



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	<i>Sep. 2017</i>
Meritorious Prize (First Prize) in Mathematical Contest in Modeling of America	<i>Feb. 2018</i>
Excellent Graduation Thesis in Huazhong University of Science and Technology	<i>Jun. 2019</i>

Skills

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