

# Aiying Zhang

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722 West 168th street, R217, New York, NY10032

Mental Health Data Science Division

New York State Psychiatric Institute

Columbia University Irving Medical Center

## EDUCATION

Columbia University	EXPECTED JULY 2023
Postdoc Training in Clinical 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: <i>Study brain functional connectivity using graphical models</i>	
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
<b>Zhang, A.</b> , 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. <i>IEEE transactions on medical imaging</i> . vol. 39, no. 2, pp. 357-365.
<b>Zhang, A.</b> , 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. <i>IEEE/ACM transactions on computational biology and bioinformatics</i> . vol. 18, no. 4, pp. 1350-1360.
<b>Zhang, A.</b> , Fang, J., Liang, F., Calhoun, V. D. and Wang, Y.-P.(2019). Aberrant Brain Connectivity in Schizophrenia Detected via a Fast Gaussian Graphical Model. <i>IEEE journal of biomedical and health informatics</i> . vol. 23, no. 4, pp. 1479-1489.
<b>Zhang, A.</b> , Zhang, G., Calhoun, V. D. and Wang, Y.-P. (2020, March). Causal brain network in schizophrenia by a two-step Bayesian network analysis. In <i>Medical Imaging 2020: Imaging Informatics for Healthcare, Research, and Applications</i> (Vol. 11318, p. 1131817). International Society for Optics and Photonics.
<b>Zhang, A.</b> , 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 <i>Medical Imaging 2019: Imaging Informatics for Healthcare, Research, and Applications</i> (Vol. 10954, p. 109540R). International Society for Optics and Photonics.
<b>Zhang, A.</b> , Fang, J., Calhoun, V. D. and Wang, Y.-P. (2018, April). High dimensional latent Gaussian copula model for mixed data in imaging genetics. In <i>2018 IEEE 15th International Symposium on Biomedical Imaging (ISBI 2018)</i> (pp. 105-109).
<b>Zhang, A.</b> , Jia, B. and Wang, Y.-P. (2018, March). Tracking the development of brain connectivity in adolescence through a fast Bayesian integrative method. In <i>Medical Imaging 2018: Imaging Informatics for Healthcare, Research, and Applications</i> (Vol. 10579, p. 105790O). International Society for Optics and Photonics.

## PUBLICATIONS (CONTINUED)

### 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 incorporating 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 multi-modal 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.

## PUBLICATIONS (CONTINUED)

### 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.  $\psi$ -Learning Incorporated Linear non-Gaussian Acyclic Model ( $\psi$ -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 cognitive 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*

## PRESENTATIONS (CONTINUED)

### 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 Advances 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 Imaging (TMI)

Reviewer for IEEE transactions on Network Science 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

<b>SHARP Traing Program: Skills for Health and Research Professionals</b>	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	
<b>Woman in Neuroscience</b>	JULY 8-10, 2019
Organization: Brown University, Dartmouth College, Montana State University and University of Nevada at Reno	
Content: Elevator Pitch Talk Training	
<b>Deep Learning by deeplearning.ai</b>	MARCH 22, 2019
Platform: Coursera	
Certification: Completion of five interconnected courses, which are <i>Neural Networks and Deep Learning</i> , <i>Improving Deep Neural Networks: Hyperparameter tuning, Regularization and Optimization</i> , <i>Structuring Machine Learning Projects</i> , <i>Convolutional Neural Networks</i> , and <i>Sequence Models</i> .	
<b>Biostatistics Summer Institutes in Statistical Genetics (SISG) and Statistics in Big Data (SISBID)</b>	JULY 11-29, 2016
Organization: University of Washington, Seattle	
Certification: Completion of <i>Quantitative Genetics</i> and <i>Supervised Methods for Statistical Machine Learning</i>	
<b>CCNS: Computational Neuroscience Summer School</b>	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

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

<b>Languages</b> C/C++, Fortran, Matlab, Python, R, SAS, SPSS, SQL, STATA	<b>Tools</b> Linux/Unix, L <sup>A</sup> T <sub>E</sub> X
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