Changwen Wu

Date of birth: 2000.11.03 **|** **Sex:** Male
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Major: Computational Neuroscience / Computer Science
Research Interests: Brain connectome; Neuromodulation; Consciousness

EDUCATION

M.Sc., South China Normal University, Guangzhou, China 2022.09-2025.06 (Expected)
Institute for Brain Research and Rehabilitation GPA: 85/100

B.Sc., Xi'an University of Posts and Telecommunications, Xi'an, China 2018.09-2022.06
Department of Computer Science GPA: 83/100

RESEARCH EXPERIENCE

Project: Allometric Scaling of Multimodal Brain Networks 2024.05-present

Estimated the scaling effects on functional, structural, and morphological networks, and explored their neurobiological underpinnings.

- **Characterized the nonlinear relationships of local-global connectivity variation** of multimodal brain networks using the allometric scaling model. **|** Both the functional and morphological networks showed significant allometric effects, but the structural network did not.
- **Aligned scaling pattern with cortical topography and hierarchy** using Spearman correlation. **|** The scaling pattern of the functional network presented a progressive hierarchy from the sensorimotor network to the default mode network and aligned with myelin content, functional gradient, microstructural hierarchy, and functional evolutionary hierarchy. The scaling pattern of the morphological network also aligned with the functional evolutionary hierarchy.
- **Examined the relationship between scaling patterns and cortex signatures**, including cortical microstructure, metabolism, neurotransmitter receptors, cell types, cognitive activation maps, and cortical abnormality patterns across 13 disorders to understand how allometric scaling relates to cortical structure, function, and pathological changes. **|** The scaling patterns of the functional and morphological networks showed strong associations with several cortex signatures.
- All correlation analyses were corrected for spatial autocorrelation with the spin-based permutation test.

My role: Methodology, formal analysis, original draft preparation (preparing), visualization.

Project: Structure-Function Coupling of Brain Networks 2023.11-2024.05

Measured structure-function coupling between morphological and functional networks (static/dynamic) and how this coupling changes with age.

- Constructed morphological networks and static/dynamic (sliding window) functional networks.
- **Clustered the dynamic functional networks** into four states using K-means.

- **Derived predictors** based on the morphological network's dynamic, topological, and geometric characterization.
- **Measured structure-function coupling** by predicting static/dynamic functional networks using predictors derived from morphological networks with multi-linear models at both whole brain and region levels. **|** Only 13 out of 400 regions showed significant structure-function (static) coupling.
- **Measured the age-related changes of structure-function coupling** using linear or nonlinear (i.e., quadratic or cubic) model. **|** Age-related changes were observed in 4 (linear/quadratic/cubic: 2/1/1) out of 13 regions with significant structure-function (static) coupling.

My role: Methodology, formal analysis.

Project: Static Cerebral Blood Flow (CBF)-Based Functional Brain Network 2023.03-2024.03

Constructed, characterized, and evaluated the CBF network based on static CBF distribution similarity.

- **Constructed CBF network** by measuring similarity between CBF distributions of two regions using JS divergence-based method, and thresholded the CBF network to exclude connections with low weights.
- **Characterized the topological organization of the CBF network** with graph theoretical analysis. **|** CBF networks exhibited non-trivial topological features (e.g., small-world organization, modular architecture, and hubs).
- **Evaluated the reliability of the CBF network**. **|** CBF networks exhibited fair test-retest reliability and high between-subject consistency.
- **Explored the genetic association of the CBF network** by analyzing the relationship between nodal degree of the CBF network and gene expression (Partial Least Square regression, gene ontology enrichment) and the relationship between the CBF network and the genetic co-expression network (Spearman correlation). **|** The CBF network's nodal degree was associated with genes enriched in cholesterol-related biological processes, while no significant correlation was found between the CBF network and the genetic co-expression network.
- **Explored the chemoarchitectonic association of the CBF network** by analyzing the relationship between nodal degree of the CBF network and neurotransmitter intensities (Spearman correlation) and the relationship between the CBF network and the chemoarchitectonic network (Spearman correlation). **|** The nodal degree of the CBF network was associated with DAT/mGluR5 intensities, and a significant correlation was found between the CBF network and the chemoarchitectonic covariance network.
- **Examined the cognitive association of the CBF network** by analyzing the relationship between the nodal degree of the CBF network and cognitive association maps from the neurosynth database. **|** The CBF network was related to language and executive functions.

My role: Methodology, formal analysis, original draft preparation, visualization.

Project: Multi-band Gradients of Functional Brain Network 2022.12-2023.03

Explored the functional gradient of the functional network at different frequency bands.

- **Filtered fMRI time series into multiple frequency bands** based on natural logarithm linear law scale and constructed functional network at each frequency band.

- **Derived function gradients** of functional networks using diffusion embedding approach.
- **Identified how gradients change with frequency** by calculating correlation coefficients among all gradients at all frequency bands. | The first gradient in the 0.01-0.1 Hz range transitioned to the second gradient at 0.1-0.22 Hz and further changed to the third gradient at 0.22-0.60 Hz. The second gradient at 0.01-0.1 Hz became the first gradient at 0.1-0.22 Hz and 0.22-0.60 Hz.

My role: Methodology, formal analysis.

AWARDS

Second Class Graduate Student Scholarship (South China Normal University)	2024
Third Class Graduate Student Scholarship (South China Normal University)	2023
First Class Graduate Student Scholarship (South China Normal University)	2022

SKILLS

Academic Skills: MRI preprocessing (fMRI/sMRI/ASL/DWI), network analysis, statistical analysis
Software: SPM12, CAT12, MRICroN, GRETNA, MRtrix3, Brainspace, abagen
Programing Language: MATLAB (proficient), Python
Others: Docker, Singularity
Language: Chinese (native), English (intermediate)

ACHIEVEMENTS

Publications:

1. Ma, X., Li, J., Yang, Y., Qiu, X., Sheng, J., Han, N., **Wu, C.** ... & Wang, J. (2024). Enhanced Cerebral Blood Flow Similarity of the Somatomotor Network in Chronic Insomnia: Transcriptomic decoding, Gut Microbial Signatures and Phenotypic Roles. *NeuroImage*, 120762.
2. Yin, G., Li, T., Jin, S., Wang, N., Li, J., **Wu, C.**, ... & Wang, J. (2023). A comprehensive evaluation of multicentric reliability of single-subject cortical morphological networks on traveling subjects. *Cerebral Cortex*, 33(14), 9003-9019.

In preparations:

1. **Wu, C.**, He, Y., Li, J., Qiu, X, & Wang, J., A novel method for functional brain networks based on static cerebral blood flow. (under review in *NeuroImage*)
2. **Wu, C.**, Qiu, X, & Wang, J., Allometric scaling of multimodal brain networks. (preparing)