Youshen Xiao

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Research Interests

Inverse Problems in Medical Imaging

• Photoacoustic Reconstruction, Limited-View, Sparse-View, Inhomogeneous Sound Speed Field, etc. **Model-based Deep Learning for Medical Imaging**

• Neural Representation, Diffusion Model, Deep Image Prior, 3D Gaussian Splatting, etc.

Education

University of Shanghai for Science and Technology *B.Eng. Biomedical Engineering, GPA 3.95/4.50* **ShanghaiTech University**

M.Sc. Electronic Engineering, GPA 3.88/4.00 Supervisor: Prof. Fei Gao and Prof. Yuyao Zhang

Research Experience

Limited-view/Sparse-view photoacoustic imaging reconstruction via high-quality self-supervised neural representation

Outcome: Two 2024 IEEE IUS (Accepted), Photoacoustics (Under review), IEEE TUFFC (Under review)

- Proposed a self-supervised deep learning model to reduce photoacoustic image artifacts from limited-view/sparse-view data.
- Integrated a differentiable photoacoustic forward model, using implicit neural representation methods to reconstruct high-quality photoacoustic images.
- Outperformed supervised counterparts and traditional methods; applied on the *in vivo* finger data scanned by our custom-developed PAT.

Resolution enhancement of under-sampled photoacoustic microscopy images using implicit neural representation

Outcome: 2025 IEEE ISBI (Under review)

- Proposed an unsupervised method to enhance the resolution of AR-PAM while accelerating the acquisition time.
- Integrated the physical model of AR-PAM, where in our method, the PSF is learnable. The implicit neural representation optimizes the original photoacoustic image while simultaneously optimizing the PSF.
- Outperformed traditional interpolation deconvolution methods on AR-PAM dataset.

Temporal super-resolution photoacoustic imaging with dynamic reconstruction through implicit neural representation in sparse-view

Outcome: IEEE TCI (Under review)

- Proposed the use of implicit neural representation (INR) as an implicit continuity regularizer for the first time for dynamic hotoacoustic imaging reconstruction under sparse-view conditions.
- The proposed INR encodes dynamic photoacoustic images as implicit functions within a neural network, learning weights directly from the (*k*, *t*)-space sparse sensor data without external training datasets or prior images. This leverages INR's strong implicit continuity and explicit low-rank and

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sparsity regularization to enhance image quality and reduce artifacts.

• Outperforms specific reconstruction methods at four different sparsity levels, effectively suppressing artifacts and ensuring image quality.

Learning 3D Gaussian Priors Driven by Diffusion Models for Enhanced Sparse-View Photoacoustic Imaging (*In progress*)

• Using Diffusion Models as Priors for 3DGS to Reconstruct Photoacoustic Images from Sparse-View.

Handheld Dual-Angle Photoacoustic Detection of Melanocytic Nevi

- A handheld, adjustable dual-angle nevus detection device was developed using photoacoustic technology, featuring two independently adjustable ultrasound probes for easy operation.
- A new metric *K* was introduced to quantify the relationship between melanin depth and photoacoustic signals.
- Both sets of experiments consistently demonstrated a stable relationship between *K* values and melanin depth, indicating the device's significant clinical potential.

Self-innovated DAQ debugging and photoacoustic data acquisition

- Collaborated with lab mates for debugging self-innovated DAQ in our lab
- Conducted photoacoustic tomography experiments on different transducer array type and different phantoms with lab mates.

Publications

- <u>Youshen Xiao</u>, Yuting Shen, Bowei Yao, xiran Cai, and Fei Gao
 "Unsupervised Neural Representation for Limited-View Photoacoustic Imaging Reconstruction" 2024 IEEE Ultrasonics, Ferroelectrics, and Frequency Control Joint Symposium (IEEE IUS 2024)
- 2. <u>Youshen Xiao</u>, Shangqing Tong, Yuyao Zhang, Fei Gao "Resolution Enhancement of Under-sampled Photoacoustic Microscopy Images using Implicit Neural Representations" • IEEE 22th International Symposium on Biomedical Imaging (IEEE ISBI 2025) • PDF
- Youshen Xiao, Yuting Shen, Bowei Yao, Xiran Cai, Yuyao Zhang, Fei Gao
 "Limited-View Photoacoustic Imaging Reconstruction Via High-quality Self-supervised Neural Representation"
 "Photoacoustics (PACS)
 Under Review
 PDF
- 4. <u>Youshen Xiao</u>, Shangqing Tong, Yuyao Zhang, Fei Gao "*Temporal Super-resolution Photoacoustic Imaging with Dynamic Reconstruction through Implicit Neural Representation in Sparse-view*"•IEEE Transactions on Computional Imaging (IEEE TCI)•Under Review
- 5. Bowei Yao, Shilong Cui, Haizhao Dai, Qing Wu, <u>Youshen Xiao</u>, Fei Gao, Jingyi Yu, Yuyao Zhang, Xiran Cai • "*Implicit Neural Representation for Sparse-view Photoacoustic Computed Tomography*"•IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control (**IEEE TUFFC**)•Under Review

Course Project

- Optical Projection Tomography (OPT) Reconstructione (2023, Digital Image Processing)
- Transcranial HIFU Probe Driving Circuit with Photoacoustic Guidance (2024, Analog Integrated Circuit)

Skills

- Programming Language: Python, Matlab, C
- Tools: Pytorch, Pandas, Numpy, Jax, 3D slicer, k-wave, j-wave, Mimics, Solidworks, ANSYS
- Language: Mandarin (Native), English (Fluent)