

# Pragya Sharma

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## Education

### Cornell University

PHD, ELECTRICAL AND COMPUTER ENGINEERING (GPA: 4.06)

Radio-Frequency Sensor Applications for Assisted Living (Prof. Edwin C. Kan)

Ithaca, NY, USA

August 2015 - December 2020

### Indian Institute of Technology (IIT), Kharagpur

BACHELORS IN TECHNOLOGY, ELECTRICAL ENGINEERING (GPA: 9.34/10)

Kharagpur, WB, India

2011 - 2015

## Experience

### Icahn School of Medicine at Mount Sinai

FACULTY INSTRUCTOR AT DEPARTMENT OF AI AND HUMAN HEALTH

New York, NY

Jun 2024 - Present

*Predict Symptomatic and Inflammatory Rheumatoid Arthritis Flares - Funded by Schmidt AI Fellowship*

- Working at the intersection of wearable devices and AI to improve Rheumatoid Arthritis (RA) patient management by predicting flares using a dataset of 50+ patients.
- Used linear mixed effect models to associate HR, RHR and steps with flare and remission periods. Cosinor models were used for HRV with circadian rhythm. (Publication submitted)

### Biofourmis

DATA SCIENTIST R&D

Boston, MA

Mar 2021 - Oct 2023

- Worked on sleep apnea detection using DL model with input SpO2 and PR signals from wearable sensor, demonstrating 0.90 AUROC and 0.59 PRAUC on test dataset for 30s epoch based apnea detection (**IEEE EMBC 2022**). AHI $\geq$ 15/hr apnea severity classification achieved 0.88-1.00 AUROC and 0.87-1.00 PRAUC on multiple public test datasets.
- Improved performance of RR estimation algorithm using wearable sensors. **Patent** submitted Oct 2023.
- Derived respiratory feature-set from pulse oximeter and IMU-sensor derived respiratory waveforms. Supported planning and protocol development for a clinical study collecting chronic respiratory patient vitals and ePROs.
- Supported remote patient monitoring (RPM) business by refining SpO2 alerts, performing alert trend visualizations and developing methodologies for alert precision and sensitivity analysis towards any adverse patient event.

### Cornell University, Prof. Edwin C. Kan

GRADUATE RESEARCH ASSISTANT | PHD

Ithaca, NY

Aug 2015 - Dec 2020

*Respiratory Pattern Monitoring with Wearable RF Sensor - Funded by NIH, DoD CDMRP Discovery Award*

- Developed a wearable near-field RF sensor prototype tuned for abnormal respiratory pattern monitoring. (**IEEE EMBC 2019**)
- Designed and implemented a testing protocol to perform human study (**N = 30**) involving simulation of breathing disorders and attentiveness using Mackworth clock test. (**NPJ 2020**)
- Developed signal processing algorithms to extract respiratory rate with accuracy **94.8%** (RMSE: 2.9 BPM) and respiratory volume with accuracy **77.5%** (RMSE: 0.11 L) for wide RR range of 2-40 BrPM in normal and irregular breathing patterns.
- Developed user attention detection model using both respiratory and heartbeat characteristics measured from the RF sensor. (**Sensors 2022**)
- Designed a semi-supervised support-vector machine (SVM) outlier-classification algorithm to detect motion artifacts with an accuracy of **91%**.
- Designed and implemented an under-the-bed sensor for sleep apnea detection in collaboration with **Cornell Weill medicine sleep center**, NY, to test setup in real-world setting.

*Indoor Occupant Counting and 3D Imaging using Ambient RF Signals - Funded by DoE ARPA-E*

- Used passive RFID tag backscattered signal for un-tagged occupant counting using an ML-CNN model with high accuracy of **93%** for up to five subjects in different positions and postures. (**IEEE Sensors 2021**)
- Performed high-resolution 3D occupant imaging using novel sparsity-based OMP and FISTA reconstruction algorithms, by setting up the RF signal model as a linear inverse problem, giving improved performance than traditional matched-filtering and Capon's method. (**IEEE Sensors 2021**)
- Designed an improved calibration algorithm with better multipath noise-cancellation than existing approach, detecting one occupant presence with **100%** accuracy and decimeter level accuracy in a 4 m  $\times$  4 m room.
- Developed an optimal frequency selection algorithm for a multi-frequency setup to generate improved Fourier-reconstructed image based on K-space sampling.

### Cornell University

TEACHING ASSISTANT

Ithaca, NY

2018, 2016

- *Scientific and Numerical Computation*: Performed grading and assisted students in QA and lab/project sessions. (Spring 2018)
- *Radio Frequency Systems*: Assisted lab-plan development and helped students in lab sessions. (Fall 2016)

## Maxim Integrated

INTERN

Dallas, TX

Summer 2017

Online Trainable Near-Field Communication (NFC) Reader

- Simulated an NFC reader in Python and demonstrated intelligent digital data demodulation with a neural network using Keras library, which achieved a test error of **1%** under optimal conditions and **11%** with low coupling efficiency and high noise.
- Implemented an online trainable real-time setup with experimental data from the reader, resulting in a low test error of < **2%**.

## Publications

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Z. Zhang, J. Zhou, T. B. Conroy, X. Hui, **P. Sharma**, G. Xu, K. Gangwar, U. Delay, A. Kapoor, E. C. Kan, "Near-field radio sensing for biomedical, biological and cyberphysical intelligence," in *IEEE Sensors Letters*, 2024.

**P. Sharma**, A. Jalali, M. Majmudar, K. S. Rajput, N. Selvaraj, "Deep-Learning based Sleep Apnea Detection using SpO<sub>2</sub> and Pulse Rate," at *IEEE Engineering in Medicine and Biology Society Conference (EMBC)*, Glasgow, Scotland, 2022.

**P. Sharma**, Z. Zhang, T. B. Conroy, X. Hui, E. C. Kan, "Attention Detection by Heartbeat and Respiratory Features from Radio-Frequency Sensor," in *Sensors*, 2022.

T. B. Conroy, X. Hui, **P. Sharma**, E. C. Kan, "Heart ID: Biometric Identification Using Wearable MIMO RF Heart Sensors," in *IEEE Journal of Electromagnetics, RF and Microwaves in Medicine and Biology*, 2022.

Z. Zhang, **P. Sharma**, T. B. Conroy, V. Phongtakuel, E. C. Kan, "Objective Scoring of Physiologically Induced Dyspnea by Non-invasive RF Sensors," in *IEEE Transactions on Biomedical Engineering*, 2021.

X. Hui, J. Zhou, **P. Sharma**, T. B. Conroy, Z. Zhang, E. C. Kan, "Wearable RF Near-Field Cough Monitoring by Frequency-Time Deep Learning," in *IEEE Transactions on Biomedical Circuits and Systems*, 2021.

**P. Sharma**, X. Hui, J. Zhou, T. B. Conroy, E. C. Kan, "Wearable Radio Frequency Sensor for Respiratory Rate, Respiratory Volume and Heart Rate Monitoring," in *Nature Partner Journal (npj) Digital Medicine*, 2020.

**P. Sharma**, G. Xu, X. Hui, D. L. Hysell, E. C. Kan, "Deep-Learning Based Occupant Counting by Ambient RF Sensing," in *IEEE Sensors Journal*, 2020.

G. Xu, **P. Sharma**, D. L. Hysell, E. C. Kan, "Indoor Object Sensing Using Radio-Frequency Identification With Inverse Methods," in *IEEE Sensors Journal*, 2021.

G. Xu, **P. Sharma**, and E. C. Kan, "Indoor Object Sensing Using Radio-Frequency Identification with Inverse Solutions," at *IEEE Sensors Conference*, October 2020.

J. Zhou, **P. Sharma**, X. Hui, E. C. Kan, "A Wireless Wearable RF Sensor for Brumation Study of Chelonians," in *IEEE Journal of Electromagnetics, RF and Microwaves in Medicine and Biology*, 2020.

Z. Zhang, **P. Sharma**, J. Zhou, X. Hui, E. C. Kan, "Furniture-Integrated Respiration Sensors by Notched Transmission Lines," in *IEEE Sensors Journal*, 2020.

**P. Sharma**, X. Hui, E. C. Kan, "A Wearable RF Sensor for Monitoring Respiratory Patterns," at *IEEE Engineering in Medicine and Biology Society Conference (EMBC)*, Berlin, Germany, July 2019.

D. L. Hysell, **P. Sharma**, M. Urco and M. A. Milla, "Aperture-Synthesis Radar Imaging With Compressive Sensing for Ionospheric Research," in *Radio Science*, 2019.

X. Hui, **P. Sharma** and E. C. Kan, "Microwave Stethoscope for Heart Sound by Near-Field Coherent Sensing," at *IEEE MTT-S International Microwave Symposium (IMS)*, Boston, MA, June 2019.

**P. Sharma** and E. C. Kan, "Sleep Scoring With a UHF RFID Tag by Near Field Coherent Sensing," at *IEEE MTT-S International Microwave Symposium (IMS)*, Philadelphia, PA, June 2018.

## Technical Skills

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**DS Tools:** Python (Scikit-Learn, Keras, Pandas, PyTorch, TensorFlow), MATLAB, Git, AWS Athena.

**Wearable Sensor Signals:** PPG, ECG, IMU, Respiration bands, RF Sensor

## Awards

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2015	<b>George W. Holbrook Jr.'52</b> , Graduate Research Award.	Cornell University
2015	<b>Best Signal Processing Project</b> , for B.Tech. project in Department of Electrical Engineering.	IIT Kharagpur
2011	<b>Inspire Scholarship</b> , among top 2% candidates in IIT Joint Entrance Examination (0.45 million applicants).	IIT Kharagpur
2011	<b>Certificate of Merit in Chemistry</b> , for being among top 0.1% candidates in Chemistry in All India Senior School Certificate Examination (12 <sup>th</sup> grade).	Delhi
2009	<b>Indian Prime Minister's Guest</b> , at Republic Day parade, for excellent performance in All India Secondary School Certificate Examination (10 <sup>th</sup> grade), with 97.80% score.	Delhi