M. MAHBUBUR RAHMAN

The University of Alabama, Dept. of Electrical and Computer Engineering
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Research Interest

My research interest lies in Signal Processing for Wireless/mmWave Sensing and Machine Learning, emphasizing multi-modal sensing for human motion recognition, fall detection, gait analysis, vehicular autonomy, and human-computer interaction.

Educational Background

2018 –2022 **The University of Alabama (UA), Tuscaloosa, AL**
Doctor of Philosophy (Ph.D.) in Electrical and Computer Engineering
Ph.D. Advisor: Dr. Sevgi Z. Gurbuz (http://www.sevgigurbuz.com/)
Expected to be Graduated by Dec 2022.

Coursework: *Advanced Radar Signal Processing, Statistical Signal Processing, Digital Signal Processing, Computer Vision and Digital Image Processing, Machine Learning, Deep Learning, Electromagnetic Waves, Automotive Radar Signal Processing, Optimal Control & Estimation, and Advanced Cyber Security*

2012-2016 **Khulna University of Engineering and Technology (KUET),** Khulna, Bangladesh
B.Sc. ***Bachelor of Science (B.Sc.) in Electronics and Communication Engineering***
GPA: 3.83/4.00

Research Experience

2019 –2022 **Graduate Research Assistant | Computational Intelligence for Radar (CI4R) LAB**

- Experiments with Human participants for Indoor activity monitoring, Sign Language recognition, and Gait Analysis.
- Experiments using RF Sensors (Ankortek 24 GHz, TI 77 GHz AWR 1443, 1642, 2243 Cascade Radar).
- Radar Data Processing: Time-Frequency Spectrograms, Range-Doppler, Range-Azimuth, Range-Elevation, Doppler integrated Range-Angle Heatmaps.
- Multi-Frequency mmWave RADAR fusion for Human activity recognition.
- Domain Adaptation for Imitation to Native ASL signs.
- Physics-aware GAN design to generate kinematically accurate Human Micro-Doppler signatures.
- Human gait parameters estimation using RF sensors and validation with VICON motion capture measurement.
- Analyzed linguistic features of radar micro-Doppler signatures of ASL signs

2018-2019

- **UA Remote Sensing Centre (Graduate Research Assistant)**
  - Developed signal processing algorithm for calculation of radar backscatter coefficient for soil moisture estimation using FMCW radar.
  - Developed algorithms for identification of snow and ice layers from airborne FMCW radar data, e.g. pulse compression, stretch processing, 2D SAR fk-migration algorithm with narrow-beam motion compensation, delay-and-sum beamforming, and layer tracking.

- Developed a Synthetic Aperture Radar (SAR) simulation environment for validation of 3D tomographic SAR imaging algorithms.

2015-2017 **Undergrad Research Assistant | Optical Networks Lab | KUET, Bangladesh**

- **Bandwidth Allocation in Passive Optical Networks**
  - Designed broadband network architecture for smart cities.
  - Developed dynamic bandwidth allocation algorithm in ethernet passive optical network to maintain quality of services.

Internship

April-Aug 2022 Research Intern @ **Mitshubishi Electric Research Laboratories (MERL),** Boston, MA.

Responsibilities:

1. Conduct experiments to collect data for Multi-Modal scene understanding.
2. RADAR and Camera calibration and fusion for Automotive Object Detection.
3. Prepare and Process (Range-Doppler, Range-Azimuth-elevation map, Pointcloud, Micro-Doppler) RADAR data for AI/ML application.
4. Design Novel Deep learning models for Radar Backbone feature extraction.

Publications

Journal:

- **MM Rahman**, SZ Gurbuz, MG Amin, '**Physics-aware Generative Adversarial Network for Radar-Based Human Activity Recognition**. IEEE Transaction of Aerospace and Electronic systems. 2022, (Under Review).

- **MM Rahman**,E Malaia, AC Gurbuz, DJ Griffin, SZ Gurbuz ,'**Effect of Kinematics and Fluency in Adversarial Synthetic Data Generation for ASL Recognition**'. Transaction of Aerospace and Electronic system (TAES), December 21, 2021

- SZ Gurbuz, **MM Rahman**, E Kurtoglu,et.al., '**Multi-Frequency RF Sensor Fusion for Word-Level Fluent ASL Recognition'.** IEEE Sensors Journal 2021

- SZ Gurbuz, AC Gurbuz, EA Malaia, DJ Griffin, CS Crawford, **MM Rahman**, et.al., **American sign language recognition using RF sensing**. IEEE Sensors Journal 21 (3), 3763-3775

- S.Z Gurbuz, E. Kurtoglu, **M.M. Rahman**, and D. Martelli, "**Gait Variability Analysis using Continuous RF Data Streams of Human Activity**". Elsevier Smart Health Journal (accepted), Oct 2022.

- **MM Rahman** and M Hossen, '**Bandwidth Allocation and Control Message Scheduling Algorithms for Improving the QoSs of High Priority Traffic in PON'**. Dec. 2018, Journal of Communication and Information Networks 3 (4), 112-120. IEEE Posts and Telecom Press, (PTP)

- Md. Selim Morshed, M Hossen, **MM Rahman, 'Dynamic hybrid slot-size bandwidth allocation algorithm for reducing packet delay and jitter variation of real time traffic in EPON**.' **Optik** 183 (April 2019), 523-533

Conference Proceedings:

- **M.M. Rahman**, Dario Martelli, SZ Gurbuz, **'Gait Variability Analysis using Multi-channel FMCW Radar for Fall Risk Assessment.'** IEEE 12th Sensor Array and Multichannel Signal Processing Workshop (SAM), Trondheim, Norway, June 20-23, 2022

- SZ Gurbuz, **M.M. Rahman,** Emre Kortuglu, Dario Martelli, "**Continuous Human Activity Recognition and Step-Time Variability Analysis with FMCW Radar**". IEEE Biomedical and Health Informatics (BHI) Conference, Ioannina, Greece, September 27-30, 2022.

- **M. M. Rahman,** E. Kurtoglu, et.al., '**Performance Comparison of Radar and Video for American Sign Language Recognition.**' IEEE Radar Conference, 22, NY.

- **M. M. Rahman,** Sevgi Gurbuz, Evie Malaia, '**Dynamic parameters of signing differences between signers and novice learners**.', Theoretical Issues in Sign Language Research conference (TISLR).

- **MM Rahman**, E Kurtoglu, R Mdrafi, AC Gurbuz et.al., **Word-Level ASL Recognition and Trigger Sign Detection with RF Sensors.** ICASSP 2021-2021

- **MM Rahman,** SZ Gurbuz, MG Amin, **'Physics-Aware Design of Multi-Branch GAN for Human RF Micro-Doppler Signature Synthesis.'** 2021 IEEE Radar Conference (RadarConf21),

- **MM Rahman**, R Mdrafi, AC Gurbuz, et.al., '**Word-level sign language recognition using linguistic adaptation of 77 GHz FMCW radar data.**' 2021 IEEE Radar Conference (RadarConf21)

- **MM Rahman,** SZ Gurbuz**, 'Multi-frequency RF sensor data adaptation for motion recognition with multi-modal deep learning.'** 2021 IEEE RadarConf20201

- SZ Gurbuz, AC Gurbuz, EA Malaia, et.al., **ASL Recognition Based on Kinematics Derived from a Multi-Frequency RF Sensor Network.** 2020 IEEE Sensors, 1-4

- R Aksu, **MM Rahman**, SZ Gurbuz , '**3D scene reconstruction from multi-sensor EO-SAR data**', Algorithms for Synthetic Aperture Radar Imagery XXVII 11393, 113930B

- SZ Gurbuz, **MM Rahman**, E Kurtoglu,et.al., '**Cross-frequency training with adversarial learning for radar micro-Doppler signature** '. Radar Sensor Technology XXIV 11408, 114080A

- SZ Gurbuz, AC Gurbuz, EA Malaia, DJ Griffin, C Crawford, **MM Rahman, et.al.,** 'A linguistic perspective on radar micro-doppler analysis of American sign language'. 2020 IEEE International Radar Conference

- D Taylor, S Yan, C O'Neill, P Gogineni, S Gurbuz, et.al., '**Airborne Dual-Band Microwave Radar System for Snow Thickness Measurement**', IGARSS 2020-2020

- R Bushra, M Hossen, **MM Rahman**, '**Online multi-thread polling algorithm with predicted window size for DBA in long reach PON.**'2016 3rd International Conference on Electrical Engineering and Information.

Scholarships and Awards

2021	Won Student paper competition (3rd place) at IEEE RADAR conference.
2020-2021	University of Alabama Graduate Council Fellowship
2017	Best paper award in IEEE International Conference on Electrical, Computer and Communication Engineering (ECCE), Cox's Bazar, Bangladesh
2013 – 2016	Vocational Scholarship from Khulna University of Engineering & Technology for outstanding academic achievement during B.Sc. Engineering studies.

Technical Skills

- **Programming Skills**: MATLAB, Python
- **Deep Learning Framework**: Keras, Tensorflow, PyTorch
- **Simulation Tools**: PSpice, Proteus, CST, LABVIEW, Packet Tracer, Wireshark, Micro-wind

Technical Projects:

University of Alabama:

[ECE 693- Automotive Radar Signal Proc.] Building an FMCW simulator with synthesized virtual antenna array for angle of arrival estimation using FFT, MUSIC and Compressive sensing.

[ECE 593 – Image Processing] Automatic Measurement of Chew Count and Chewing Rate during food intake using Optical flow and face recognition technique from an eating video episode.

[ECE 693 – Deep Learning] Recognizing human activities in an indoor environment from micro-Doppler signatures using Residual Neural Networks.

Undergrad projects @ KUET:

- Accelerometer Based Wireless Hand Gestured Controlled Robots.
- Design and Hardware implementation of an Amplitude and Frequency Modulation Receiver
- Design and Hardware Implementation of Electro-Cardio Graph (ECG) Signal amplifier.
- Design and Hardware implantation of a DC power supply with necessary protection circuitry.

References:

1. **Dr. Sevgi Zubeyde Gurbuz**
   Assistant Professor, ECE
   The University of Alabama, Tuscaloosa, AL
   PI, Computational Intelligence for RADAR (CI4R) LAB
   Email: szgurbuz@eng.ua.edu

2. **Dr. Moeness G. Amin**
   Professor of ECE, Villanova University, PA, USA.
   Director of the Center for Advanced Communications (CAC), Villanova University.
   Email: moeness.amin@villanova.edu