Proposal: Using Machine Learning to Detect Geomagnetically Induced Currents in Power Grids

Introduction: Geomagnetically induced currents (GICs) are a significant threat to power grids, especially during solar storms. GICs can cause negative impacts on power grid equipment and even damage the power transformers resulting in a significant risk of blackouts. Therefore, monitoring GICs in power systems and developing solutions to mitigate their impacts before rising to a certain threatening level is urgently needed. This proposal aims to use machine learning algorithms to detect GICs in power grids.

Objectives: The primary objective of this proposal is to develop a framework for detecting GICs in power transmission systems through a hybrid time-frequency analysis combined with machine learning technology. The proposed approach will analyze data from sensors and other sources to identify patterns associated with GICs.

The specific objectives of this proposal are as follows:
1. Develop a machine learning model that can accurately detect GICs in power grids.
2. Train the model using historical data on GIC events.
3. Test the model using simulated data under various grid operating conditions.
4. Evaluate the performance of the model and compare it with existing methods for detecting GICs.

Methodology: The proposed approach will use a hybrid time-frequency analysis combined with machine learning technology to detect GICs in power grids.

The methodology involves the following steps:
1. Collect data from sensors and other sources on current transformers.
2. Preprocess the data by removing noise and filtering out irrelevant information.
3. Use wavelet transform (WT) for feature extraction.
4. Train a convolutional neural network (CNN) using historical data on GIC events.
5. Test the CNN using simulated data under various grid operating conditions.
6. Evaluate the performance of the CNN by comparing it with existing methods for detecting GICs.

Expected Outcomes: The expected outcomes of this proposal are as follows:
1. A machine learning model that can accurately detect GICs in power grids.
2. Improved understanding of the patterns associated with GICs in power grids.
3. Identification of the limitations and challenges of using machine learning for GIC detection.
4. Recommendations for future research on GIC detection using machine learning.

Conclusion: This proposal aims to use machine learning algorithms to detect geomagnetically induced currents (GICs) in power grids. The proposed approach will analyze data from sensors and other sources to identify patterns associated with GICs. The expected outcomes of this proposal include a machine learning model that can accurately detect.