



Zijing Zhang

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Objective

Looking for a technical position in the field of Digital Healthcare or Human-Computer Interface. [LinkedIn](#)

Education

Cornell University, Ithaca, NY

Aug. 2019 – (Expected) May. 2023

Ph.D. Candidate, Electrical and Computer Engineering

Thesis: **RF Sensors for Medical and Cyber-physical Intelligence**

Advisor: Edwin C. Kan

Huazhong University of Science and Technology, Wuhan, China

Sep. 2015- Jun. 2019

Bachelor of Engineering, Optoelectronic Information Science and Engineering

Publications

- [1] **Z. Zhang**, and E. C. Kan, " Novel muscle monitoring by radiomyography (RMG) and its application to hand gesture recognition ", submitted to *IEEE Trans. Hum. Mach. Syst.* [link](#) [video](#)
- [2] **Z. Zhang**, J. Zhou, T. B. Conroy, S. Chung, J. Choi, P. Chau, D. B. Green, A. C. Krieger and E. C. Kan, " Objective dyspnea evaluation on COVID-19 patients learning from exertion-induced dyspnea scores," submitted to *IEEE Trans. Biomed. Engr.* [link](#)
- [3] **Z. Zhang**, T. B. Conroy, A. C. Krieger and E. C. Kan, " Identification and prediction of sleep disorder by covert bed integrated RF sensors," *IEEE Trans. Biomed. Engr.*, 2022, doi: 10.1109/TBME.2022.3212619. [link](#)
- [4] **Z. Zhang**, and E. C. Kan, " Radiooculogram (ROG) for eye movement sensing with eyes closed", in *21st IEEE Conf. on Sensors*, Dallas, TX, Oct. 30 – Nov. 2, 2022 [link](#)
- [5] **Z. Zhang**, G. Xu, and E. C. Kan, "Outlooks for RFID-based autonomous retails and factories", *IEEE J. Radio Frequency Identification (RFID)*, 2022, doi: 10.1109/JRFID.2022.3211474 [link](#)
- [6] **Z. Zhang**, G. Xu, and E. C. Kan, "3D geometry recognition by RFID Box based on deep learning", in *16th Intl. Conf. on RFID*, Las Vegas, NV, May 16 – 19, 2022. [link](#) [video](#)
- [7] **Z. Zhang**, P. Sharma, T. B. Conroy, V. Phongtankuel, and E. C. Kan, "Objective scoring of physiologically induced dyspnea by non-invasive RF sensors," *IEEE Trans. Biomed. Engr.*, vol. 69, no. 1, pp. 432-442, 2021. [link](#)
- [8] **Z. Zhang**, P. Sharma, J. Zhou, X. Hui and E. C. Kan, "Furniture-integrated respiration sensors by notched transmission lines," *IEEE Sens. J.*, vol. 21, no. 4, pp. 5303-5311, 2021 [link](#)
- [9] P. Sharma, **Z. Zhang**, T. B. Conroy, X. Hui, and E. C. Kan, "Attention Detection by Heartbeat and Respiratory Features from Radio-Frequency Sensor," *Sensors*, vol. 22, no. 20, p. 8047, 2022. [link](#)
- [10] X. Hui, J. Zhou, P. Sharma, T. B. Conroy, **Z. Zhang** and E. C. Kan, "Wearable RF near-field cough monitoring by frequency-time deep learning", *IEEE Trans. Biomed. Circuits & Sys*, vol. 15, no. 4, pp. 756 – 764, 2021 [link](#)
- [11] **Z. Zhang**, et al., "Wideband and continuously-tunable fractional photonic Hilbert transformer based on a single high- birefringence planar Bragg grating," *Opt. Express*, vol. 26, pp. 20450-20458, 2018. [link](#)
- [12] **Z. Zhang**, et al., "Design of a broadband achromatic dielectric meta-lens for linear polarization in the near-infrared spectrum," *OSA Contin.*, vol. 1, pp. 882-890, 2018. [link](#)
- [13] **Z. Zhang**, et al., "Micro-machining for TE/TM mode phase matching in high-birefringence planar waveguide and implementation in continuously-tunable fractional Hilbert transform," *Intl. Photonics & Optoelectronics Mtg., OSA Tech. Dig.*, OT4A.2, 2018. [link](#)
- [14] H. Sun, W. Zhou, **Z. Zhang** and Z. Wan. "A MEMS variable optical attenuator with ultra-low wavelength-dependent loss and polarization-dependent loss," *Micromachines*, vol. 9, no. 12, p. 632, 2018. [link](#)

Patents

- [1] **Z. Zhang**, and E. C. Kan, "Radiomyography (RMG) for accurate hand gesture recognition by forearm wearable radio sensors", US Patent (Provisional)

Research Interests

- Non-invasive sensing of physiological signals including respiration, muscle motion, and other biological signals.
- Diagnosis and prognosis of pulmonary diseases, including dyspnea, COPD and COVID-19, and sleep disorders.
- Muscle monitoring system for hand gesture recognition, biometrics, and eye movement detection.
- Machine learning, deep neural network, and signal processing.

Research Experiences

- 1 *Hand gesture recognition system by non-invasive muscle monitoring sensors* [link](#) [pdf](#)
 - Proposed a novel radio-myography (RMG) for continuous muscle actuation sensing that can be wearable and touchless, with high user comfort, low time latency, capturing superficial and deep muscle groups.
 - Experimentally demonstrated that RMG can achieve high accuracy (99%) for 23 gestures on participants ($N=8$).
 - Adopted vision transformer (ViT) as the deep learning model to boost accuracy and efficiency compared with CNN.
 - lead to new methods for assessment of muscle functions, fatigue, and diagnosis of neuromuscular disorders; also promising for future HCI applications including exoskeleton robotic control, and virtual reality interface.
- 2 *Non-invasive eye movement monitoring* [link](#) [pdf](#)
 - Presented radio-oculogram (ROG), wearable RF sensor for non-invasive eye movement monitoring with eyes closed.
 - Demonstrated accurate measurements of eye movement frequency and directions for 5 participants and benchmarked with electrooculogram (EOG).
 - Serve as the baseline implementation for sleep rapid EM monitoring.
- 3 *Dynamic muscle fatigue detection using RMG and sEMG* [link](#)
 - Performed human study ($N=8$) and monitored muscle actuation status in fatigue vs. non-fatigue routines on forearm and leg.
 - fused RMG and sEMG to derive muscle stimulation-actuation correlation reflecting fatigue status.
 - Implemented machine learning model to detection muscle fatigue.
- 4 *Air-Writing recognition by forearm wearable RMG* [link](#)
 - Enables the user to hand-write in the air in an intuitive and natural way with non-invasive sensor on the forearm.
 - Demonstrated detection of all alphabets from A-Z with accuracy over 90%.
- 5 *Dyspnea evaluation on COVID-19 patients* [link](#) [pdf](#)
 - Employed wireless and wearable sensors on COVID-19 patients ($N=12$) to continuously (~16 hours) monitor respiratory metrics and evaluate dyspnea using machine learning models.
 - Revealed the high similarity between chronic dyspnea on COVID patients and physiologically induced dyspnea on healthy subjects
 - The proposed system can help diagnosis of COVID symptoms, and be potentially applied to other pulmonary disorders.
- 6 *Sleep apnea detection and prediction based on bed-integrated RF sensor* [link](#) [pdf](#)
 - Collected data from clinical study ($N=27$) in Weill Sleep Center of overnight recording using bed-integrated sensor invisible to the user.
 - Developed machine-learning algorithms that can automatically detect and predict sleep disorder events on real patients with high fidelity.
 - Demonstrated the capability to prognosticate sleep apnea events in 90 seconds earlier.
- 7 *Objective scoring of dyspnea with wearable RF sensor* [link](#) [pdf](#)
 - Designed a testing protocol to perform human study ($N=32$) on simulated dyspnea by the exertion and facemasks.
 - Implemented algorithms to identify various features embedded in breathing waveforms and designed a learning model to predict objective dyspnea score in comparison with the self-report scores.
- 8 *Invisible furniture-integrated RF sensors for respiratory pattern monitoring* [link](#) [pdf](#)
 - Developed a non-invasive respiration sensor integrated into furniture that can be invisible to the user to enhance comfort and convenience.
 - Performed a human study ($N=10$) that confirmed the validity to capture the cardiopulmonary waveforms and detect simulated respiratory disorders including central and obstructive sleep apnea.
- 9 *3D Geometry recognition by RFID Box based on deep learning*
 - Employed ambient low-cost passive RFID tags for the recognition of 3D shape and geometry of hand gesture and feet.

Internship Experience

Signal Processing and Machine Learning Intern in Digital Healthcare Group Analog Devices, Wilmington, MA May –Aug. 2021

Awards

CSC Scholarship (Chinese Government Scholarships) for outstanding undergraduate students	Sep. 2017
Meritorious Prize (First Prize) in Mathematical Contest in Modeling of America	Feb. 2018
Excellent Graduation Thesis in Huazhong University of Science and Technology	Jun. 2019

Skills

Programming and tools: MATLAB; Python; PyTorch; CST Microwave Studio; LabVIEW; COMSOL; C