SSBT's College of Engineering and Technology, Bambhori Jalgaon
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Grade A (3.14) NAAC Accredited

A Seminar on

Fault Analysis of the Power System and AI Techniques

Activity Report

Academic Year	2024-25
Program Driven by	A Seminar on Fault Analysis of the Power System and AI Techniques
Quarter	II
Program / Activity Name	A Seminar on Fault Analysis of the Power System and AI Techniques
Program Type	
Program Theme	Innovation and startups
Start Date	08-02-2025
End Date	08-02-2025
Duration of the Activity (in Mins)	60
Number of Student Participant	50
Number of Faculty Participant	70
Number of external Participant	--
Expenditure Amount in Rs.	
Any Remark	--
Mode of Session Delivery	Offline
Objective	
Benefit in terms of Learning / Skills / Knowledge obtained	
Feedback	
Video url (mp4)	
Photograph 1 (jpg)	Attached
Photograph 2 (jpg)	Attached
Overall report of the Activity (pdf)	As given below

Dr. P. H. Zope

Convener IIC

A Seminar on

Fault Analysis of the Power System and AI Techniques

Seminar on Fault Analysis of the Power System and AI Techniques

Introduction

Fault analysis in power systems is a crucial aspect of ensuring the reliability and stability of electrical networks. Power system faults, such as short circuits, open circuits, and unbalanced faults, can cause significant disruptions, leading to power outages, equipment damage, and financial losses. Traditional methods of fault detection and classification rely on analytical and numerical techniques, but with advancements in Artificial Intelligence (AI), fault analysis has become more efficient and accurate. This seminar discusses fault analysis methods and the role of AI techniques in enhancing fault diagnosis and mitigation.

Faults in Power Systems

Power system faults can be categorized into different types:

1. **Symmetrical Faults:** These include three-phase short circuits, which are rare but severe.
2. **Asymmetrical Faults:** These include single-line-to-ground (SLG), line-to-line (LL), and double-line-to-ground (DLG) faults, which occur more frequently.
3. **Open Circuit Faults:** These occur due to the disconnection of a conductor, leading to an unbalanced system operation.

Traditional Fault Analysis Techniques

1. Symmetrical Component Analysis

- Used for analyzing unbalanced faults by breaking them down into symmetrical components: positive, negative, and zero sequences.
- Helps in determining fault location and type.

2. Impedance-Based Methods

- Uses voltage and current measurements to calculate fault impedance and locate faults.
- Susceptible to errors due to varying network conditions.

3. Traveling Wave-Based Methods

- Detects faults using high-frequency transient signals generated at the point of disturbance.
- Requires fast and high-precision measurement devices.

Role of AI in Fault Analysis

AI techniques have revolutionized fault analysis by providing real-time, adaptive, and accurate fault detection and classification.

1. Machine Learning (ML) Approaches

- **Support Vector Machines (SVM):** Used for fault classification based on feature extraction from voltage and current waveforms.
- **Decision Trees:** Used for identifying fault types and locations by analyzing historical fault data.
- **Random Forests:** Improve accuracy by using multiple decision trees for fault prediction.

2. Deep Learning Techniques

- **Artificial Neural Networks (ANNs):** Model complex relationships between input parameters and fault characteristics.
- **Convolutional Neural Networks (CNNs):** Used for pattern recognition in power system signals.
- **Recurrent Neural Networks (RNNs):** Effective for time-series analysis in real-time fault detection.

3. Hybrid AI Approaches

- Combining ML and deep learning methods with traditional techniques enhances accuracy.
- Fuzzy logic and genetic algorithms optimize fault classification and location prediction.

Applications of AI in Power System Fault Analysis

- **Real-Time Monitoring:** AI-based systems continuously monitor power networks and detect anomalies.
- **Predictive Maintenance:** Machine learning models predict potential faults before they occur, reducing downtime.
- **Smart Grid Implementation:** AI aids in autonomous fault recovery and self-healing networks.
- **Energy Management:** AI optimizes load distribution to minimize fault impact.

Challenges and Future Trends

- **Data Availability:** AI models require large datasets for training, which may not always be available.
- **Computational Complexity:** Deep learning models require high processing power for real-time applications.
- **Cybersecurity Concerns:** AI-based fault detection systems need protection against cyber threats.
- **Integration with Existing Infrastructure:** AI adoption requires upgrades in traditional power systems.

Conclusion

Fault analysis in power systems is essential for ensuring reliability and preventing disruptions. While traditional methods have served well, AI techniques significantly enhance fault detection, classification, and prevention. With the rapid advancements in AI and smart grid technologies, the future of power system fault analysis will be more automated, intelligent, and efficient.

References

- IEEE Power & Energy Society papers on AI-based fault analysis.
- Recent research on machine learning applications in power systems.
- Case studies from power utilities implementing AI for fault management.


Village
Decimal
DMS
Latitude
21.014066
21°0'50" N
Longitude
75.502681
75°30'9" E