Xiaokai Wang

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Education

University of Michigan, Ann Arbor, MI, USA

- Ph.D. candidate, Biomedical Engineering   GPA: 4.0/4.0   Jan, 2020- Present

Purdue University, West Lafayette, IN, USA

- Ph.D. student, Electrical and Computer Engineering   GPA: 4.0/4.0   Sep, 2018- Jan, 2020

Johns Hopkins University, Baltimore, MD, USA

- M.S., Biomedical Engineering   GPA: 3.9/4.0   Sep, 2016- June, 2018

Zhejiang University, Hangzhou, Zhejiang, China

- B.S., Biomedical Engineering   GPA: 3.9/4.0   Sep, 2012- June, 2016

Professional Experience

Laboratory of Integrated Brain Imaging: Gastric MR imaging, image analysis, machine learning, deep learning, gastric electrophysiology, and neurophysiology

(Graduate Research Assistant, Purdue University and University of Michigan)   Aug., 2018- Present

- Project Leader: Characterizing abnormalities in idiopathic and diabetic gastroparesis patients (ongoing)
    - Characterizing gastric motor dysfunctions against normal controls
    - Studying the correlation between quantitative measurements and the severity of the symptoms
- Project Leader: Imaging gastric motor functions in awake rodents (2023-present)
    - Established an imaging protocol to study gastric functions in awake rats, including an animal acclimation procedure and MRI imaging procedure
    - Established an automatic post-processing pipeline to handle the enormous motion artifacts
- Project Leader: A cross-species study in gastric motor functions based on dynamic MRI (2023)
    - Established comparable imaging and mapping pipelines based on dynamic MRI in both humans and rats
    - Captured and compared various aspects of the gastric motor functions across two species
    - Reported potentially new insights about gastric physiology
- Project leader: Non-invasive mapping of the gastric motor functions in rats (2022-2023)
    - Developed a diffeomorphic surface registration algorithm using Neural Ordinary Differential Equations
    - Allowed the tracking of stomach motion over time and enabled a group-level quantification of gastric motility in rats
- Project leader: Accelerate dynamic MRI imaging of gastrointestinal tract in rats (2021)
    - Developed and implemented a fast dynamic contrast-enhanced gastric MRI imaging

sequence on the 7T Agilent scanner using k-t GRAPPA
- o Achieved ~5 times faster than the commercialized multi-slice gradient recalled echo on the same scanner
- o Achieved a comprehensive coverage of entire stomach using one single volumetric scan

- Project leader: 3D volumetric segmentation of gastric MRI image using deep neural networks (2019-2020)
  - o Created manual labels for rats' stomachs as the ground truth (n=30) for training and validation
  - o Improved the performances of the MR image segmentation with a deep neural network and achieved ~96% segmentation accuracy on the validation data set with an improved speed of processing

- Collaboration: Electrical and mechanical modulation of the brain-gut interaction (ongoing)
  - o Co-establishing the techniques for multi-site brain neurophysiological recordings with simultaneous electrical or mechanical stimulations to the stomach in rats
  - o Studying the brain-gut interactions and their modulation with the established platform

- Collaboration: Neuronal tracing with Manganese-Enhanced MRI (2023- present)
  - o Contributed to tracing vagal afferent projections using MEMRI
  - o Re-analyzed the existing data for validating the activity-dependent MEMRI technique
  - o Replicated the same results on a different image scanner (7T Agilent scanner vs. 7T Brucker scanner)
  - o Working on improvements to the existing technique

- Collaboration: The pathways and mechanisms for stomach-brain interactions (2021-2022)
  - o Co-established the technique to simultaneously record surface electrogastrogram or serosal gastric myoelectrical activities with dynamic contrast-enhanced MR imaging of the gut or functional MR imaging of the brain in rats
  - o Verified the developed fast imaging techniques using these concurrent electrical recordings based on the electrical-mechanical coupling
  - o Studied the coherence between the brain and the gut with the developed technique
  - o Studied the orientation-tuning properties of the NTS neurons

- Collaboration (Takeda): Test prokinetic medicine for promoting gastric motility in rats (2018)

Image Analysis and Communication Lab: Motion Tracking Algorithm, Tagged MRI
(Graduate Research Assistant, Johns Hopkins University)   May,2017- June,2018

- Project Leader: Characterizing the tongue muscle movements during speech based on tagged MRI
  - o Tested different digital filters for 3D HARP analysis of tagged MRI
  - o Exhibited approximately 50% improvements in tracking accuracy in MICCAI challenge phantom datasets compared with traditional methods
  - o Established a strategy to distinguish between consistent and inconsistent sequential tagged MRI images

Undergraduate Thesis Project: Electrohydrodynamic Printing

(Undergraduate, Zhejiang University)   Jan., 2016- May,2016

- Project Leader: EHD Direct-Writing 3D Macro/Nano-Scaled Patterns
    - Achieved 3D patterns with direct writing technique by using variable speed settings
    - Examined the influence of different parameters on the formation of the specific 3D pattern

Summer Research Training in the University of Rochester: Diffuse Optics Methods
(Summer Research Intern, University of Rochester)   July, 2015- Aug., 2015

- Collaboration: Optimization of the diffuse optics methods in detecting breast cancers
    - Co-designed optimal probe for breast cancer imaging in remission geometry
    - Simulated the influence of anomaly locations and sizes on image quality when using specific breast probe
    - Collected simulated results.

Undergraduate Student Research Training Project: Research on Respiratory Gases Monitor
(Undergraduate, Zhejiang University)   Nov.,2014- May,2015

- Collaboration: The design of a respiratory gas monitor to detect bad breath in humans
    - Co-designed the respiratory gases monitor to detect bad breath in humans
    - Designed a sensor array using MQ-3 and TGS-2602
    - Developed an APP to record, display, and analyze sample data and give corresponding medical advice
    - Conducted calibration using training experimental data and achieved approximately 80% detection accuracy
    - Won an outstanding school project award

Teaching Experience

Guest Lecturer, Machine Learning for Biomedical Signal and Image Processing, BIOMEDE 599
                                                                       Sep.,2023- Dec., 2023

- Gave a guest lecture about medical image registration
- Held office hours to help address questions about medical image segmentation, deep neural networks, and Python programming

Teaching Assistant, Image Processing and Analysis EN.520.614
                                                                       Sep.,2017- Dec., 2017

- Held weekly office hours to answer questions related to course materials and homework
- Graded HW assignments

Internship Experience

Intern, Sir Run Run Shaw Hospital Equipment Division   Jan., 2015- Feb., 2015

- Learned to operate common medical imaging systems

- Maintained syringe pumps
- Observed minor surgeries

Extracurricular Activities

Social Investigation Project in the National University of Singapore   July, 2014- Aug., 2014

- Led team to investigate the health care system and BME programs in China
- Arranged a seminar to compare educational issues, health care systems, and the doctor-patient relationship between China and Singapore
- Awarded as the Most Outstanding Student on the project

Prizes & Awards

- (2024) Richard and Eleanor Towner Prize for Outstanding Ph.D. Research
- (2024) ISMRM Summa cum Laude Merit Award
- (2022) Glenn V. Edmonson Scholarship
- (2021) ISMRM Magna Cum Laude Merit Award
- (2013-2015) First-Class Academic Scholarship
- (2013-2015) Outstanding Student
- (2014) First Prize in 'Sanhao Cup' Volleyball Match
- (2013) Third-Class Academic Scholarship
- (2013) Freshma

Skills

- *Software*: MATLAB, Multism, LabView
- *Language*: Python, C, C++
- *Wet*-lab: rat and mouse handling, anesthesia, euthanasia, blood collection, abdominal recovery surgery, and brain recovery and non-recovery surgery in rats

Publications

1. **Wang, Xiaokai**, Fatimah Alkaabi, Madeleine R Di Natale, Ulrich Scheven, John B. Furness, Zhongming Liu. "Imaging stomach in conscious rats." Ready to submission.

2. **Xiaokai Wang**, Fatimah Alkaabi, Minkyu Choi, Madeleine R Di Natale, Ulrich Scheven, Douglas C. Noll, John B. Furness, Zhongming Liu. "Surface Mapping of Gastric Motor Functions Using MRI: A Comparative Study between Humans and Rats." American Journal of Physiology-Gastrointestinal and Liver Physiology (2024).

3. Athavale, Omkar N., Recep Avci, Alys R. Clark, Madeleine R. Di Natale, **Xiaokai Wang**, John B. Furness, Zhongming Liu, Leo K. Cheng, and Peng Du. "Neural regulation of slow waves and phasic contractions in the distal stomach: a mathematical model." Journal of Neural Engineering (2023).

4. Di Natale, Madeleine R., Billie Hunne, Martin J. Stebbing, **Xiaokai Wang**, Zhongming Liu, and John B. Furness. "Characterization of neuromuscular transmission and projections of muscle

motor neurons in the rat stomach." American Journal of Physiology-Gastrointestinal and Liver Physiology (2023).

5. Di Natale, Madeleine R, Omkar N. Athavale, **Xiaokai Wang**, Peng Du, Leo K. Cheng, Zhongming Liu, and John B. Furness. "Functional and anatomical gastric regions and their relations to motility control." Neurogastroenterology & Motility. doi:10.1111/nmo.14560 (2023).

6. Choi, Minkyu, Yizhen Zhang, Kuan Han, **Xiaokai Wang**, and Zhongming Liu, "Human eyes inspired recurrent neural networks are more robust against adversarial noises," arXiv: 10.48550/arXiv.2206.07282 (2023).

7. Oleson, Steven., Jiayue Cao, **Xiaokai Wang**, and Zhongming Liu. "In vivo Tracing of the Ascending Vagal Projections to the Brain with Manganese Enhanced Magnetic Resonance Imaging." Front. Neurosci. 17:1254097. doi: 10.3389/fnins.2023.1254097 (2023)

8. **Wang, Xiaokai**, Jiayue Cao, Kuan Han, Minkyu Choi, Yushi She, Ulrich Scheven, Recep Avci, Peng Du, Leo K. Cheng, Madeleine R. Di Natale, John B. Furness, and Zhongming Liu. "Diffeomorphic Surface Modeling for MRI-Based Characterization of Gastric Anatomy and Motility." IEEE Transactions on Biomedical Engineering (2023).

9. Liu, Zhongming, **Xiaokai Wang**, Ana Cecilia Saavedra Bazan, and Jiayue Cao. "Interoceptive influences on resting-state fMRI." In Advances in Resting-State Functional MRI, pp. 87-105. Academic Press (2023).

10. Cao, Jiayue, **Xiaokai Wang**, Jiande Chen, Nanying Zhang, and Zhongming Liu, "The vagus nerve mediates the stomach-brain coherence in rats," NeuroImage, 263: 119628 (2022).

11. Lu, Kun-Han, Zhongming Liu, Deborah Jaffey, John M. Wo, Kristine M. Mosier, Jiayue Cao, **Xiaokai Wang**, and Terry L. Powley. "Automatic assessment of human gastric motility and emptying from dynamic 3D magnetic resonance imaging." Neurogastroenterology & Motility 34, no. 1 (2022): e14239.

12. Cao, Jiayue, **Xiaokai Wang**, Terry L. Powley, and Zhongming Liu. "Gastric neurons in the nucleus tractus solitarius are selective to the orientation of gastric electrical stimulation." Journal of Neural Engineering 18, no. 5 (2021): 056066.

13. Di Natale, Madeleine R., Lauren Patten, Juan C. Molero, Martin J. Stebbing, Billie Hunne, **Xiaokai Wang**, Zhongming Liu, and John B. Furness. "Organisation of the musculature of the rat stomach." Journal of Anatomy (2021).

Conference Proceedings and Presentations

1. **Wang, Xiaokai**, Fatimah Alkaabi, Ulrich Scheven, Minkyu Choi, Douglas Noll, and Zhongming Liu "Cross-species comparison: imaging and mapping gastric motor functions in humans and rats using contrast-enhanced rapid MRI. " Oral Presentation, ISMRM (2024).

2. **Wang, Xiaokai**, Fatimah Alkaabi, and Zhongming Liu. "Mo1640 PERSONALIZED CHARACTERIZATION OF GASTRIC DYSFUNCTIONS IN GASTROPARESIS PATIENTS BASED ON MRI AND SURFACE MAPPING." Poster Presentation, Digestive Disease Week (2024).

3. Choi, Minkyu, Kuan Han, **Xiaokai Wang**, Yizhen Zhang, and Zhongming Liu. "[A Dual-Stream Neural Network Explains the Functional Segregation of Dorsal and Ventral Visual Pathways in Human Brains](#)." Conference Proceeding, Neurips (2023).

4. **Wang, Xiaokai**, and Zhongming Liu. "Tu1994 MAPPING AND COMPARING GASTRIC MOTILITY IN RATS VS. HUMANS." Poster Presentation, Gastroenterology 164, no. 6 (2023): S-1179.

5. **Wang, Xiaokai**, Angela Yee, Jiayue Cao, Ashley Cornett, Fatimah Alkaabi, Yushi She, Ulrich Scheven, and Zhongming Liu. "Su1956 MAGNETIC RESONANCE IMAGING OF GASTRIC EMPTYING AND MOTILITY IN AWAKE RATS." Poster Presentation, Gastroenterology 164, no. 6 (2023): S-719.

6. **Wang, Xiaokai**, Jiayue Cao, Kuan Han, Minkyu Choi, Yushi She, Ulrich Scheven, and Zhongming Liu. "Tracking the moving stomach using MRI and neural ordinary differential equations" Poster Presentation, ISMRM (2023).

7. **Wang, Xiaokai**, Jiayue Cao, Kuan Han, Minkyu Choi, Ana Cecilia Saavedra Bazan, Jon-Fredrik Nielsen, Douglas C. Noll, and Zhongming Liu. "Mapping human gastric motility using contrast-enhanced MRI with a natural test meal" Oral Presentation, ISMRM (2023).

8. **Wang, Xiaokai**, Angela Yee, Jiayue Cao, Ashley Cornett, Fatimah Alkaabi, Yushi She, Ulrich Scheven, and Zhongming Liu. "Gastrointestinal MRI with Conscious Rats" Poster Presentation, ISMRM (2023).

9. **Wang, Xiaokai**, Jiayue Cao, Minkyu Choi, and Zhongming Liu. "Deep learning based fully automatic analysis of gastric motility from contrasty-enhanced MRI." The 29th international Society of Magnetic Resonance in Medicine Annual Scientific Meeting, Oral presentation, May 15th- 20th, (2021)

10. Cao, Jiayue, **Xiaokai Wang**, Yizhen Zhang, and Zhongming Liu. "Power and Frequency Fluctuations of Gastric Electrical Activity Modulate fMRI Activity in Rat Brains" The 29th international Society of Magnetic Resonance in Medicine Annual Scientific Meeting, Oral presentation, May 15th- 20th , (2021)

11. **Wang, Xiaokai**, Jiayue Cao, Ulrich Scheven, and Zhongming Liu. "Accelerated contrast-enhanced gastrointestinal MRI captures whole-stomach motor events in rats Accelerated contrast--enhanced gastrointestinal MRI captures whole-stomach motor events in rats." The 19th American Neurogastroenterology and Motility Society Annual Scientific Meeting, Poster session, August 13th- 15th, (2021)

12. Cao, Jiayue, **Xiaokai Wang**, Yizhen Zhang, and Zhongming Liu. "Brain fMRI activity follows the gastric rhythm and encodes the power fluctuations of gastric electrical activity in rats." The 19th American Neurogastroenterology and Motility Society Annual Scientific Meeting, Oral presentation, August 13th- 15th, (2021)

13. **Wang, Xiaokai**, Jiayue Cao, Minkyu Choi, and Zhongming Liu. "Gastric motility characterization from GI-MRI using a deep-learning-based automatic method." The 19th American Neurogastroenterology and Motility Society Annual Scientific Meeting, Oral presentation, August 13th- 15th, (2021)

14. Lu, Kun-Han, Zhongming Liu, Deborah Jaffey, John M. Wo, Kristine Mosier, Jiayue Cao, **Xiaokai Wang**, Fred Hermann, and Terry L. Powley. "Su594 AUTOMATED MRI-BASED ASSESSMENT OF

HUMAN GASTRIC EMPTYING AND MOTILITY IN HEALTH AND GASTROPARESIS." Poster Presentation, Gastroenterology 160, no. 6 (2021): S-747.

15. **Wang, Xiaokai**, Kun-Han Lu, Minkyu Choi, Jiayue Cao, Deborah Jaffey, Terry Powley, and Zhongming Liu. "SPARC: Deep Learning for Stomach Segmentation with Contrast Enhanced Magnetic Resonance Imaging of the Gastrointestinal Tract." Poster Presentation, The FASEB Journal 34, no. S1 (2020): 1-1.

16. Cao, Jiayue, **Xiaokai Wang**, Kun-Han Lu, Zhenjun Tan, Robert Phillips, Deborah Jaffey, John Wo, Kristine Mosier, Terry Powley, and Zhongming Liu. "SPARC: Brain-stomach Synchrony Observed with Functional Magnetic Resonance Imaging and Electrogastrogram in Rats." Poster Presentation, The FASEB Journal 34, no. S1 (2020): 1-1.

17. Lu, Kun-Han, **Xiaokai Wang**, Jiayue Cao, James Wang, Deborah Jaffey, Kristine Marie Mosier, John Wo, Terry Powley, and Zhongming Liu. "SPARC: Simultaneous Assessment of Gastric Emptying and Motility with Contrast-Enhanced Magnetic Resonance Imaging in Humans." Oral Presentation, The FASEB Journal 34, no. S1 (2020): 1-1.

18. **Wang, Xiaokai**, Maureen L. Stone, Jerry L. Prince, and Arnold D. Gomez. "A novel filtering approach for 3D harmonic phase analysis of tagged MRI." In Medical Imaging 2018: Image Processing, vol. 10574, p. 1057414. Oral Presentation, International Society for Optics and Photonics, (2018)