Lianrui Zuo | Curriculum Vitae

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PROFESSIONAL EXPERIENCE

Postdoctoral Research Fellow, Vanderbilt University — **Nashville, United States**
Medical-image Analysis and Statistical Interpretation (MASI) Laboratory — *Mar 2024 – Present*
Advisor: Dr. Bennett Landman

Predoctoral Research Fellow, National Institute on Aging, NIH — **Baltimore, United States**
Laboratory of Behavioral Neuroscience — *Sep 2019 – Sep 2023*
Advisor: Dr. Susan M. Resnick

Graduate Research Assistant, Johns Hopkins University — **Baltimore, United States**
Image Analysis and Communications Laboratory (IACL) — *Sep 2017 – Jan 2024*
Advisor: Dr. Jerry L. Prince

EDUCATION

Johns Hopkins University — **Baltimore, United States**
Ph.D. in Electrical and Computer Engineering — *Jul 2018 – Jan 2024*
Thesis: "Unsupervised structural MRI harmonization by learning disentangled representations."

Johns Hopkins University — **Baltimore, United States**
M.S.E. in Electrical and Computer Engineering — *Aug 2016 – May 2018*
Thesis: "Quality assurance using outlier detection for cerebellar lobule segmentation."

Jilin University — **Changchun, China**
B.S. in Instrumentation Science and Technology — *Sep 2012 – May 2016*
Distinctive undergraduate with top 3% GPA

HONORS & AWARDS

Bold font indicates sole award recipient or as first author.

2019 – 2023

- **Predoctoral Intramural Research Training Award.** Fellowship number: NIH89367. *National Institutes of Health.*

2023

- **Best Poster Award.** "(First author) Inconsistent MR acquisition in longitudinal volumetric analysis: impacts and solutions." *Americas Committee for Treatment and Research in Multiple Sclerosis (ACTRIMS) Young Scientist Summit, 2023.*
- Best Paper Award. "(Third author) Self-supervised super-resolution for anisotropic MR images with and without slice gap." *The 8th Workshop in Simulation and Synthesis in Medical Imaging (SASHIMI) in conjunction with MICCAI 2023.*
- **(Finalist) Siebel Scholarship 2024**. *Siebel Scholars Foundation*.

- **Young Scientist Summit Training Award**. *Americas Committee for Treatment and Research in Multiple Sclerosis (ACTRIMS), 2023.*
- **(Nomination) Best Platform in Multiple Sclerosis Research Award**. *Consortium of Multiple Sclerosis Centers (CMSC) Annual Meeting, 2023.*

2022

- **Best Paper Award.** "(First author) Disentangling a single MR modality." *The Second Workshop on Data Augmentation, Labeling, and Imperfections (DALI) in conjunction with MICCAI 2022.*

2021

- **Best Poster Award.** "(First author) Information-based disentangled representation learning for unsupervised MR harmonization." *The 27th Conference on Information Processing in Medical Imaging (IPMI), 2021.*

2020

- Best Paper Award. "(Second author) Variational intensity cross channel encoder for unsupervised vessel segmentation on OCT angiography." *In Medical Imaging: International Society for Optics and Photonics (SPIE), 2020.*
- **Scientific Director Award.** *The 25th Annual National Institute on Aging Intramural Research Program Scientific Retreat, 2020.*

2019

- **(Finalist) Excellence in Teaching Award.** *Whiting School of Engineering, Johns Hopkins University.*

2013 – 2016

- **Outstanding Student Award.** *Jilin University.*

MEDIA COVERAGE & INVITED TALKS

Media coverage

- Interviewed by *NeurologyLive* on novel harmonization approaches for multiple scelrosis care. June 2023. Available at `https://www.neurologylive.com/conferences/cmsc`.
- Interviewed by *Video Journal of Neurology* about how image harmonization can help with multi-cohort MS trials. June 2023. Available at `https://vjneurology.com/speaker/lianrui-zuo/`.

Invited talks

- "From voxels to patients: A data-centric journey towards consistent translational AI." December 2023. Host: Dr. Bennett Landman, Department of Electrical and Computer Engineering, Vanderbilt University.
- "Unsupervised MR image harmonization with disentangled representation learning." August 2023 (virtual). Host: Dr. Yogesh Rathi, Brigham and Women's Hospital, Harvard Medical School.
- "Unsupervised MR harmonization with disentanglement." November 2022 (virtual). Host: Dr. Kevin S. Zhou, University of Science and Technology of China.
- "Domain shift, domain adaptation, and magnetic resonance image harmonization." October 2022. At CS 600.475 Machine Learning. Host: Dr. Mark Dredze, Johns Hopkins University.

- "An overview of disentangled representation learning for MR harmonization." September 2022. At Neural Systems Analysis Laboratory. Host: Dr. Arachana Venkataraman, Johns Hopkins University.
- "Unsupervised MR image harmonization using disentangled representation learning." August 2021 (virtual). At Computational Neuroimage Science Laboratory. Host: Dr. Kilian Pohl, Stanford University.

MENTORING & TEACHING

Mentoring

Graduate Independent Study — **Johns Hopkins University**
Research mentor — *Spring 2023*
Investigated using deep learning based deformable image registration to achieve medical image synthesis. A full-length conference paper [C4] is accepted at SPIE 2024 as a long oral presentation, journal version is currently in preparation.

Graduate Independent Study — **Johns Hopkins University**
Research mentor — *Fall 2022*
Investigated using disentangled harmonization to identify optimal operating contrasts for different segmentation algorithms. Published two conference papers [C7-C8] and a conference abstract [A6].

Undergraduate Independent Study — **Johns Hopkins University**
Research mentor — *Spring 2022*
Investigated the impact of harmonization on longitudinal volumetric analysis.

Research Experiences for Undergraduates — **National Science Foundation**
Research mentor — *Summer 2021*
Published a full-length conference paper [C20] as a research mentor.

Teaching

EN 520.414/520.614 Image Processing and Analysis I — **Johns Hopkins University**
Teaching Assistant — *Fall 2017, Fall 2018*
Instructor: Dr. John Goutsias

EN 520.433/520.623 Medical Image Analysis — **Johns Hopkins University**
Teaching Assistant — *Spring 2018, Spring 2021*
Instructor: Dr. Jerry L. Prince

COMMUNITY SERVICES

Organizer

- **Chair.** *The 9th Workshop on Simulation and Synthesis in Medical Imaging (SASHIMI), in conjunction with MICCAI 2024.*
- **Editorial Chair.** *The 3rd International Workshop on Data Augmentation, Labeling, and Imperfections (DALI), in conjunction with MICCAI 2023*

Journal Reviewer

- Artificial Intelligence in Medicine
- Biomedical Signal Processing and Control

- Computers and Electrical Engineering
- Computers in Biology and Medicine
- Computer Methods and Programs in Biomedicine
- IEEE Transactions on Big Data
- IEEE Transactions on Medical Imaging
- Journal of Imaging Informatics in Medicine
- Pattern Recognition
- Multimedia Systems
- Medical Image Analysis

Conference Reviewer

- International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI).
- International Workshop on Data Augmentation, Labeling, and Imperfections (DALI) in conjunction with MICCAI.

BOOK CHAPTERS

B1. **L. Zuo**, Y. Liu, J. L. Prince, and A. Carass. "An overview of disentangled representation learning for MR image harmonization." *Deep Learning for Medical Image Analysis* (*Second Edition*), editors: S. K. Zhou, H. Greenspan, and D. Shen, December 2023.

B2. Y. Liu, **L. Zuo**, Y. He, S. Han, J. Lei, J. L. Prince, and A. Carass. "OCTA segmentation with limited training data using disentangled representation learning." *Deep Learning for Medical Image Analysis* (*Second Edition*), editors: S. K. Zhou, H. Greenspan, and D. Shen, December 2023.

B3. B. E. Dewey, Y. He, Y. Liu, **L. Zuo**, and J. L. Prince. "Medical image harmonization through synthesis." *Biomedical Image Synthesis and Simulation: Methods and Applications* (*First Edition*), edited by N. Burgos and D. Svoboda, June 2022.

JOURNAL PUBLICATIONS

J1. (Under revision) Y. Liu, J. Chen, **L. Zuo**, Y. Du, A. Carass, and J. L. Prince. "Vector field attention for deformable image registration" *IEEE Transactions on Medical Imaging* (*2023*).

J2. **L. Zuo**, Y. Liu, Y. Xue, B. E. Dewey, S. W. Remedios, S. P. Hays, M. Bilgel, E. M. Mowry, S. D. Newsome, P. A. Calabresi, S. M. Resnick, J. L. Prince, and A. Carass. "HACA3: A unified approach for multi-site MR image harmonization". *Computerized Medical Imaging and Graphics* (*2023*).
Software available at: `https://github.com/lianruizuo/haca3`

J3. Y. Liu, A. Carass, **L. Zuo**, Y. He, S. Han, L. Gregori, S. Murray, R. Mishra, J. Lei, P. A. Calabresi, S. Saidha and J. L. Prince. "Disentangled representation learning for OCTA vessel segmentation with limited training data." *IEEE Transactions on Medical Imaging* (*2022*), *41*(*12*), *pp.3686-3698.*

J4. **L. Zuo**, B. E. Dewey, Y. Liu, Y. He, S. D. Newsome, E. M. Mowry, S. M. Resnick, J. L. Prince, and A. Carass. "Unsupervised MR harmonization by learning disentangled representations using information bottleneck theory." *NeuroImage (2021), 243, p.118569.*

J5. Y. He, A. Carass, **L. Zuo**, B. E. Dewey, and J. L. Prince. "Autoencoder based self-supervised test-time adaptation for medical image analysis." *Medical Image Analysis (2021), 72, p.102136.*

FULL-LENGTH CONFERENCE PUBLICATIONS

C1. (Accepted) J. Zhang, **L. Zuo**, B. E. Dewey, S. W. Remedios, D. L. Pham, A. Carass, and J. L. Prince. "Towards an accurate and generalizable multiple sclerosis lesion segmentation model using self-ensembled lesion fusion." *International Symposium on Biomedical Imaging (ISBI), 2024.*

C2. (Accepted) Y. Wang, Y. Liu, S. Wei, Y. Xue, **L. Zuo**, S. W. Remedios, Z. Bian, M. Meggyesy, J. Ahn, R. Lee, M. G. Luciano, J .L. Prince, and A. Carass. "Deep Learning-Based Segmentation of Hydrocephalus Brain Ventricle from Ultrasound." *International Society of Optics and Photonics (SPIE), 2024.*

C3. (Accepted) J. Zhang, **L. Zuo**, B. E. Dewey, S. W. Remedios, S. P. Hays, D. L. Pham, J. L. Prince, and A. Carass. "Harmonization-enriched domain adaptation with light fine-tuning for multiple sclerosis lesion segmentation." *International Society of Optics and Photonics (SPIE), 2024.*

C4. (Accepted) S. P. Hays, **L. Zuo**, Y. Liu, J. Zhuo, J. L. Prince, and A. Carass. "Revisiting registration-based synthesis: A focus on unsupervised MR image synthesis" *International Society of Optics and Photonics (SPIE), 2024.* **Long oral presentation**

C5. S. W. Remedios, S. Han, **L. Zuo**, A. Carass, D. Pham, J. L. Prince, and B. E. Dewey. "Self-supervised super-resolution for anisotropic MR images with and without slice gap." *The 8th Workshop in Simulation and Synthesis in Medical Imaging (SASHIMI) in conjunction with International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI) 2023.* **Oral presentation. Best Paper Award.**

C6. S. Wei, Y. Liu, Z. Bian, Y. Wang, **L. Zuo**, P. A. Calabresi, S. Saidha, J. L. Prince, and A. Carass. "Recurrent self fusion: Iterative denoising for consistent retinal OCT segmentation." *The 10th Ophthalmic Medical Image Analysis Workshop (OMIA) in conjunction with International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI), vol 14096, pp. 42–51, 2023.*

C7. S. P. Hays, **L. Zuo**, Y. Wang, M. G. Luciano, A. Carass, and J. L. Prince. "Exploring the optimal operating MR contrast for brain ventricle parcellation." *Medical Imaging with Deep Learning (MIDL)*, Nashville, TN, July 10–12, 2023.

C8. S. P. Hays, **L. Zuo**, Y. Wang, M. G. Luciano, A. Carass, and J. L. Prince. "Exploring the optimal operating MR contrast for brain ventricle parcellation." *International Symposium on Biomedical Imaging (ISBI), 2023.*

C9. P. Duan, Y. Xue, S. Han, **L. Zuo**, A. Carass, C. Bernhard, P. A. Calabresi, S. M. Resnick, J. S. Duncan, and J L. Prince. "Rapid brain meninges surface reconstruction with layer topology guarantee" *International Symposium on Biomedical Imaging (ISBI), 2023.* **Oral Presentation.**

C10. Y. Wang, A. Feng, Y. Xue, **L. Zuo**, Y. Liu, M. G. Luciano, A. Carass, and J. L. Prince. "Automated ventricle parcellation and Evan's ratio computation in pre- and post-surgical ventriculomegaly." *International Symposium on Biomedical Imaging (ISBI) 2023.*

C11. **L. Zuo**, Y. Xue, B. E. Dewey, Y. Liu, J. L. Prince, and A. Carass. "A latent space for unsupervised MR image quality control via artifact assessment." *Medical Imaging 2023: Image Processing, vol. 12464. International Society of Optics and Photonics (SPIE), 2023.* **Oral Presentation.**

C12. A. Hong, A. Carass, **L. Zuo**, J. L. Prince, A. Alshareef. "Investigating the effect of cerebral atrophy on brain deformation using subject-specific models." *Medical Imaging 2023: Biomedical Applications in Molecular, Structural, and Functional Imaging, vol. 12468. International Society of Optics and Photonics (SPIE), 2023.* **Oral Presentation.**

C13. Y. Xue, **L. Zuo**, S. W. Remedios, B. E. Dewey, P. Duan, Y. Liu, R. Zhang, S. D. Newsome, E. M. Mowry, A. Carass, and J. L. Prince. "Unsupervised quality assurance for brain MR image rigid registration using latent shape representation." *Medical Imaging 2023: Image Processing, vol. 12464. International Society of Optics and Photonics (SPIE), 2023.*

C14. P. Tohidi, S. Han, **L. Zuo**, J. Zhuo, S. R. Roys, A. Carass, R. Gullapalli, and J. L. Prince. "Joint synthesis of WMn MPRAGE and parameter maps using deep learning and an imaging equation." *Medical Imaging 2023: Image Processing. Vol. 12464. International Society of Optics and Photonics (SPIE), 2023.*

C15. **L. Zuo**, Y. Liu, Y. Xue, S. Han, M. Bilgel, S. M. Resnick, J. L. Prince, and A. Carass. "Disentangling a single MR modality." *Second Workshop in Data Augmentation, Labeling, and Imperfections (DALI) 2022, held in conjunction with International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI)*, pp. 54–63. Singapore, 2022. **Best Paper Award.**

C16. Y. Xue, B. E. Dewey, **L. Zuo**, S. Han, A. Carass, P. Duan, S. W. Remedios, D. L. Pham, S. Saidha, P. A. Calabresi, J. L. Prince. "Bi-directional synthesis of pre- and post-contrast MRI via guided feature disentanglement." *The 7th Workshop in Simulation and Synthesis in Medical Imaging (SASHIMI) 2022, held in conjunction with International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI)*, pp. 55-65. Singapore, 2022. **Oral Presentation.**

C17. Y. Liu, **L. Zuo**, S. Han, J. L. Prince, and A. Carass. "Coordinate translator for learning deformable medical image registration." *Third Workshop in Multiscale Multimodal Medical Imaging (MMMI) 2022, held in conjunction with International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI)*, pp. 98-109. Singapore, 2022. **Oral Presentation.**

C18. M. Shao, **L. Zuo**, A. Carass, J. Zhuo, R. P. Gullapalli, J. L. Prince. "Evaluating the impact of MR image harmonization on thalamus deep network segmentation." *In Medical Imaging 2022: Image Processing, vol. 12032, pp. 115-121. International Society of Optics and Photonics (SPIE), 2022.* **Oral Presentation.**

C19. P. Duan, S. Han, **L. Zuo**, Y. An, Y. Liu, A. Alshareef, J. Lee, A. Carass, S. M. Resnick, J. L. Prince. "Cranial meninges reconstruction based on convolutional networks and deformable models: applications to longitudinal study of normal aging." *In Medical Imaging 2022: Image Processing, vol. 12032, pp. 1203215-1. International Society of Optics and Photonics (SPIE), 2022.* **Oral Presentation.**

C20. S. P. Hays, **L. Zuo**, A. Carass, and J. L. Prince. "Evaluating the impact of MR image contrast on whole brain segmentation." *In Medical Imaging 2022: Image Processing, vol. 12032, pp. 122-126. International Society of Optics and Photonics (SPIE), 2022.* **Oral Presentation.**

C21. **L. Zuo**, B. E. Dewey, A. Carass, Y. Liu, Y. He, P. A. Calabresi, and J. L. Prince. "Information-based disentangled representation learning for unsupervised MR harmonization." *In International Conference on Information Processing in Medical Imaging (IPMI) 2021*, pp. 346-359. **Best Poster Award.**

C22. **L. Zuo**, B. E. Dewey, A. Carass, Y. He, M. Shao, J. C. Reinhold, and J. L. Prince. "Synthesizing realistic brain MR images with noise control." *Fifth Workshop in Simulation and Synthesis in Medical Imaging (SASHIMI), held in conjunction with the International Conference on Medical Image Computing and Computer Assisted Intervention (MICCAI) 2020*, pp. 21-31. **Oral Presentation.**

C23. B. E. Dewey, **L. Zuo**, A. Carass, Y. He, Y. Liu, E M. Mowry, S.D. Newsome, J. Oh, P. A. Calabresi, and J. L. Prince. "A disentangled latent space for cross-Site MRI harmonization." *In International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI) 2020*, pp. 720-729. **Oral Presentation.**

C24. Y. He, A. Carass, **L. Zuo**, B. E. Dewey, and J. L. Prince. "Self domain adapted network." *In International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI) 2020*, pp. 437-446. **Oral Presentation.**

C25. Y. Liu, **L. Zuo**, A. Carass, Y. He, A. Filippatou, S. D. Solomon, S. Saidha, P. A. Calabresi, and J. L. Prince. "Variational intensity cross channel encoder for unsupervised vessel segmentation on OCT angiography." *In Medical Imaging 2020: Image Processing, vol. 11313, p. 113130Y. International Society of Optics and Photonics (SPIE), 2020.* **Best Paper Award.**

C26. **L. Zuo**, S. Han, A. Carass, S. H. Ying, C. U. Onyike, and J. L. Prince. "Automatic quality control using hierarchical shape analysis for cerebellum parcellation." *In Medical Imaging 2019: Image Processing, vol. 10949, p. 109490J. International Society of Optics and Photonics (SPIE), 2019.* **Oral Presentation.**

C27. **L. Zuo**, A. Carass, S. Han, and J. L. Prince. "Automatic outlier detection using hidden Markov model for cerebellar lobule segmentation." *In Medical Imaging 2018: Biomedical Applications in Molecular, Structural, and Functional Imaging, vol. 10578, p. 105780D. International Society of Optics and Photonics (SPIE), 2018.* **Oral Presentation.**

CONFERENCE ABSTRACTS

A1. **L. Zuo**, S. P. Hays, B. E. Dewey, S. W. Remedios, Y. Xue, S. D. Cassard, C. Koch, A. Fishman, A. Carass, J. L. Prince, E. M. Mowry, and S. D. Newsome. "Inconsistent MR acquisition in longitudinal volumetric analysis: impacts and solutions." *Consortium of Multiple Sclerosis Centers (CMSC) Annual Meeting*, Aurora, CO, May 31–June 3, 2023. **Best Platform in Multiple Sclerosis Research Award (Nomination).**
Presentation available at: `https://github.com/lianruizuo/inconsistent_acquisition`

A2. S. Wei, Y. Liu, **L. Zuo**, S. Saidha, P. A. Calabresi, J. L. Prince, and A. Carass. "Retinal layer thickness comparison between the UK BioBank and people with multiple sclerosis." *Consortium of Multiple Sclerosis Centers (CMSC) Annual Meeting*, Aurora, CO, May 31–June 3, 2023.

A3. Y. Xue, B. E. Dewey, **L. Zuo**, S. W. Remedios, S. P. Hays, S. D. Cassard, C. Koch, A. Fishman, A. Carass, P. A. Calabresi, Jerry L. Prince, E. M. Mowry, and S. D. Newsome. "Synthesizing

missing MRI sequences to improve processing images in multiple sclerosis." *Consortium of Multiple Sclerosis Centers* (*CMSC*) *Annual Meeting*, Aurora, CO, May 31–June 3, 2023.

A4. B. E. Dewey, A. Fishman, S. D. Cassard, **L. Zuo**, S. W. Remedios, Y. Xue, C. Koch, A. Carass, J. L. Prince, E. M. Mowry, and S. D. Newsome. "Measuring MRIs Differences Between Sites: Design of a Traveling Subject Study in MS." *Consortium of Multiple Sclerosis Centers* (*CMSC*) *Annual Meeting*, Aurora, CO, May 31–June 3, 2023.

A5. B. E. Dewey, **L. Zuo**, S. W. Remedios, Y. Xue, S. D. Cassard, C. Koch, A. Fishman, A. Carass, J. L. Prince, E. M. Mowry, and S. D. Newsome. "Compliance with CMSC MRI guidelines in a multi-center, pragmatic, randomized clinical trial: Improvements over time." *Consortium of Multiple Sclerosis Centers* (*CMSC*) *Annual Meeting*, Aurora, CO, May 31–June 3, 2023.

A6. S. P. Hays, **L. Zuo**, B. E. Dewey, S. W. Remedios, Y. Xue, S. D. Cassard, C. Koch, A. Fishman, A. Carass, P. A. Calabresi, J. L. Prince, E. M. Mowry, and S. D. Newsome. "Quantifying contrast differences among MR images used in clinical studies." *Consortium of Multiple Sclerosis Centers* (*CMSC*) *Annual Meeting*, Aurora, CO, May 31–June 3, 2023.

A7. S. W. Remedios, B. E. Dewey, Y. Xue, **L. Zuo**, S. D. Cassard, C. Koch, A. Fishman, A. Carass, J. L. Prince, E. M. Mowry, and S. D. Newsome. "Cautions in anisotropy: Thick slices and slice gaps in 2D MR acquisition tarnish volumetrics." *Consortium of Multiple Sclerosis Centers* (*CMSC*) *Annual Meeting*, Aurora, CO, May 31–June 3, 2023.

A8. B. E. Dewey, S. D. Cassard, A. Fishman, **L. Zuo**, Y. He, A. Carass, J. L. Prince, E. M. Mowry, and S. D. Newsome. "Improving the utilization of standardized MRIs in multiple sclerosis care: A pragmatic trial perspective" *Consortium of Multiple Sclerosis Centers* (*CMSC*) *Annual Meeting*, Orlando, FL, Oct 25–28, 2021. **Oral Presentation.**