MANISHA. M. A

Final Project

GENERATIVE ADVERSARIAL NETWORK FOR SIGNAL PROCESSING

AGENDA

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PROBLEM STATEMENT

The ever-growing demand for high-quality signal processing applications necessitates robust and adaptable models. However, real-world signal data can be limited, noisy, and prone to anomalies.
Traditional methods might struggle with these challenges.
Generative Adversarial Networks (GANs) offer a promising solution by leveraging adversarial training to generate new, realistic signals and enhance existing ones.
This presentation explores how GANs can be employed in signal processing tasks like signal augmentation,noise reduction, and anomaly detection,ultimately leading to improved model performance and generalizability.

PROJECT OVERVIEW

This project investigates the potential of Generative Adversarial Networks (GANs) to address challenges in signal processing. We're particularly interested in applying GANs to the task of noise reduction, signal augmentation, anomaly detection. By leveraging the adversarial training process between a generator and discriminator network, we aim to achieve generating realistic, denoised signals, creating diverse training data, or identifying unusual patterns.

This project will involve acquiring and pre-processing signal data, designing the GAN architecture, and implementing a training strategy with appropriate metrics. The successful implementation of this project will contribute to improved signal quality, enhanced model performance, or more robust anomaly detection.

WHO ARE THE END USERS?

Broad Range: GANs benefit various fields by improving signal quality, generating data, and detecting anomalies.

1. Engineering:
   - Machine Condition Monitoring: Early detection of equipment failure through anomaly detection in sensor data (factories, power plants).
   - Communications Engineering: Enhanced signal processing for cleaner data transmission and reception (telecommunication systems).
2. Healthcare:
   - Medical Imaging: Denoising medical images (X-rays, MRIs) for improved diagnosis.
   - Biosignal Processing: Noise reduction in ECG, EEG, EMG signals for better analysis of heart, brain, or muscle activity.
3. Scientific Research:
   - Data Augmentation: Generating synthetic scientific data for training models in various research areas (astronomy, physics).
   - Anomaly Detection: Identifying unusual patterns in scientific data that could lead to new discoveries.
4. Evolving Landscape: As GAN technology advances, its applications in signal processing are expected to expand further.

YOUR SOLUTION AND ITS VALUE PROPOSITION

Our solution tackles signal processing challenges using Generative Adversarial Networks (GANs). This powerful approach leverages adversarial training to create a GAN that can generate realistic, denoised signals or identify unusual patterns. By applying this GAN to noisy sensor data, medical images, we aim to significantly improve signal quality, diagnostic accuracy.

This translates to early detection of equipment failures, more effective medical diagnoses.

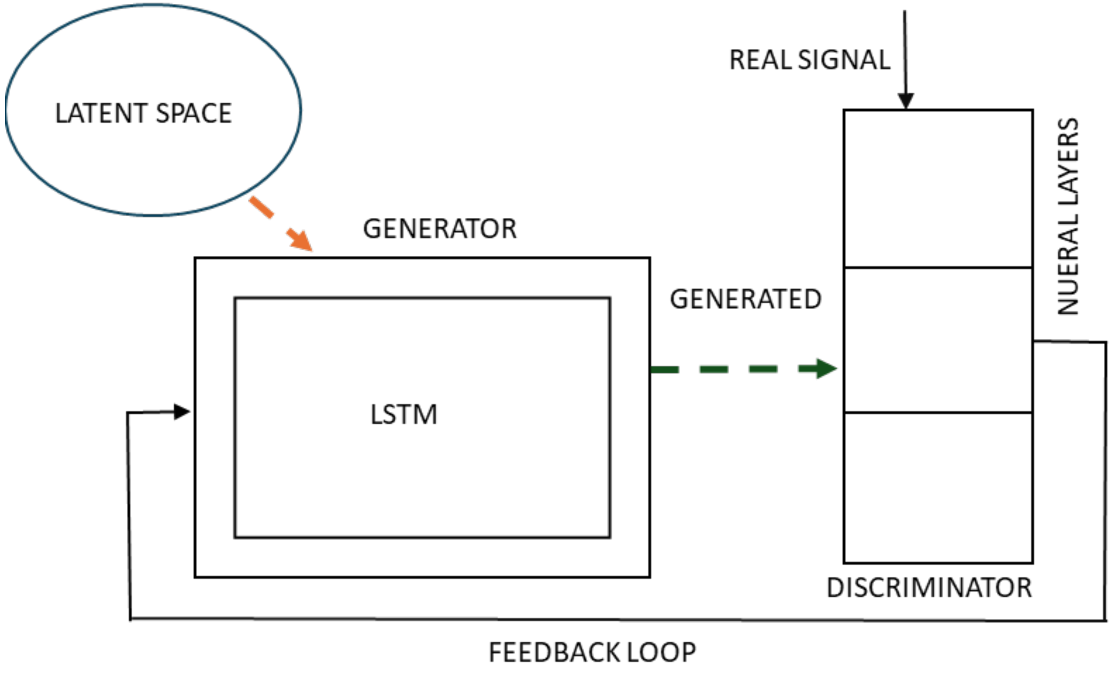
THE WOW IN YOUR SOLUTION

Forget traditional methods limited by real-world data constraints! Our GAN solution injects a powerful "wow factor" into signal processing. By harnessing the adversarial nature of GANs, we can fabricate realistic data on-demand or unearth hidden anomalies with exceptional precision. This translates to simulating various signal conditions for robust model training or spotting faint yet critical deviations in real-time.

Imagine the possibilities: preventing catastrophic equipment failures or enabling groundbreaking medical discoveries.

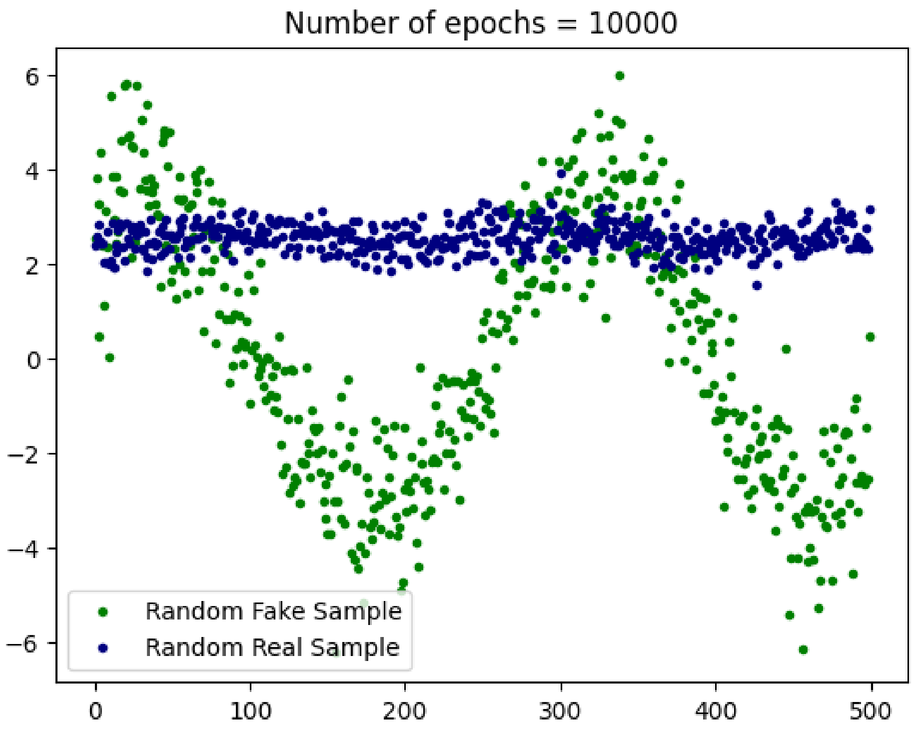
Our GAN solution unlocks a whole new level of signal processing prowess, taking it from ordinary to extraordinary.

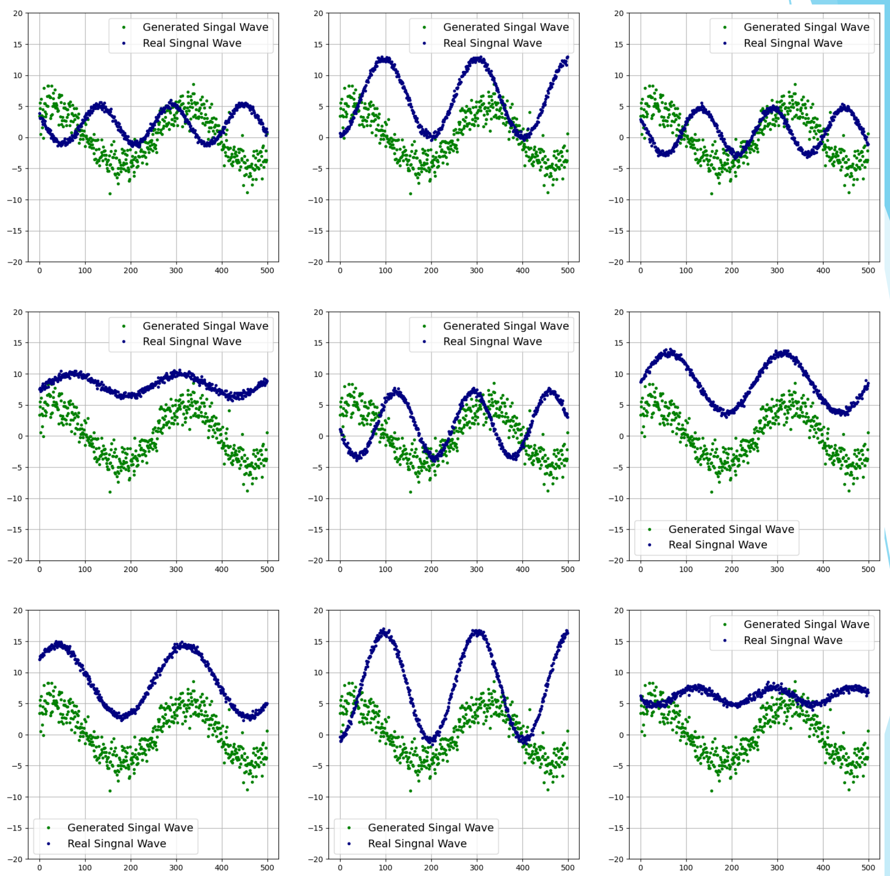
MODELLING



This figure shows that Generative Adversarial Networks (GANs) can be used to uncover hidden patterns within signal data. A GAN architecture consists of two neural networks: a generator that learns to create realistic signals, and a discriminator that attempts to differentiate between real and generated signals. Through an adversarial training process, the generator improves its ability to create realisticsignals, while the discriminator hones its skills at identifying fakes. This competition allows the GAN to effectively capture the underlying patterns and complexities present in real-world signals.

RESULTS





This project explored the potential of Generative Adversarial Networks (GANs) for signal processing. We implemented a GAN architecture featuring an LSTM-based generator and a multi-layer discriminator.

[Demo Link]