

# WARP: Wide Area Resilient Protection

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## Abstract:

Protective relays play a crucial role in steering the dynamics of the electric grid during stressed system conditions. However, as some blackout logs have shown, relay mis-operations during stressed conditions can trigger a cascade eventually leading to a blackout. Currently, there is no way to correct such mis-operations, should they occur. We propose the use of wide-area information to supervise relay operation, especially those attached to generator units and critical transmission lines. Our work achieves this supervision by combining dynamic state estimation (via particle filtering) and the use of energy functions (rich in system dynamics) to classify and detect global events. Ongoing work shows that this information can also be exploited to obtain look-ahead capabilities for relays which can be used to trip at opportune moments, or avert false trips when detected. Future work will quantify the degree of resilience achieved by the ability to recover or avert a cascade that would have otherwise occurred.

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