Chenyu Gao

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Education

Vanderbilt University July 2022 – May 2026 (expected)
Doctor of Philosophy in Electrical & Computer Engineering *Nashville, TN*

Johns Hopkins University Aug 2020 – May 2022
Master of Science in Biomedical Engineering *Baltimore, MD*

Sun Yat-sen University Aug 2016 – June 2020
Bachelor of Science in Biomedical Engineering *Guangzhou, China*

Professional Skills

- Areas of expertise: computer vision, generative models, machine learning, multi-modality, medical imaging
- Programming languages: Python, MATLAB, Bash, R
- Libraries: PyTorch, pandas, multiprocessing, NiBabel, TensorFlow, VTK

Research Experience

Multi-Modality Representation Learning and Uncertainty Inference July 2022 – Present
Vanderbilt University (advisor: Bennett A. Landman), Research Assistant *Nashville, TN*

- Characterized the heteroscedasticity of uncertainty in diffusion tensor imaging (DTI) of aging brains.
- Designed brain age estimation models that focus on the microstructural information ("texture") in the white matter regions, by deliberately destroying the macrostructural information ("shape") through non-rigid transformations ("warping"). Enabled earlier biomarkers for predicting neurodegenerative diseases. [GitHub]
- Developed conditional generative adversarial network (cGAN) for field-of-view extension of diffusion MRI.
- Developed cascaded diffusion models to generate high-resolution 3D MR images with high-fidelity human faces from defaced MR images, demonstrating a potential malicious privacy attack.

Building the World's Largest Diffusion and Structural MRI Database July 2022 – Present
Vanderbilt University (advisor: Bennett A. Landman), Research Assistant *Nashville, TN*

- Coordinated the collection and processing of 20 large-scale MRI datasets from multiple sites, encompassing over 28,000 participants. Standardized data organization using the Brain Imaging Data Structure (BIDS).
- Cleaned and organized demographic and diagnostic data from over 48,000 sessions using pandas.
- Implemented containerization of pipelines with Docker and Singularity to ensure reproducibility and scalability.
- Utilized both local computation and high-performance computing (HPC) resources for cost-effective and high-throughput parallel processing.
- Developed strategies for efficient quality assurance of millions of image samples in real-time collaboration.

Medical Image Analysis and MRI Defacing Dec 2020 – May 2022
Johns Hopkins University (advisor: Jerry L. Prince), Research Assistant *Baltimore, MD*

- Implemented classical image processing algorithms and deep learning-based methods for registration, segmentation, and synthesis of MR images.
- Evaluated the effects of defacing whole-head MRI on segmentation reproducibility.

ProgLearn: Omnidirectional Transfer for Quasilinear Lifelong Learning Aug 2020 – May 2021
Johns Hopkins University (advisor: Joshua T. Vogelstein), Research Assistant *Baltimore, MD*

- Extended the application of a lifelong learning algorithm, ProgLearn, from vision to speech, validated and benchmarked the backward and forward knowledge transfer against transfer learning. [GitHub]

Refereed Journal Articles

J1. **Chenyu Gao**, et al. "Field-of-view extension for brain diffusion MRI via deep generative models." *Journal of Medical Imaging*. 2024.

J2. **Chenyu Gao**, et al. "Characterizing patterns of diffusion tensor imaging variance in aging brains." *Journal of Medical Imaging*. 2024.

J3. **Chenyu Gao**, Bennett A. Landman, Jerry L. Prince, Aaron Carass. "Reproducibility evaluation of the effects of MRI defacing on brain segmentation." *Journal of Medical Imaging*. 2023.

J4. Amalia Peterson, Aditi Sathe, Dimitrios Zaras, Yisu Yang, Alaina Durant, Kacie D Deters, Niranjana Shashikumar, Kimberly R Pechman, Michael E Kim, **Chenyu Gao**, et al. "Sex and APOE-ε4 allele differences in longitudinal white matter microstructure in multiple cohorts of aging and Alzheimer's disease." *Alzheimer's & dementia: the journal of the Alzheimer's Association*. 2024.

J5. Praitayini Kanakaraj, Tianyuan Yao, Leon Y Cai, Ho Hin Lee, Nancy R Newlin, Michael E Kim, **Chenyu Gao**, et al. "DeepN4: Learning N4ITK Bias Field Correction for T1-weighted Images." *Neuroinformatics*. 2024.

J6. Michael E Kim, **Chenyu Gao**, et al. "Empirical assessment of the assumptions of ComBat with diffusion tensor imaging." *Journal of Medical Imaging*. 2024.

Refereed Conference Publications

C1. **Chenyu Gao**, et al. "Predicting age from white matter diffusivity with residual learning." *Medical Imaging 2024: Image Processing*. International Society for Optics and Photonics (SPIE). 2024.

C2. **Chenyu Gao**, Linghao Jin, Jerry L Prince, Aaron Carass. "Effects of defacing whole head MRI on neuroanalysis." *Medical Imaging 2022: Image Processing*. International Society for Optics and Photonics (SPIE). 2022.

C3. Ema Topolnjak*, **Chenyu Gao***, et al. "Assessment of subject head motion in diffusion MRI." *Medical Imaging 2024: Image Processing*. International Society for Optics and Photonics (SPIE). 2024.

C4. Aravind R Krishnan, Kaiwen Xu, Thomas Li, **Chenyu Gao**, et al. "Inter-vendor harmonization of CT reconstruction kernels using unpaired image translation." *Medical Imaging 2024: Image Processing*. International Society for Optics and Photonics (SPIE). 2024.

C5. Tian Yu, Yunhe Li, Michael E Kim, **Chenyu Gao**, et al. "Tractography with T1-weighted MRI and associated anatomical constraints on clinical quality diffusion MRI." *Medical Imaging 2024: Image Processing*. International Society for Optics and Photonics (SPIE). 2024.

C6. Hanliang Xu, Nancy R Newlin, Michael E Kim, **Chenyu Gao**, et al. "Evaluation of mean shift, ComBat, and CycleGAN for harmonizing brain connectivity matrices across sites." *Medical Imaging 2024: Image Processing*. International Society for Optics and Photonics (SPIE). 2024.

C7. Michael E Kim, Ho Hin Lee, Karthik Ramadass, **Chenyu Gao**, et al. "Characterizing low-cost registration for photographic images to computed tomography." *Medical Imaging 2024: Clinical and Biomedical Imaging*. International Society for Optics and Photonics (SPIE). 2024.

Manuscripts Under Review

P1. **Chenyu Gao***, Kaiwen Xu*, et al. "Pitfalls of defacing whole-head MRI: re-identification risk with diffusion models." (submitted)

P2. **Chenyu Gao**, et al. "Brain age identification from diffusion MRI synergistically predicts neurodegenerative disease." (submitted). [arXiv]

P3. Zhiyuan Li, Tianyuan Yao, Praitayini Kanakaraj, **Chenyu Gao**, et al. "Multi-Modality Conditioned Variational U-Net for Field-of-View Extension in Brain Diffusion MRI." (submitted). [arXiv]

P4. Michael E. Kim, **Chenyu Gao**, et al. "Scalable quality control on processing of large diffusion-weighted and structural magnetic resonance imaging datasets." (submitted). [arXiv]

P5. Joshua T. Vogelstein, Jayanta Dey, Hayden S. Helm, Will LeVine, Ronak D. Mehta, Tyler M. Tomita, Haoyin Xu, Ali Geisa, Qingyang Wang, Gido M. van de Ven, **Chenyu Gao**, et al. "A Simple Lifelong Learning Approach." (submitted). [arXiv]

Intellectual Property

IP1. **Chenyu Gao**, Bennett A. Landman, Michael E. Kim. 2024. System and Method of Brain Age Identification for Predicting Neuro-Degenerative Disease. U.S. Patent 63/701,861, filed Oct 1, 2024. Provisional patent.