Pragya Sharma

PhD Candidate · Electrical and Computer Engineering

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Objective

I am a PhD candidate with background in RF vital sign sensing and image processing, currently looking for opportunities in the field of data analysis, algorithms and wireless system applications in the Northeast region.

Education

Cornell University

Ithaca, NY 14853

PhD candidate

Electrical and Computer Engineering (GPA: 4.06)

August 2015 - Expected August 2020

Advisor: Prof. Edwin C. Kan

Thesis: RF Sensor Systems for Indoor People Tracking and Cardiopulmonary Monitoring.

Indian Institute of Technology (IIT), Kharagpur

Kharagpur, WB 721302

Bachelors in Technology

2011 - 2015

Electrical Engineering (GPA: 9.34/10)

Publications

P. Sharma, G. Xu, D. L. Hysell and E. C. Kan, "Multistatic 3D Indoor RF Imaging With Sparsity-Based Reconstruction," 2020. (*Under Submission*)

P. Sharma, X. Hui, J. Zhou, T. Conroy and E. C. Kan, "Long-Term Continuous Cardiopulmonary Monitoring Using Wearable RF Sensors," 2020. (*Under Submission*)

G. Xu, **P. Sharma**, X. Hui and E. C. Kan, "3D Device-Free Object Locating Using Passive Radio-Frequency Identification," 2020. (*Under Submission*)

P. Sharma, X. Hui and E. C. Kan, "A Wearable RF Sensor for Monitoring Respiratory Patterns," at *IEEE Engineering in Medicine and Biology Society Conference (EMBC)*, Berlin, Germany, July 23-27, 2019, pp. 1217-1223.

D. L. Hysell, **P. Sharma**, M. Urco and M. A. Milla, "Aperture-Synthesis Radar Imaging With Compressive Sensing for Ionospheric Research," in *Radio Science*, vol. 54, pp. 503– 516 , 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 2 - 7, 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 10 - 15, 2018, pp. 1419-1422.

Projects

Indoor Imaging from RFID Tag Backscatter for Real-Time People Tracking

Cornell University

Funded by ARPA-E (Department Of Energy)

January 2016 - Present

Profs. Edwin Kan and David Hysell

- Implemented novel sparsity-based OMP and FISTA reconstruction algorithms for high resolution RF imaging, using untagged-object backscattered phase from ambient low-cost passive UHF RFID tags.
- Developed simulation study in CST Microwave Studio to compare relative tag-receiver placement and algorithm performance.
- Designed a background-subtraction calibration algorithm with improved noise-cancellation, achieving **100%** counting accuracy for 1-person test at all locations in an experimental room.
- Developed ensemble algorithms to improve the performance and reduce parameter sensitivity for inverse methods with limited bandwidth and spatial diversity.
- Implemented convex optimization and level-set approaches to extract object shape and size from the pixel reflectivity of imaging domain.
- Developed an optimal frequency selection algorithm for a broad bandwidth, multi-frequency setup to generate improved Fourier-reconstructed image based on K-space sampling.
- Tested super-resolution imaging based Capon and maximum entropy algorithms, which provided improved performance over matched-filtering for shape estimation with increased computational and time complexity.

Respiratory Pattern Monitoring with RF Near-Field Coherent Sensing (NCS)

Cornell University

Funded by National Institutes of Health (NIH)

August 2016 - Present

Prof. Edwin Kan

- Developed an over-clothing cardiopulmonary sensor by a software-defined radio to collect detailed respiratory and heartbeat waveforms. Designed and implemented a testing protocol to perform human study (N = 30) on simulated breathing disorders and apnea.

- Implemented a nearly tuning-free peak-detection algorithm to identify respiratory disorder with broad frequency range of 2-40 breaths per minute (BPM), which achieved high rate accuracy of **94.8%** (RMSE: 2.9 BPM) and respiratory volume accuracy of **77.5**% (RMSE: 0.11 L) under simulated deep, fast and central sleep apnea conditions.
- Designed a semi-supervised support-vector machine (SVM) outlier-classification algorithm to detect motion artifacts with an accuracy of **91%**.
- Designed and implemented a bed-integrated sensor for sleep apnea detection in collaboration with Cornell Weill medical sleep center. The sensor is invisible to the user with improved antenna design and placement to measure chest motion.
- Programmed an attention test protocol on PsyToolkit for a large-scale human study to evaluate stress/attention using both respiratory and heartbeat characteristics from the NCS sensor.

Accuracy and Resources Trade-off in Machine Learning Algorithms

Cornell University

Course: CS 6780 Advanced Machine Learning

March - May 2019

- Developed approximation techniques to tackle constrained-resource issues with large training data and limited CPU, memory and energy availability, specifically in mobile devices.
- Implemented different approximation techniques including parameter pruning, loop perforation and quantization at both training and inference in machine learning algorithms including regression, neural networks and SVM in Tensorflow.

Online Trainable Near-Field Communication (NFC) Reader

Maxim Integrated, Dallas

Internship: Maxim Integrated (Micros, Security and Software BU)

May - July 2017

- Programmed an NFC reader model including analog frontend and digital baseband processing in Python. Implemented new modulation protocols on output of the existing hardware to predict future challenges.
- Developed intelligent multi-class classification algorithm using a simple neural network architecture on Keras platform, to perform digital data demodulation, which achieved low test error of **1%** under optimal conditions, and **11%** with low coupling efficiency and high noise.
- Implemented a real-time trainable setup for testing the experimental data from the reader, resulting in low test error of **< 2%**.

Low-Voltage Arc Detection and Sensor Placement

IIT Kharagpur

Prof. Aurobinda Routray

May 2014 - April 2015

- Developed an algorithm for low-voltage (230 V, 50 Hz) arc characterization and classification from other spikes using k-means clustering of PSD spectral distance measurements, achieving high accuracy **> 96%**.
- Developed an algorithm to estimate optimal sensor number and location for arc detection using bipartite graph approach with high accuracy, which achieved cost reduction by **24.75%** in smaller electrical networks.

Awards

2015	**George W. Holbrook Jr.'52,** Graduate Research Award.	*Cornell University*
2015	**Best signal processing project award,** in Department of Electrical Engineering.	*IIT Kharagpur*
2011	**Inspire Scholarship,** among top 2% candidates in IIT Joint Entrance Examination (0.45 million applicants).	*IIT Kharagpur*
2011	**Certificate of Merit in Chemistry,** for being among top 0.1% candidates in Chemistry in All India Senior School Certificate Examination (12^{th} grade).	*Delhi*
2009	**Indian Prime Minister's Guest,** at Republic Day parade, awarded to top 4 candidates in All India Secondary School Certificate Examination (10^{th} grade), with 97.80% score.	*Delhi*

Teaching Experience

ECE 4960, *Scientific and Numerical Computation*, Teaching Assistant. *Spring 2018*

ECE 4880, *Radio Frequency Systems*, assisted lab development and headed sessions. *Fall 2016*

Technical Skills

Programming: MATLAB, Python, C, C++.

Tools: CST Microwave Studio, LabVIEW.

Relevant Courses

Wireless and RF System: RF Systems, Wireless Communications, Advanced High Speed and RF Integrated Circuits.

Algorithms and Data Processing: Inverse Methods in Natural Sciences, Scientific and Numerical Computation, Advanced Machine Learning, Digital Signal Processing, Digital Image Processing.