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# Failure Prevention and Repair for Energy Distributions

**A new network topology analysis method minimizes electrical grid failure propagation, damage costs, and repair time by strategically scheduling high-priority and impending-failure node repairs.**

The United States electrical grid is a complex system including numerous utility companies distributing power across large distances, often being bought or sold to other companies before eventually reaching the consumer. This distributed system has many lines operating at near capacity on older equipment. These factors greatly increase the probability of a node failure in the system, which can easily damage other nodes causing a cascade of node failures. Repairs to these failures in the grid are currently completed in random order. This does nothing to minimize the further propagation of failures in the grid and increases the cost of the failures.

Purdue University researchers have developed a new method for selecting the nodes to repair in an electrical grid. This method analyzes the network topology to schedule repairs in a way to minimize the damage caused and prevent additional failure. The data processing device will perform one or both of two possible sub-analyses to determine which nodes are root nodes that should have high priority for repair and which nodes may be about to experience failure that may induce failure in leaf nodes connected to it. The repairs can be done in a centralized or decentralized manner, depending on the resources available, providing a customized repair strategy for any failure. In a demonstration modeling daily activity in the Western United States power grid, the new model outperformed the current practice taking 50 percent less time to respond to and complete repairs, 80 percent less damage cost, and increased prevention of additional node failure by 300 percent.

**Advantages**:

-Customized repair strategy for any failure

-Outperforms current process

**Technology ID**

2013-NOF-66347

**Category**

Artificial Intelligence & Machine Learning/Reinforcement & Federated Learning

Energy & Power Systems/Grid Modernization & Smart Grids

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Potential Applications:

-Utility companies

**TRL:** 4

**Intellectual Property:**

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**Keywords:** electrical grid repair, network topology analysis, node failure prevention, cascade failure mitigation, customized repair strategy, power grid optimization, utility company solutions, root node priority repair, decentralized repair, damage cost reduction, Clean Energy, Computer Technology, Electrical Engineering, Network Software, Software