

Announces the Ph.D. Dissertation Defense of

Hamid Akbarian

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

“DEEP LEARNING BASED ANOMALY DETECTION IN SPACE SYSTEMS AND OPERATIONS”

March 26, 2024, Time 3:00 p.m.

Building EE96, Room #405, R961 f6Tf4f()T5J0 T482 0 hh9T20 BDC 2
Boca Raton, FL

DEPARTMENT:

Department of Electrical Engineering and Computer Science

ADVISOR: Imadeldin Mahgoub, Ph.D.

PH.D. SUPERVISORY COMMITTEE:

Imadeldin Mahgoub, Ph.D., Chair

Mohammad Ilyas, Ph.D.

Deep Learning Based Anomaly Detection in Space Systems and Operations.

study, we delve into cutting-edge techniques in deep learning (DL) with a depth examination of recent breakthroughs and hurdles in deep learning-based systems and operations. A key advantage of deep learning-based approaches is their ability to handle the high-dimensional and complex data encountered in space missions. For instance, Convolutional Neural Networks (CNNs) are well-suited for processing high-dimensional data, rendering them well-suited for tasks such as image recognition. Recurrent Neural Networks (RNNs), with their temporal modeling ability, excel in identifying patterns in time-series data. Despite the potential of deep learning, several challenges persist in its application to space systems. The scarcity of labeled data presents a formidable hurdle, as acquiring labeled data is often expensive and impractical. Additionally, the interpretability of deep learning models is a challenge, particularly where human operators need to comprehend the rationale behind the model's decisions. To address these challenges, innovative approaches, such as the fusion of diverse deep learning models, are being explored. This dissertation addresses the challenges inherent in space systems and operations, this dissertation explores the use of an Autoencoder (AE), Long Short-Term Memory (LSTM), and K-means clustering for anomaly detection. Additionally, K-means clustering techniques are employed to analyze the data and identify anomalies.

BIOGRAPHICAL SKETCH

Born in Tehran, Iran (US Citizen)

B.S., Florida Atlantic University, Boca Raton, Florida, 1999

M.S., Florida Atlantic University, Boca Raton, Florida, 2001

Ph.D., Florida Atlantic University, Boca Raton, Florida, 2024

CONCERNING PERIOD OF PREPARATION & QUALIFYING EXAMINATION

Time in Preparation: 2020 – 2024

Qualifying Examination Passed: Semester Spring 2011

Published Papers:

- A Survey of Machine Learning Based Schemes in Space Communications, 16th International Conference on Space Operations, 3-5 May 2021. Vol 4, ISBN: 9781713855538
- "Autoencoder-LSTM Algorithm for Anomaly Detection". In proceedings of the 2023 IEEE 20th International Conference (HONET), pp. 1-6. DOI: 10.1109/HONET59747.2023.10374710
- "Autoencoder-K-Means Algorithm for Efficient Anomaly Detection to Improve Space Operations" in 2024 International Conference on Smart Applications, Communications and Networking (SmartNets). (Submitted)
- "Autoencoder-LSTM-K-Means Algorithms for Efficient Anomaly Detection in Space Systems" Journal of IEEE Transactions on Aerospace and Electronic Systems. (Submitted)