Artificial Intelligence Based Dynamic Voltage Restorer

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Introduction to Dynamic Voltage Restorer (DVR)

Purpose

Corrects voltage sags and interruptions swiftly for sensitive loads.

Major Components

- Voltage Source Converter
- Energy Storage System
- Control System

Applications

- Industrial Facilities
- Commercial Buildings
- Healthcare Facilities
- Renewable Energy Integration

Fundamentals of Artificial Neural Networks

Neurons & Layers

Input, hidden, and output layers process signals with activation functions.

Weights & Biases

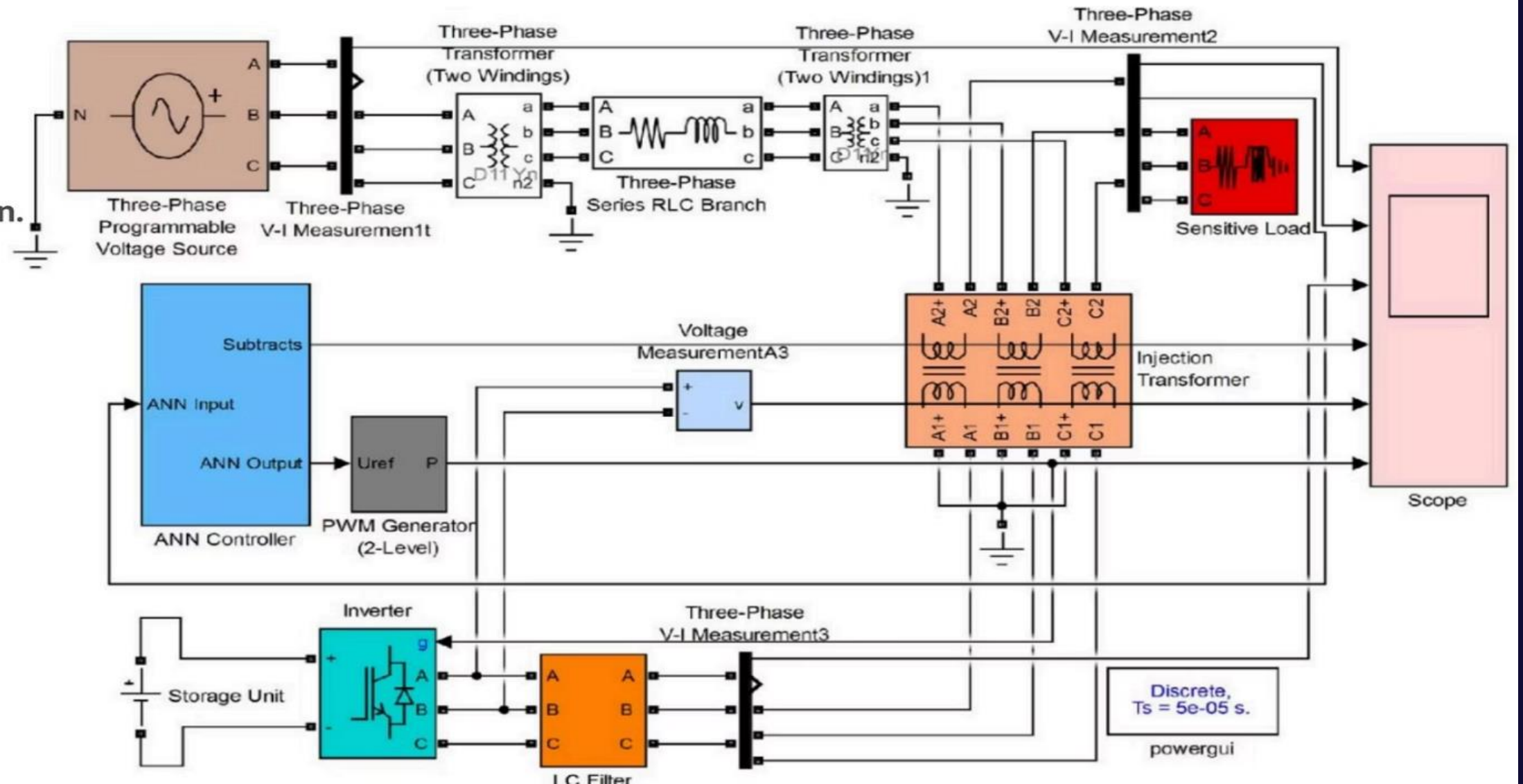Determine connection strengths and activation thresholds.

Learning Process

Feedforward propagation and backpropagation minimize prediction errors.

Conventional vs ANN–Based DVR

- **Nonlinearity Representation.**

- **Adaptive Learning.**

- **Parallel Processing.**
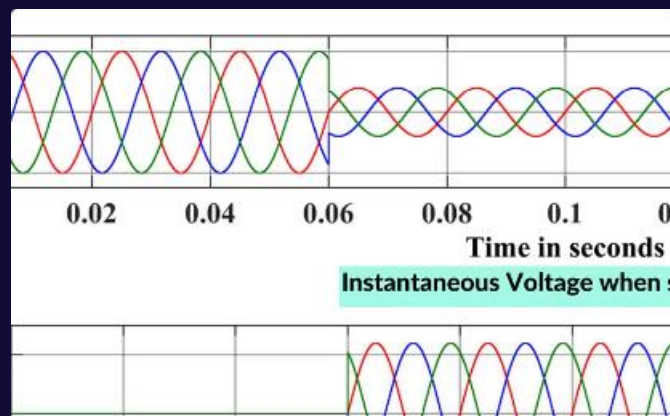
- **Robustness**

- **Generalization Ability.**

Conventional DVR
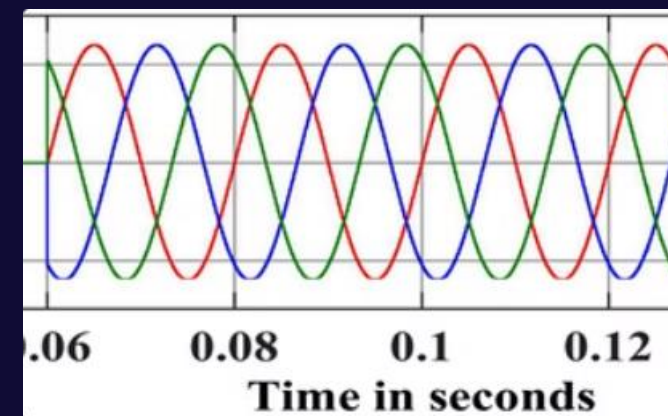- Tuning complexity
- Limited adaptability

ANN–Based DVR

Improves adaptability and control precision.
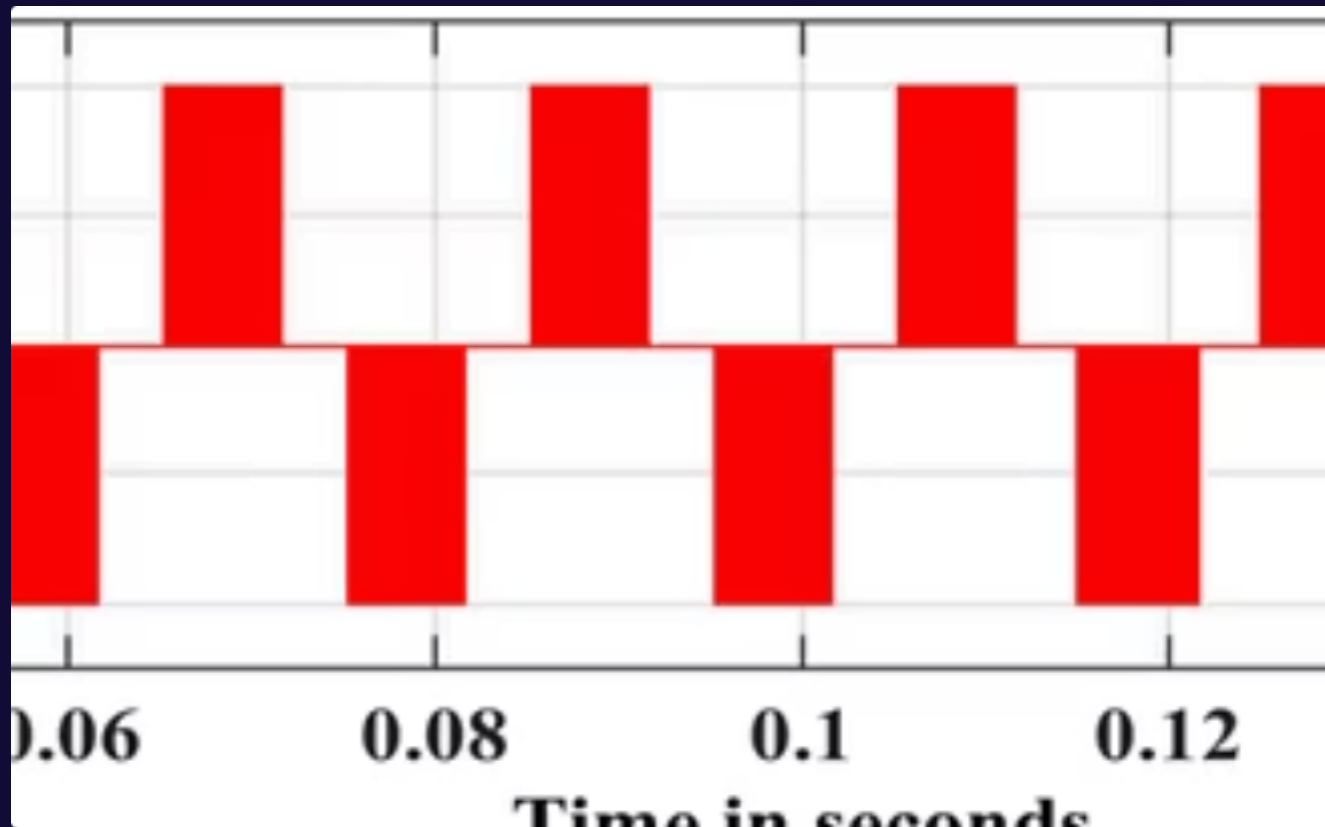
Simulation Results: Voltage Sag Mitigation
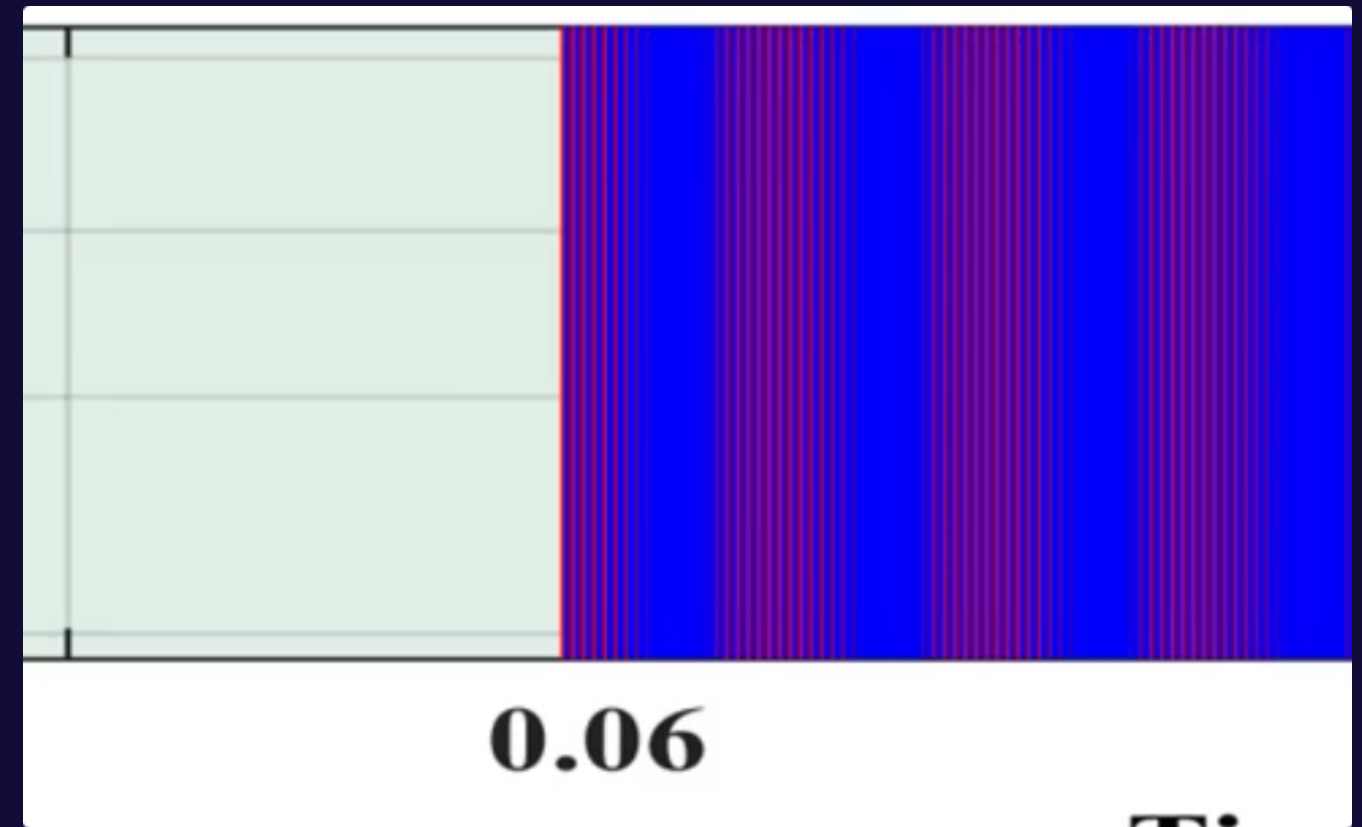

Voltage Sag Mitigation

Voltage Sag Mitigation
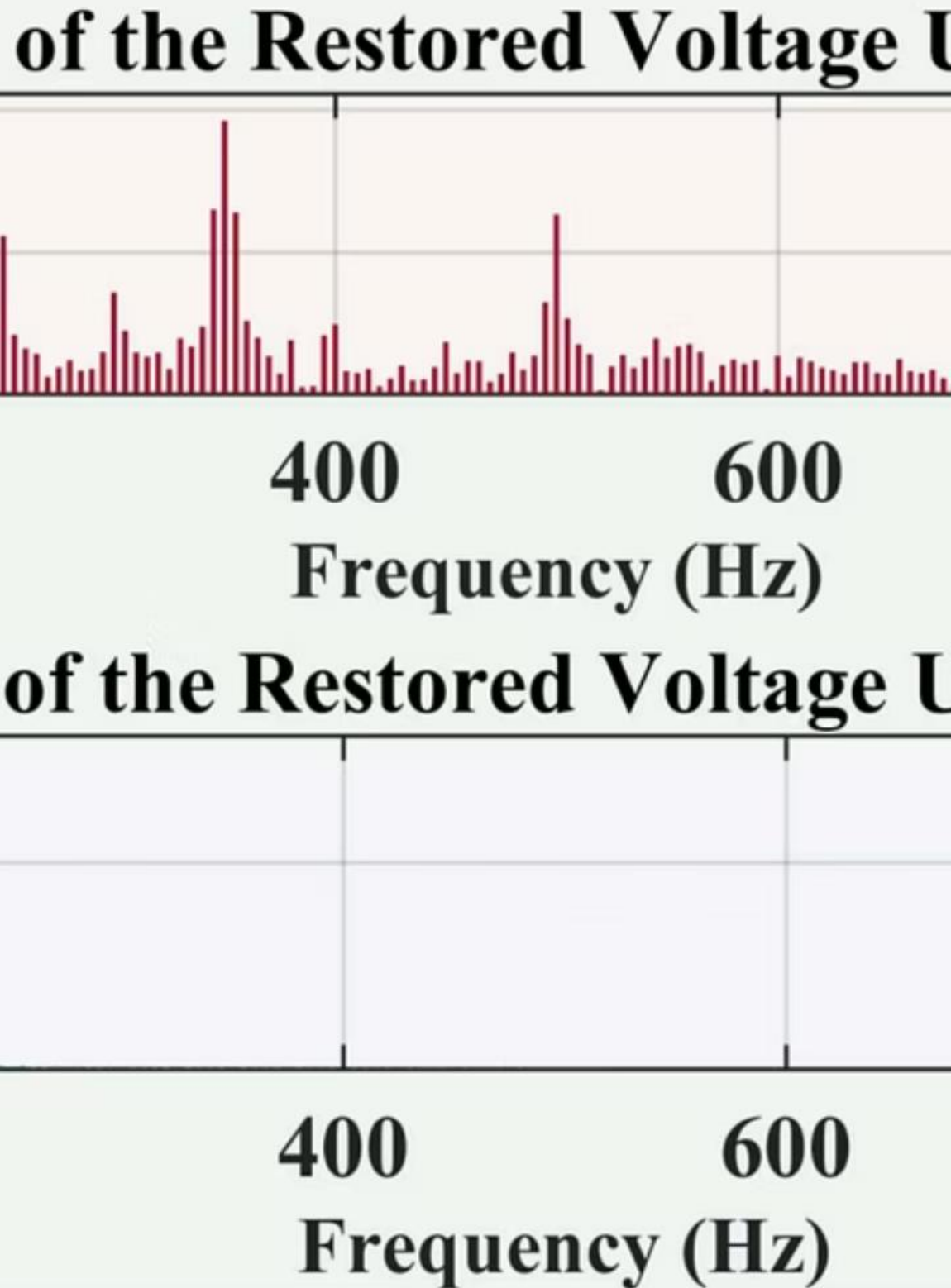
Inverter Output and PWM Generation

Inverter Output Voltage

PWM Signal Generation

Controller Performance Comparison

Parameter	ANN	PID
3-Φ Voltage Sag Restoration	99.8%	98.1%
1-Φ Voltage Sag Restoration	99.5%	98.4%
3-Φ Voltage Swell Restoration	99.6%	97%
1-Φ Voltage Swell Restoration	99.8%	98.2%
%THID Mitigation	13.5%	19.7%

of the Restored Voltage U

400   600

Frequency (Hz)

of the Restored Voltage U

400   600

Frequency (Hz)

comparision between PID and ANN co

Key Takeaways and Conclusion

ANN–Based DVR

Offers superior performance and robustness over conventional methods.

Simulation Results

Confirm high accuracy in voltage restoration and THID mitigation.

Future Applications

Ideal for sensitive industrial, commercial, and renewable energy systems.

Thank you for your attention.