College of Engineering and Computer Science
Office of the Dean
777 Glades Road, EE96, Room 308
Boca Raton, FL 33431
561.297.3400

FLORIDA ATLANTIC UNIVERSITY

Announces the Ph.D. Dissertation Defense of

Ali Salem Abdulmajeed Altaher

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

APPLICATIONS OF DEEP LEARNING AND SIGNAL PROCESSING IN ACOUSTICS, OCEANOGRAPHY, AND BIOMETRICS

4/4/2025, 12 pm
Engineering East, Room 405
777 Glades Road
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DEPARTMENT:
Electrical Engineering and Computer Science

ADVISORS:
Professor Hanqi Zhuang, Ph.D.
Professor Laurent Cherubin, Ph.D.

PH.D. SUPERVISORY COMMITTEE:
Professor Hanqi Zhuang, Ph.D., Chair
Professor Laurent Cherubin, Ph.D., Co-chair
Professor Xingquan (Hill) Zhu, Ph.D.
Professor Dimitris Pados, Ph.D.

ABSTRACT OF DISSERTATION

This dissertation examines innovative multidisciplinary methods in marine research, computational modeling, and artificial intelligence. This dissertation tackles significant issues in ecological monitoring, ocean dynamics forecasting, and assistive technology via three independent but interrelated research streams.

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The first study examines the localization and distribution of marine organisms along Florida's East Coast via passive acoustic monitoring methods. The research analyzed more than 65,000 audio recordings to delineate the geographical distribution of several marine creatures, such as black drum, toadfish, Sei whales, North Atlantic right whales, dolphins, and false killer whales. A novel automated detection and localization model was developed, using an adaptive matching filter and Time Difference of Arrival (TDOA) algorithm, which demonstrated accurate marine species tracking with localization errors of about 2 meters across distances of 50 meters.

The second research enhances oceanic modeling with a hybrid deep learning methodology that integrates Empirical Orthogonal Function (EOF) analysis with a Fourier Neural Operator (FNO). This novel technique significantly improves the prediction of ocean velocity fields, demonstrating exceptional performance across several datasets. The suggested EOF-FNO model has exceptional zero-shot super-resolution capabilities and shows improved stability in capturing intricate spatiotemporal marine dynamics, offering a viable computational approach for comprehending oceanic systems.

The last research examines deep learning applications in biometrics, with a particular focus on communication accessibility and security technologies. The research attained exceptional performance in American Sign Language (ASL) recognition and Finger Knuckle Print (FKP) classification via extensive comparative analyses of several neural network architectures. The Vision Mamba (ViM) models have shown exceptional performance, with an accuracy of 99.98% in ASL recognition and 99.1% in biometric identification, underscoring the capabilities of modern deep learning methodologies in assistive and security applications.

These research efforts bring advanced computational approaches that integrate ecological monitoring, deep learning, and biometric innovation. This dissertation integrates modern sensing technologies, complex algorithms, and deep learning methods to provide unique insights and tools for comprehending marine ecosystems, forecasting oceanic incidents, and creating dependable assistive technologies. This work's highlights the capacity of the advanced computational methods in tackling intricate scientific and technical issues.

BIOGRAPHICAL SKETCH

B.Sc., University of Baghdad, Baghdad, Iraq, 2013
M.Sc., University of Baghdad, Baghdad, Iraq, 2016
Ph.D., Florida Atlantic University, Boca Raton, Florida, 2025
President, Google Developer Student Clubs, Florida Atlantic University, Boca Raton, Florida, 2022-2023
President, VP and Co-founder, Data Science and Machine Learning Club, Florida Atlantic University, Boca Raton, Florida, 2021-2022
Student Conduct Board member, Florida Atlantic University, Boca Raton, Florida, 2021-2023
Ambassador, Graduate and Professional Student Association, Florida Atlantic University, Boca Raton, Florida, 2021-2022
Ambassador, Inaugural Engineering Fab Lab, Florida Atlantic University, Boca Raton, Florida, 2021-2022
Campus Recreation Advisory Board, Florida Atlantic University, Boca Raton, Florida, 2022-2023

CONCERNING PERIOD OF PREPARATION & QUALIFYING EXAMINATION

Time in Preparation: 2019-2025
Qualifying Examination Passed: Spring 2020

Published Papers:

1. Ali Altaher et al., Mamba vision models: Automated American sign language recognition. Franklin Open, (2025): 100224
2. Ali Altaher et al., Finger Knuckle Print Classification Using Pretrained Vision Models. In 2023 IEEE 20th International Conference on Smart Communities: Improving Quality of Life using AI, Robotics and IoT (HONET), pp. 62-67. IEEE, 2023
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4. Ali Altaher et al., Using multi-inception CNN for face emotion recognition. Journal of Bioengineering Research 3, no. 1 (2020): 1-12
5. B Alsharif, Ali Altaher, ..., Deep Learning Technology to Recognize American Sign Language Alphabet. Sensors 23, no. 18: 7970. https://doi.org/10.3390/s23187970
6. M Alsaidi, AS Altaher, ..., COVID-19 Classification Using Deep Learning Two-Stage Approach. ArXiv preprint arXiv:2211.15817 (2022)
7. M Ali, ..., Ali Altaher, ..., Ocean Currents Velocity Hindcast and Forecast Bias Correction Using a Deep-Learning Approach. Journal of

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8. M Alanazi, …, Ali Altaher, ..., Multi-Dataset Human Activity Recognition: Leveraging Fusion for Enhanced Performance. In 2023 IEEE 20th International Conference on Smart Communities: Improving Quality of Life using AI, Robotics and IoT (HONET), pp. 1-6. IEEE, 2023
9. B Alsharif, …, Ali Altaher, …, Deep Learning Technology to Recognize American Sign Language Alphabet Using Mulit-Focus Image Fusion Technique. In 2023 IEEE 20th International Conference on Smart Communities: Improving Quality of Life using AI, Robotics and IoT (HONET), pp. 1-6. IEEE, 2023
10. M Ali, …, Ali Altaher, ..., A Deep-Learning Usability Expansion Model of Ocean Observations. ArXiv preprint arXiv:2206.01599 (2022)
11. A Abidalkareem, …, Ali Altaher, ..., Diabetic retinopathy (DR) severity level classification using multimodel convolutional neural networks. In 2020 42nd Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), pp. 1404-1407. IEEE, 2020
12. M Khalid, …, Ali Altaher, ..., Cortico-Hippocampal computational modeling using quantum-inspired neural networks. Frontiers in Computational Neuroscience 14 (2020): 80

Papers submitted to Journals (under review):

1. Ali Altaher et al., Vision Mamba's Superior Performance in Aerial Scene Classification: An Evaluation Across Datasets. AI Open.
2. Ali Altaher et al., Finger Knuckle Print Classification: Leveraging Vision Mamba for Low Complexity and High Accuracy. Franklin Open - Science Direct - Elsevier.
3. C Bang, Ali Altaher, …, Physics-Informed Neural Networks to Reconstruct Surface Velocity Field from Drifter Data. Journal of Advances in Modeling Earth Systems (JAMES).
4. A Altaher, Ali Altaher, …, Alzheimer's Disease: Rationale for Research into Early Detection Using Deep Learning and PET Imaging. Franklin Open - Science Direct - Elsevier.
5. M Alanazi, …, Ali Altaher, ..., Deep Learning for Multimodal Fusion in Human Activity Recognition Using Wearable Sensors and Visual Data. Franklin Open - Science Direct - Elsevier.