COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

Rajesh Baliram Singh

for the degree of Doctor of Philosophy (Ph.D.)

"Measurement, Analysis, Classification and Detection of Gunshot and Gunshot-like Sounds"

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Dissertation Defense
Zoom Meeting
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Meeting ID: 837 4703 1447
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DEPARTMENT:
Electrical Engineering and Computer Science

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ABSTRACT OF DISSERTATION
Measurement, Analysis, Classification and Detection of Gunshot and Gunshot-like Sounds

The recent uptick in senseless shootings in otherwise quiet and relatively safe environments is powerful evidence of the need, now more than ever, to reduce these occurrences. Artificial intelligence (AI) can play a significant role in deterring individuals from attempting these acts of violence. The installation of audio sensors can assist in the proper surveillance of surroundings linked to public safety, which is the first step toward AI-driven surveillance. With the increasing popularity of machine learning (ML) processes, systems are being developed and optimized to assist personnel in highly dangerous situations. In addition to saving innocent lives, supporting the capture of the responsible criminals is part of the AI algorithm that can be hosted in acoustic gunshot detection systems (AGDSs). Although there has been some speculation that these AGDSs produce a higher false positive rate (FPR) than reported in their specifications, optimizing the dataset used for the model's training and testing will enhance its performance.

This dissertation proposes a new gunshot-like sound database that can be incorporated into a dataset for improved training and testing of a ML gunshot detection model. Reduction of the sample bias (that is, a bias in ML caused by an incomplete database) is achievable. The Mel frequency cepstral coefficient (MFCC) feature extraction process was utilized in this research. The uniform manifold and projection (UMAP) algorithm revealed that the MFCCs of this newly created database were the closest sounds to a gunshot sound, as compared to other gunshot-like sounds reported in literature. The UMAP algorithm reinforced the outcome derived from the calculation of the distances of the centroids of various gunshot-like sounds in MFCCs' clusters. Further research was conducted into the feature reduction aspect of the gunshot detection ML model. Reducing a feature set to a minimum, while also maintaining a high accuracy rate, is a key parameter of a highly efficient model. Therefore, it is necessary for field deployed ML applications to be computationally light weight and highly efficient. Building on the discoveries of this research can lead to the development of highly efficient gunshot detection models.

BIOGRAPHICAL SKETCH
Born in Trinidad, West Indies
B.Sc., The University of the West Indies, St. Augustine, Trinidad, 1998

M.S., University of South Florida, Tampa, Florida, 2001
Senior Electrical Engineer, Motorola Solutions, (2000 - Present)
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CONCERNING PERIOD OF PREPARATION & QUALIFYING EXAMINATION

Time in Preparation: 2016 – 2022

Qualifying Examination Passed: Fall 2018

Published Papers:

R. Baliram Singh, H. Zhuang, and J. K. Pawani, "Data Collection, Modeling, and Classification for Gunshot and Gunshot-like Audio Events: A Case Study," *Sensors*, vol. 21, no. 21, p. 7320, Nov. 2021, doi: 10.3390/s21217320.

Paper under review:

R. Baliram Singh and H. Zhuang, "Measurements, Analysis, Classification and Detection of Gunshot and Gunshot-like Sounds," – Submitted to the MDPI Sensors Journal.