ninglu@umich.edu

# Ning Lu

## MISSION STATEMENT

I am an ultrasound scientist specializing in developing integrated systems and computational tools for medical imaging, non-invasive therapy, image-guided intervention, and wearable devices.

## EDUCATION

**University of Michigan, Ann Arbor, MI** 08/ 2018 – 07/ 2023
Ph.D. in Biomedical Engineering & Scientific Computing *(PI: Zhen Xu)* GPA: 4.0/4.0

**Southeast University, Nanjing, China** 08/ 2014 – 06/ 2018
B.E. in Biomedical Engineering (Highest Honor, Chien-Shiung Wu College*) GPA: 3.6/4.0
* Only the top 30 engineering undergraduates in Southeast University are selected for this college.

## WORK EXPERIENCE

**United Imaging Healthcare America Inc, Bellevue, WA** 03/ 2025 - Present
Senior Ultrasound Engineer

**Stanford University, Palo Alto, CA** 08/ 2023 – 03/2025
Postdoctoral Scholar *(PI: Katherine W. Ferrara)*

## RESEARCH EXPERIENCE

**High-resolution Ultrasound Volumetric Imaging**
Stanford University, Palo Alto, CA 08/ 2023 – 03/2025

- Developed volumetric spine imaging techniques using a large-aperture array for diagnosis and real-time interventional guidance.
- Developing a high-resolution ultrasound tomography scanner for non-radiant breast cancer screening.
- Developing real-time aberration correction algorithms to improve image quality in 3D anatomical and functional imaging.

**Transcranial MR-guided Histotripsy (TcMRgHt) for Brain Treatment**
University of Michigan, Ann Arbor, MI 08/ 2018 – 07/ 2023
*Dissertation committee: Drs. Zhen Xu, Douglas C. Noll, Jeffrey A. Fessler, Timothy L. Hall, Jonathan R. Sukovich, Aditya Pandey*

- Designed and constructed the first human-scale TcMRgHt system, including the phased array, the transmit-and-receive capable electronic driver, and peripheral mechanical structures.
- Developed a two-step aberration correction method to improve treatment efficacy and precision, which uses CT-based raytracing as the first step, followed by a cavitation-based time-reversal approach.
- Developed imaging algorithms for focused ultrasound treatment monitoring, with a spatial-temporal resolution that allows imaging for every cavitation event including the skull surface cavitation.
- Evaluated the feasibility, safety, and outcome of TcMRgHt treatment *ex vivo* and *in vivo*.

**Ultrasound Eye Tracking for AR/VR Devices**
Meta (formerly Facebook) Reality Labs, Redmond, WA 05/ 2022 – 09/ 2022

- Developed an acoustic simulation platform to synthesize data for ultrasound eye tracking data as a function of transducer/system design, sensor noise, eye/face occlusion, and headset slippage.
- Achieved end-to-end eye tracking using a machine learning algorithm to jointly estimate gaze and

headset slippage.

**High-Speed Photon Counter for Multi-photon Optical Imaging System**

Johns Hopkins University, Baltimore, MD 06/ 2017 – 09/ 2017

- Designed a fast signal acquisition pipeline using a high-speed amplifier and digitizer to increase the sensitivity and precision of photon detection for multi-photon imaging systems.
- Achieved a data processing rate of up to 7 GB/s using multi-threading and GPU acceleration.

**High-Performance Cluster Building and Parallel Optimization**

National Supercomputer Center, Wuxi, China 01/ 2017 – 04/ 2017

(First Class Award in Asia Student Supercomputer Challenge 2017)

- Implemented parallel optimization for high-resolution surface wave simulations on a supercomputer.
- Designed and built a 6-node server cluster, achieved a LINPACK benchmark score of 4 TFLOPS, and conducted genome assembly simulation and molecular dynamics simulation on the cluster.

**Design, Optimization, and Software Development of 1310 nm SS-OCT System**

Southeast University, Nanjing, China 12/ 2017 – 06/ 2018

- Built a 1310 nm SS-OCT system with an imaging depth of 4.8 mm and axial resolution of 25 μm for ex-vivo tissue imaging.

**Multichannel Micro-electrode for in vivo Neural Signal Recording**

Southeast University, Nanjing, China 04/ 2015 – 01/ 2017

- Designed a lightweight, highly integrated 256-channel 3D micro-electrode for neural signal recording on freely moving rats.

## HONORS & AWARDS

| | |
|---|---|
| IEEE IUS Student Travel Award | 06/ 2023 |
| ISTU Student Registration Award | 06/ 2021 |
| Rackham Conference Travel Grant at the University of Michigan | 2019 - 2022 |
| Rackham International Student Fellowship (Top 1%) | 12/ 2019 |
| BME Departmental Fellowship | 09/ 2018 |
| Best Undergraduate Thesis Award, Southeast University (Top 1%) | 06/ 2018 |

## PUBLICATIONS

1. **N Lu,** J Foiret, B Yoon, KW Ferrara. "Improving Ultrasound Spine Imaging with a Large-Aperture Array". Science Advances, 2025, 11 (30). doi:10.1126/sciadv.adw2601.
2. **N Lu,** E Yeats, JR Sukovich, TL Hall, Z Xu. "Treatment Envelope of Transcranial Histotripsy: Strategies to Improve the Treatment Efficacy for Targets Near Skull Surface". *Physics in Medicine & Biology*, 2024. doi: 10.1088/1361-6560/ad8d9f.
3. **N Lu**, F LaRocca, S Talathi. "Accurate and Robust Eye Tracking with Ultrasound: A Computational Study." *IEEE International Ultrasonics Symposium (IUS) Proceedings*, 2023. doi: 10.1109/IUS51837.2023.10306398.
4. **N Lu**, TL Hall, JR Sukovich, SW Choi, J Snell, N McDannold, Z Xu. "Two-step Aberration Correction: Application to Transcranial Histotripsy". *Physics in Medicine & Biology,* 2022; 67 (12). doi: 10.1088/1361-6560/ac72ed.
5. **N Lu,** D Gupta, BJ Daou, A Fox, D Choi, JR Sukovich, TL Hall, S Camelo-Piragua, N Chaudhary, J Snell, AS Pandey, DC Noll, Z Xu. "Transcranial MR-guided Histotripsy for Brain Surgery – Pre-

clinical Investigation". *Ultrasound in Medicine & Biology,* 2022; 48 (1). doi: 10.1016/j. ultrasmedbio.2021.09.008.

6. **N Lu,** TL Hall, D Choi, D Gupta, BJ Daou, JR Sukovich, A Fox, TI Gerhardson, AS Pandey, DC Noll, Z Xu. "Transcranial MR-Guided Histotripsy System." *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control,* 2021; 68 (9). doi: 10.1109/TUFFC.2021. 3068113.
7. R Wodnicki, J Foiret, B Liu, **N Lu**, X Sun, J Zhang, H Kang, H Bendjador, L Fu, C Notard, M Legros, Q Zhou, KW Ferrara. "Handheld Large 2D Array with Azimuthal Planewave and Row-Multiplexed Elevation Beamforming Enabled by local ASIC Electronics". *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control,* 2025; 72 (7). doi: 10.1109/TUFFC.2025. 3570732.
8. E Yeats, G Stocker, **N Lu**, M Komaiha, JR Sukovich, Z Xu, TL Hall. "In Vivo Cavitation-Based Aberration Correction of Histotripsy in Porcine Liver". *IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control,* 2024; 71(8). doi: 10.1109/TUFFC.2024. 3409638.
9. SW Choi, M Komaiha, D Choi, **N Lu**, TI Gerhardson, A Fox, N Chaudhary, S Camelo-Piragua, TL Hall, AS Pandey, Z Xu, JR Sukovich. "Neuro-navigation-guided Transcranial Histotripsy (NaviTH) System". *Ultrasound in Medicine & Biology,* 2024. doi:10.1016/j.ultrasmedbio.2024. 04.001.
10. S Haskell, **N Lu**, G Stocker, Z Xu, JR Sukovich. "Monitoring Cavitation Dynamics Evolution in Tissue-mimicking Hydrogels for Repeated Exposures via Acoustic Cavitation Emissions". *Journal of the Acoustical Society of America,* 2023; 153 (237). doi:10.1121/10.0016849.
11. E Yeats, **N Lu**, JR Sukovich, Z Xu, TL Hall. "Soft Tissue Aberration Correction for Histotripsy Using Acoustic Emissions from Cavitation Cloud Nucleation and Collapse". *Ultrasound in Medicine & Biology,* 2022; 49 (5). doi:10.1016/j.ultrasmedbio.2023.01.004.
12. D Gupta, D Choi, **N Lu**, SP Allen, TL Hall, DC Noll, Z Xu. "MR-thermometry Targeting for MR-guided histotripsy treatments". *Ultrasound in Medicine & Biology,* 2022; 49 (5). doi: 10.1016/j.ultrasmedbio.2022.12.009.
13. **N Lu**, D Xing, T Sheng, W Lu. The mechanism and function of hippocampal neural oscillation. Acta Physiologica Sinica, 2017, 69(5): 647–656. DOI: 10.13294/j.aps.2017.0052

## ACADEMIC PRESENTATIONS (* = PRESENTER, 1 = TALK, 2 = POSTER)

1. **N Lu*[1],** J Foiret, B Yoon, KW Ferrara. "Real-time volumetric spine imaging for interventional guidance with a large-aperture array". *IEEE International Ultrasonics Symposium (IUS) 2024,* Taipei.
2. **N Lu*[1],** J Foiret, EY Park, S Poplack, KW Ferrara. "High-resolution large field-of-view volumetric ultrasound scanner for breast imaging." *IEEE IUS 2024,* Taipei.
3. R Wodnicki**,** J Foiret, B Liu, **N Lu,** et al. "2D arrays: Technologies and challenges, a review of past, present, and future." Invited talk at *IEEE IUS 2024,* Taipei.
4. E Yeats, **N Lu**, G Stocker, M Komaiha, JR Sukovich, Z Xu, TL Hall. "In Vivo Aberration Correction of Histotripsy Using Acoustic Cavitation Emissions". *IEEE IUS 2024,* Taipei.
5. **N Lu*[1]**, F LaRocca, S Talathi. "Accurate and robust eye tracking with ultrasound: a computational study." *IEEE IUS 2023,* Montreal, Canada.
6. **N Lu*[2]**, M Komaiha, JR Sukovich, TL Hall, Z Xu. "Passive cavitation mapping for transcranial histotripsy." *IEEE IUS 2023,* Montreal, Canada.

7. **N Lu*[2],** JR Sukovich, S Camelo-Piragua, Z Xu, AS Pandey. "Ablation of human brain tumors using histotripsy". *Congress of Neurological Surgeons (CNS) Annual Meeting 2023,* Washington D.C., USA.
8. **N Lu*[1]**, JR Sukovich, TL Hall, Z Xu. "Treatment envelope of transcranial histotripsy: Strategies to improve the treatment efficacy for targets near skull surface." *International Symposium on Therapeutic Ultrasound (ISTU) 2023,* Lyon, France.
9. **N Lu*[2]**, JR Sukovich, TL Hall, Z Xu. "Electronic steering capabilities of aberration correction for transcranial histotripsy." *IEEE IUS 2022,* Venice, Italy.
10. **N Lu*[1]**, TL Hall, JR Sukovich, et al. "Two-step aberration correction: application to transcranial histotripsy". *ISTU 2022,* Toronto, Canada.
11. **N Lu*[2]**, TL Hall, JR Sukovich, Z Xu. "Aberration Correction for Transcranial Histotripsy". *IEEE IUS 2021,* virtual.
12. **N Lu*[1],** D Gupta, BJ Daou, et al. "Transcranial MR-guided histotripsy for brain surgery - re-clinical investigation". *ISTU 2021,* virtual (selected as Student Speed Talk Finalist) and *7th International Symposium on Focused Ultrasound, 2020,* virtual.
13. **N Lu*[1],** TI Gerhardson, D Choi, et al. "MR-guided histotripsy system for transcranial therapy." *IEEE IUS 2020,* virtual.
14. **N Lu*[2],** JR Sukovich, T Gerhardson, et al. "Ablation of human brain tumors using histotripsy". *IEEE IUS 2019,* Glasgow, UK.
15. J Foiret, EY Park, **N Lu**, KW Ferrara. "Large aperture imaging, from multi-array prototype to imaging device." *SPIE Medical Imaging*, 2024, San Diego, USA.
16. D Gupta, T Kaovasia, D Choi, **N Lu**, SP Allen, TL Hall, Z Xu, and DC Noll, "Evaluating histotripsy treatment dosage in the brain using MRI". *International Society for Magnetic Resonance in Medicine* (*ISMRM) Annual Meeting, 2023*, Toronto, Canada.
17. JR Sukovich, TL Hall, M Komaiha, S Haskell, **N Lu**, et al. "Acoustic cavitation localization during histotripsy using transmit-receive capable arrays". *Acoustical Society of America (ASA) Meeting 2023*, Chicago, USA.
18. JR Sukovich, **N Lu**, SW Choi, et al. "High-rate implicit cavitation localization during histotripsy via backwards transmit-delay acoustic cavitation emission (backTRACE) methods". *IEEE IUS 2022*, Venice, Italy.
19. G Stocker, **N Lu**, Z Xu, JR Sukovich, TL Hall. "Evaluating cavitation mapping during histotripsy with electronic focal steering". *ISTU 2022*, Toronto, Canada.
20. SW Choi, JR Sukovich, D Choi, M Komaiha, **N Lu**, et al. "Neuronavigation-guided transcranial histotripsy on human cadavers: a feasibility study". *ISTU 2022*, Toronto, Canada.
21. D Gupta, D Choi, **N Lu**, et al. "MR-Thermometry based targeting for histotripsy treatments in ex-vivo tissues". *ISMRM Annual Meeting, 2022*, London, UK.
22. D Gupta, **N Lu**, A Fox, D Choi, et al. "Technical feasibility and imaging of transcranial MR-guided in-vivo histotripsy treatment." *ISMRM Annual Meeting, 2021, virtual*.
23. D Gupta, **N Lu**, JR Sukovich, et al. "MRI assessment and monitoring of cavitation-based ultrasound therapy (histotripsy) for transcranial brain treatment in vivo". *ISMRM Annual Meeting, 2020*, virtual.
24. TI Gerhardson, JR Sukovich, J Lundt, **N Lu**, et al. "Design of a histotripsy array for the treatment of intracerebral hemorrhage". *ASA meeting 2019,* Louisville, USA.

## PATENT APPLICATIONS

1. F. LaRocca, A. Shkel, S. Talathi, **N. Lu**. Phase delay ultrasound for steered ultrasound beam. US Patent 12313740.

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## PROFESSIONAL SERVICES

Technical Reviewer:

- IEEE Transactions on Biomedical Engineering (TBME), IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control (TUFFC), Frontiers in Neurology, IEEE International Symposium on Biomedical Imaging (ISBI), Ultrasound in Medicine & Biology, Physics in Medicine & Biology, Journal of Neural Engineering, Medical Engineering & Physics.

Conference Session Chair:

- Brain session at Histotripsy Symposium 2022, Madison, Wisconsin, USA.

Volunteer:

- Deputy Chair of the IEEE UFFC-S Publicity Committee, 2024 – Present.
- Leadership Committee for Women in Molecular Imaging Network (WIMIN), 2024 – 2026.
- President of IEEE UFFC Student Chapter at the University of Michigan, 2020 - 2023.
- Peer mentor for Graduate Rackham International (GRIN), University of Michigan, 2019 – 2021.
- Peer mentor for BME Mentorship Program, University of Michigan, 2019 and 2022.
- Mentor for BME Graduate Application Assistance Program (GAAP), University of Michigan, 2022.

## TEACHING TRAINING & EXPERIENCE

Guest Lecturer: 3D+ Imaging Sensors (EE 119/219) Spring 2024
*Stanford University*

Mentoring Skills Workshops Winter 2024
*Teaching & Mentoring Academy, Stanford Medicine*

Guest Lecturer for Ultrasound Lab: Medical Imaging System (BME/EECS 516) Fall 2019 & 2022
*University of Michigan*

## TEACHING INTEREST

Biomedical Ultrasound, Scientific Computing, Medical Imaging Systems & Labs, Signal & Image Processing, Image-guided Therapy.

## PROFESSIONAL MEMBERSHIPS

- IEEE UFFC, IEEE Signal Processing Society (SPS), IEEE Young Professionals
- Society for Industrial and Applied Mathematics (SIAM)
- ACM Special Interest Group on High-Performance Computing (SIGHPC)

## SKILLS

**Programming**: Python, C/C++, CUDA, shell scripting, Verilog, R.

**Software**: Matlab, Julia, PyTorch, LaTeX, LabVIEW.

**Technical**: Signal and image processing, circuit design (schematic & PCB layout), transducer design and fabrication, parallel optimization, 3D printing, mechanical design, MRI, animal experiments.

## SELECTED COURSE PROJECTS

• *Learning-based Optimization for Under-Sampling MRI*
Image Processing (EECS 556), Winter 2021 (KLA Runner-up Team Prize)

• *VolumeRend for 3D Lung Nodule Segmentation*
Advanced Topics in Computer Vision (EECS 542), Fall 2020

• *Point-source Separation for Aberration Correction in Ultrasound Therapy using GAN*
Advanced Machine Learning for Bioinformatics (BIOINFO 590), Fall 2019