Zijing Zhang

Personal Website   ✉ zz587@cornell.edu   GitHub

Objective

Looking for a technical position in biomedical sensors, 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, GPA: 3.92/4.0

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 Experience

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

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 by human study (N=8).
- Adopted vision transformer (ViT) as the deep learning model to boost accuracy and efficiency compared with CNN.
- Developed new methods for assessment of muscle functions, fatigue, and diagnosis of neuromuscular disorders, together with future applications on human-machine interface of exoskeleton robotic control and virtual/augmented reality.

2 Non-invasive eye movement monitoring link pdf
- Prototyped radio-oculogram (ROG), wearable RF sensing for non-invasive eye movement with eyes open or closed.
- Measured accurate eye movement frequency and directions, and benchmarked with electrooculogram (EOG).
- Formulated the baseline implementation for sleep rapid EM monitoring.

3 Dynamic muscle fatigue detection using RMG and sEMG link
- Demonstrated muscle actuation sensing in fatigue vs. non-fatigue routines on forearms and legs.
- Fused RMG and sEMG to derive muscle stimulation-actuation correlation reflecting fatigue status.
- Implemented machine learning models to classify dynamic muscle fatigue.

4 Air-Writing recognition by forearm wearable RMG link
- Enabled the user to hand-write in the air in an intuitive and natural way with non-invasive sensor on the forearm.
- Demonstrated detection of individual 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.
- Demonstrated diagnosis and prognosis of COVID dyspnea, which can be potentially applied to other pulmonary disorders such as asthma and COPD.

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 sensors invisible to the user.
- Developed machine-learning algorithms that can automatically detect and predict sleep apneic 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 respiratory RF sensor link pdf
- Designed a testing protocol to perform human study (N=32) on simulated dyspnea by 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, convenience and acceptance.
- Performed a human study (N=10) that confirmed the validity of sensing the cardiopulmonary waveforms and simulated respiratory disorders including central and obstructive sleep apnea.

9 3D Geometry recognition by RFID Box based on deep learning link pdf
- Employed ambient low-cost passive RFID tags for the recognition of 3D shape and geometry of hand gesture and foot size. Studied the read yield rates as a function of deployment and antenna detuning.

Internship Experience

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

Awards

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

Skills

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

RF equipment: Software-defined radios; network analyzers; spectrum analyzers.

Biomedical sensors: EMG; ECG; PPG; respiratory chest belt; polysomnography; accelerometers.