI)

  Content: Courses on five major research topics in computational neuroscience, including neural spike train analysis, compressed sensing for signal processing, functional data analysis for medical imaging data, big-biomedical data integration and analysis, shape analysis and diffeomorphisms for medical imaging data.

MEMBERSHIP

Member of American Statistician Association (ASA).	2015 – PRESENT
Member of SPIE, the international society for optics and photonics	2018 – PRESENT

HONORS AND REWARDS

2021 Chinese Government Award for Outstanding Self-financed Students Abroad, China Scholar Council	2022
2021 Biomedical Engineering Graduate Student Outstanding Achivement Award, Tulane University	2021
GSSA Travel Award, Tulane University	2017 – 2020
Certificate of Outstanding Academic Achievement, University of Florida	2014 – 2015
Outstanding Student Scholarship , USTC	2011 – 2013
Outstanding Freshman Scholarship, USTC	2010

GRANT APPLICATION EXPERIENCE

NIH Director's Early Independence Awards (RFA-RM-21-018), Application ID: DP5OD033432	2021
NIH Pathway to Independence Award (PA-20-188), Application ID: -	2022

SKILLS

Languages C/C++, Fortran, Matlab, Python, R, SAS, SPSS, SQL, STATA   **Tools** Linux/Unix, LaTeX