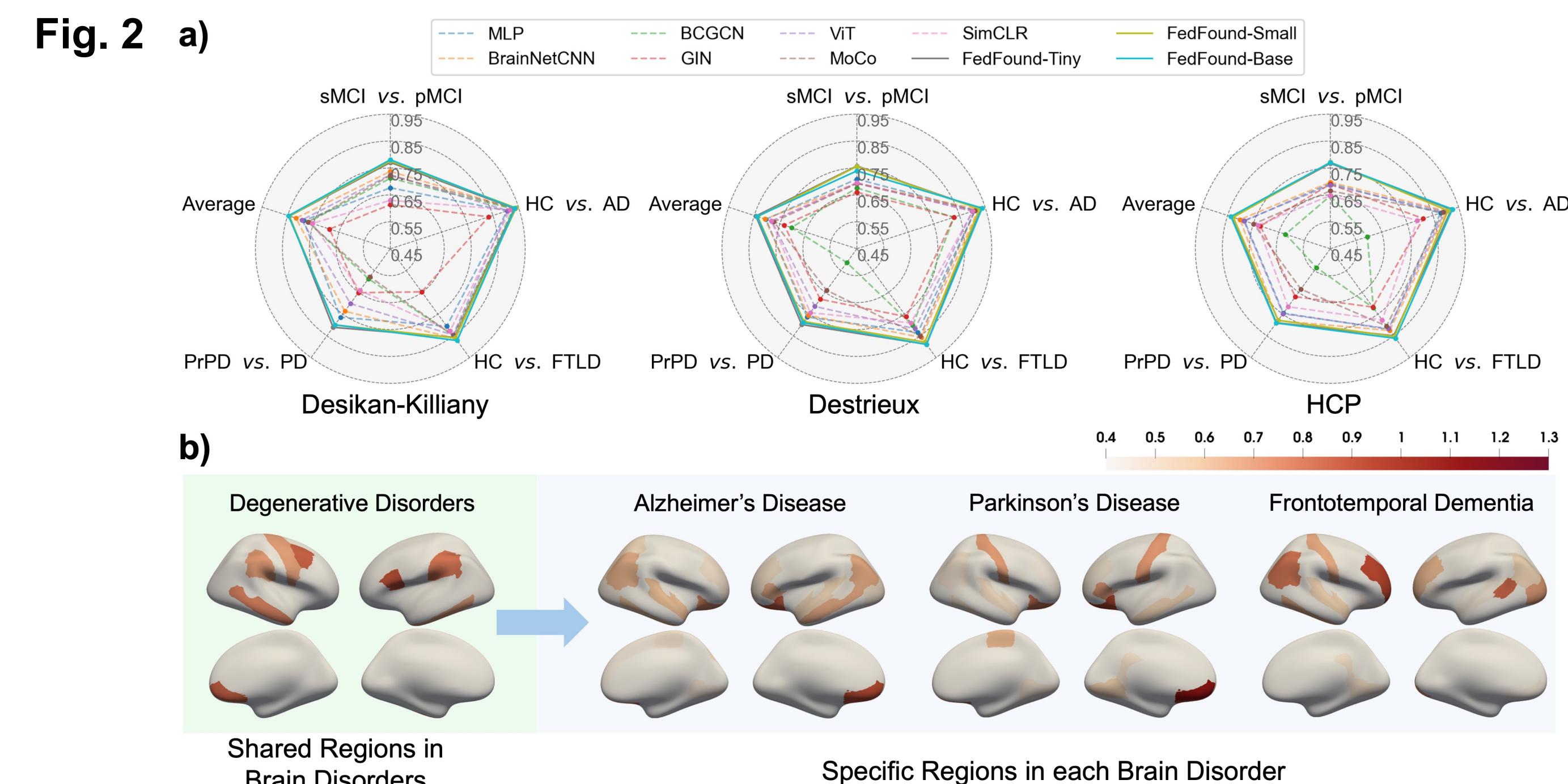
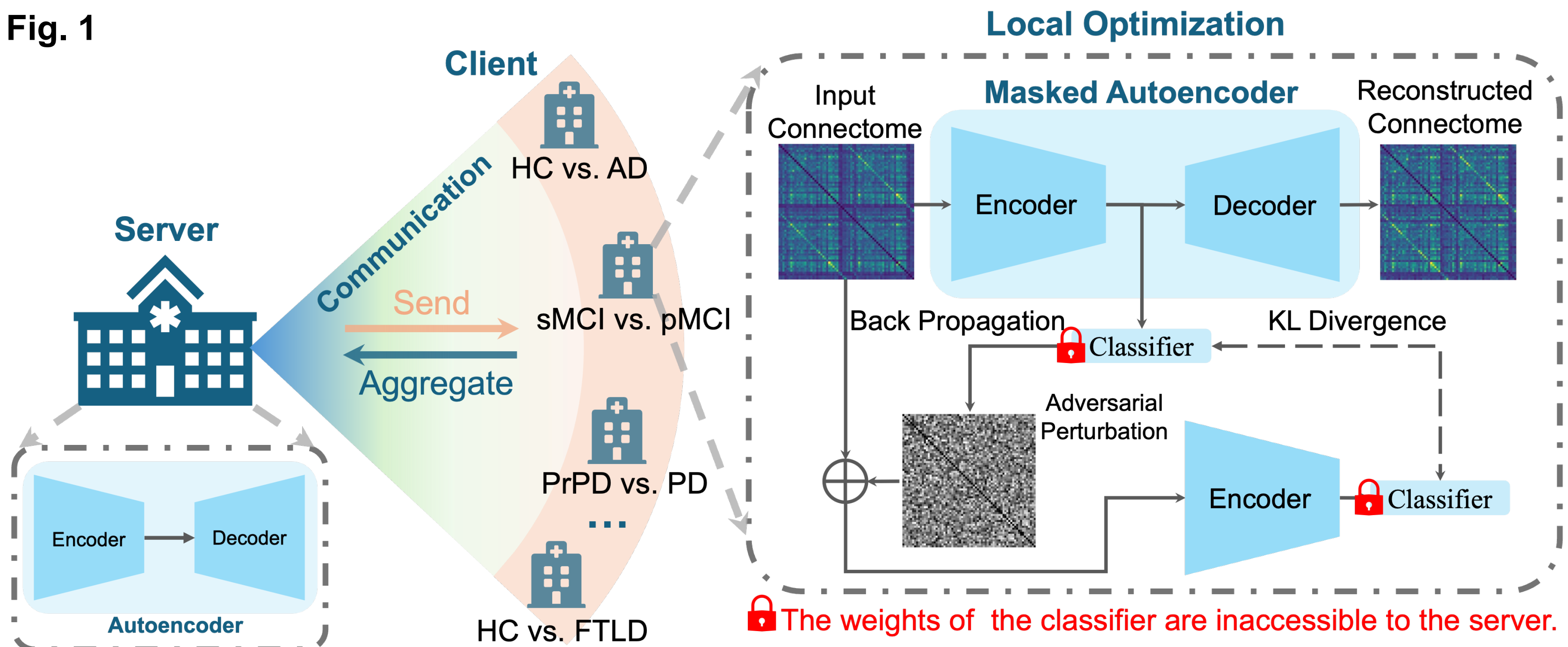


FedFound: A Federated Foundation Model for Lifespan Brain Morphological Connectome Analysis

Kangfu Han, Dan Hu, Ya Wang, Zhengwang Wu, Sheng-Che Hung, Li Wang, Weili Lin, and Gang Li
Department of Radiology and Biomedical Research Imaging Center, University of North Carolina at Chapel Hill, NC, USA

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FedFound represents a significant advancement toward the development of a generalized foundation model for brain morphological connectome analysis. It offers a scalable and interpretable framework that bridges radiological expertise, machine learning innovation, and clinical relevance.



INTRODUCTION	METHODS	RESULTS	CONCLUSIONS	REFERENCES
➤ Growing evidence has linked alterations on brain morphological connectome¹ to neurological conditions, including Alzheimer's disease and related disorders. ➤ However, heterogeneous and complex brain morphological patterns present significant challenges for accurate and generalizable diagnosis using machine learning. ➤ Existing foundation models often neglected the disease information and the potential in fostering interdisciplinary collaboration to uncover the complicated patterns across disease etiologies.	➤ We propose FedFound (Fig. 1), the first federated foundation model enabling robust and scalable analysis of brain morphological connectomes across diverse populations. ➤ FedFound pretrains a masked autoencoder² on a large-scale morphological connectome dataset from over 12,000 diverse subjects to capture lifespan individual variability. ➤ FedFound employs federated learning for supervised refinement on disease-specific datasets, promoting robust representation learning across etiologies.	➤ Across four diagnostic tasks, e.g., HC vs AD, FedFound achieved an average AUC of 0.847 under Desikan-Killiany parcellation Fig. 2(a), substantially outperforming state-of-the-art methods, including MLP, BrainNetCNN, GCGCN, GIN, ViT, MoCo, and SimCLR. ➤ Counterfactual analyses³ Fig. 2(b) based on FedFound further revealed disorder-relevant morphological alterations, with prominent patterns in orbitofrontal, temporal, and supramarginal cortices across neurodegenerative disorders (e.g., AD, PD, and FTLD).	➤ By integrating large-scale self-supervised pre-training with supervised federated refinement, FedFound demonstrates significant improvements in brain disorder classification and effectively captures both shared and disorder-specific brain alterations across a diverse spectrum of neurodegenerative diseases. ➤ Results highlight its potential to support collaborative, neuroimaging studies and to advance reliable, generalizable diagnostic tools for Alzheimer's disease and related disorders.	1. Sebenius, Isaac, et al. "Robust estimation of cortical similarity networks from brain MRI." <i>Nature neuroscience</i> 26.8 (2023): 1461-1471. 2. He, Kaiming, et al. "Masked autoencoders are scalable vision learners." <i>Proceedings of the IEEE/CVF conference on computer vision and pattern recognition</i>. 2022. 3. Dombrowski, Ann-Kathrin, et al. "Diffeomorphic counterfactuals with generative models." <i>IEEE Transactions on Pattern Analysis and Machine Intelligence</i> 46.5 (2023): 3257-3274.
				ACKNOWLEDGEMENTS
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