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ACADEMIC POSITIONS

Post-Baccalaureate Research Fellow <i>Northwestern University</i>	2022-Present	Querrey Simpson Institute for Bioelectronic Advisor: Prof. John A. Rogers
Undergraduate Researcher <i>University of British Columbia</i>	2020-2021	Laboratory of Metabolomics and Systems Biology Advisor: Prof. Tao Huan

EDUCATION

The University of British Columbia BASc, Bioinformatic under Biomedical Engineering	Sept. 2017 - May 2022 Major GPA 3.95/4.3
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RESEARCH PROJECTS

- *Northwestern University, John A. Rogers' Lab*

“At-home wearable vital monitoring combined with AI for clinical assessment of sleep stage and apnea.”

Preparing manuscript, (Co-first author) 2022 - present

We demonstrate a high-frequency wearable mechanoacoustic sensor to capture the cardiorespiratory and activity information and manipulate their variability features. We show these features sufficient to classify sleep stages through a machine learning framework.

Contributions

- Examined neuron pathways related to sleep and utilized those distinct to various sleep stages to formulate our features.
- Processed waveform accelerometry signals using wavelet transformation, Shannon energy envelopes, and polynomial interpolation to derive heartbeat and breathing intervals.
- Derived cardiorespiratory variability features through spectrogram, detrended fluctuation analysis, Poincaré plot, and distribution analysis.
- Utilized LSTM machine learning models for sleep stage classification. Enhanced model understanding using balanced Random Forest Tree techniques and SHARP insights.
- Device encapsulation, including mold design and CNC fabrication.

“Closed-loop wireless devices for quantifying vocal fatigue and providing user feedback.”

Published on PNAS 2022 - 2023

We used a soft wearable device that mounts on the upper chest to capture vocal vibrations, quantify vocal fatigue, and provide closed-loop feedback.

Contribution

- Analyze acoustic signals with short-time Fourier transform spectrogram and cepstrum, then use Convolutional Neural Networks to distinguish between singing and speaking vocal signals.

“Implantable chronic ECG monitoring for mice”

Preparing the manuscript 2022 - present

Use a wireless, battery-free, and skin-conformal device with a Y-shape serpentine-connected electrode implanted on the back of the mouse to record ECG signals for longer than 1 month.

Contribution

- ECG signal processing using zero-phase Butterworth filter and Shannon energy envelop.
- Serpentine design and optimization using AutoCAD and FEA software Abaqus.
- Implantable device encapsulation using CNC molding, parylene coating, and ultra-soft silicone.
- Electrode prototyping using microfabrication.

“Sewing Approach to the Fabrication of Eco/bioresorbable Electronics”

Published on SMALL

2022 - 2023

- bioresorbable polyurethane encapsulation
- NFC coil design

“Bioresorbable, shape-adaptive materials structures for ultrasonic monitoring of deep-tissue homeostasis”

In review

2022 - present

- Use MATLAB program to analyze the implanted device’s morphology change in the ultrasound image.
- Construct a polynomial function to predict environment pH based on the device’s morphology change.

“Wearable skin-conformal multichannel ECG, EMG, EEG monitoring device”

Preparing manuscript

2022-present

- Wearable device encapsulation.
- EEG, EMG power spectrum analysis.

-University of British Columbia, **Tao Huan’s Lab**

Flanker - Computational Metabolomics

2020 - 2021

- Use C# language to build a UWP application integrated with R code analysis process.

Recognize insource fragmentation in mass spectrometry data

2020

- Calculate peak-to-peak Pearson correlation of mass spectrum and filter out unreal fragments by checking their precursor ions.

PUBLICATION

(Co-first authorship marked with #)

In preparation

[1] Du, Y. #, **Gu, J. #**, Shiyuan Duan #, Shin H.S., Tzavelis, A., Li X., Wang, Y., Kwak J., Trueb J., Huang Y., Davies C., & Rogers, J. A. At-home wearable vital monitoring combined with AI for clinical assessment of sleep stage and apnea.

Submitted

[2] Liu, J. #, Liu, N. #, Xu, Y. #, Wu, M. #, Zhang, H. #, Wang, Y., Yan, Y., Hill, A., Song, R., Xu, Z., Park, M., Wu, Y., **Gu, J.**, Luan, H., Zhang, Y., Yang, T., Ahn, H.-Y., Li, S., Ray, W. Z., Franz, C. K., MacEwan, M. R., Huang, Y., Hammill, C. W., Wang, H., & Rogers, J. A. Bioresorbable, shape-adaptive materials structures for ultrasonic monitoring of deep-tissue homeostasis. *Science*

Peer-Reviewed Publication

[3] Wu, Y., Rytkin, E., Bimrose, M., Li, S., Choi, Y. S., Lee, G., Wang, Y., Tang, L., Madrid, M., Wickerson, G., Chang, J., **Gu, J.**, Zhang, Y., Liu, J., Tawfick, S., Huang, Y., King, W. P., Efimov, I. R., & Rogers, J. A. (2023). A sewing approach to the fabrication of ECO/Bioresorbable Electronics. *Small*, 2305017. <https://doi.org/10.1002/sml.202305017>

[4] Jeong, H., Yoo, J.-Y., Ouyang, W., Greane, A. L., Wiebe, A. J., Huang, I., Lee, Y. J., Lee, J. Y., Kim, J., Ni, X., Kim, S., Huynh, H. L.-T., Zhong, I., Chin, Y. X., **Gu, J.**, Johnson, A. M., Brancaccio, T., & Rogers, J. A. (2023). Closed-loop network of skin-interfaced wireless devices for quantifying vocal fatigue and providing user feedback. *Proceedings of the National Academy of Sciences*, 120(9), e2219394120. <https://doi.org/10.1073/pnas.2219394120>

GRANTS

QSIB Opportunity Grant Querrey Simpson Institute for Bioelectronics

2023 - present

“Multimodal muscle fatigue prediction”

Mingzheng Wu, Yue Wang, Jianyu Gu

SKILLS

- Lab Skill:
 - Prototyping: CNC, molding, Implantable and wearable device packaging,
 - Micro-/Nano- fabrication: (Photolithography, wet etching)
 - Molecular Biology Techniques: CRISPR-Cas9, PCR, DNA cutting, protein crystallization, UV-spectrum structural analysis, oscilloscope, gel electrophoresis, fluorescence microscopy, growing bacteria.
 - Computation: Machine learning, image recognition, time series signal processing and analysis.
- Software: Blynk, Tableau, SolidWorks, PyMol, Chimera, Arduino, Rhino, Eagle, Ansys
- Programming Language: Python, C++. Java, LabVIEW, R, C#, SQL, RUST, MATLAB