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Introduction

Fast and accurate source location is of importance for forced oscillation mitigation in interconnected power grids. This paper proposes a synthetic approach for forced oscillation source location using synchrophasor measurements. This approach uses three methods, dissipating potential-based, oscillation magnitude-based, and oscillation mode angle-based, to estimate the source location individually, and then provide the final estimation based on the weights of different methods. A tool called Forced Oscillation Localization Tool is developed, which uses voltage synchrophasor measurements for source location without knowing system topology information. The developed tool is tested with the IEEE test case library of power system sustained oscillations and an actual forced oscillation event in EI. The test results demonstrate the effectiveness of the tool in forced oscillation source location.

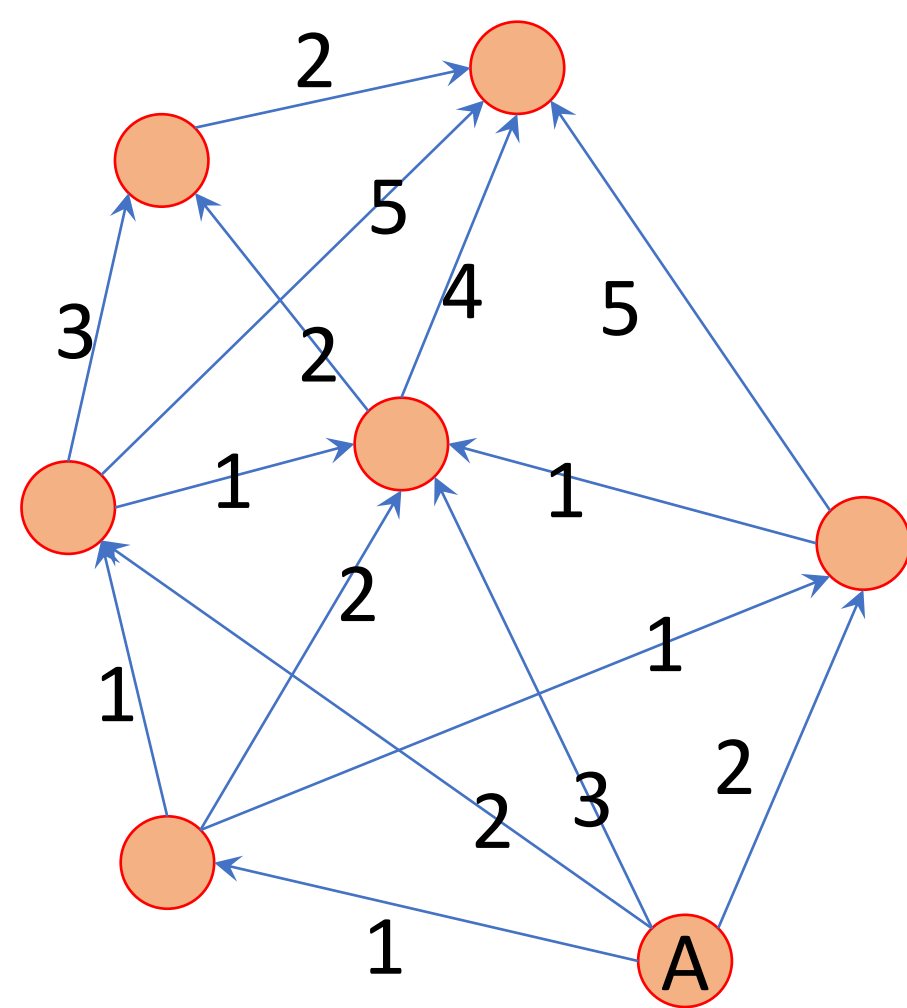
Dissipating Potential based source location algorithm

$$DE = \int (2\pi\Delta P_{ij}\Delta f_i dt + \Delta Q_{ij}d(\Delta \ln V_i))$$

Dissipating energy flow method requires real-time topology and full observation.

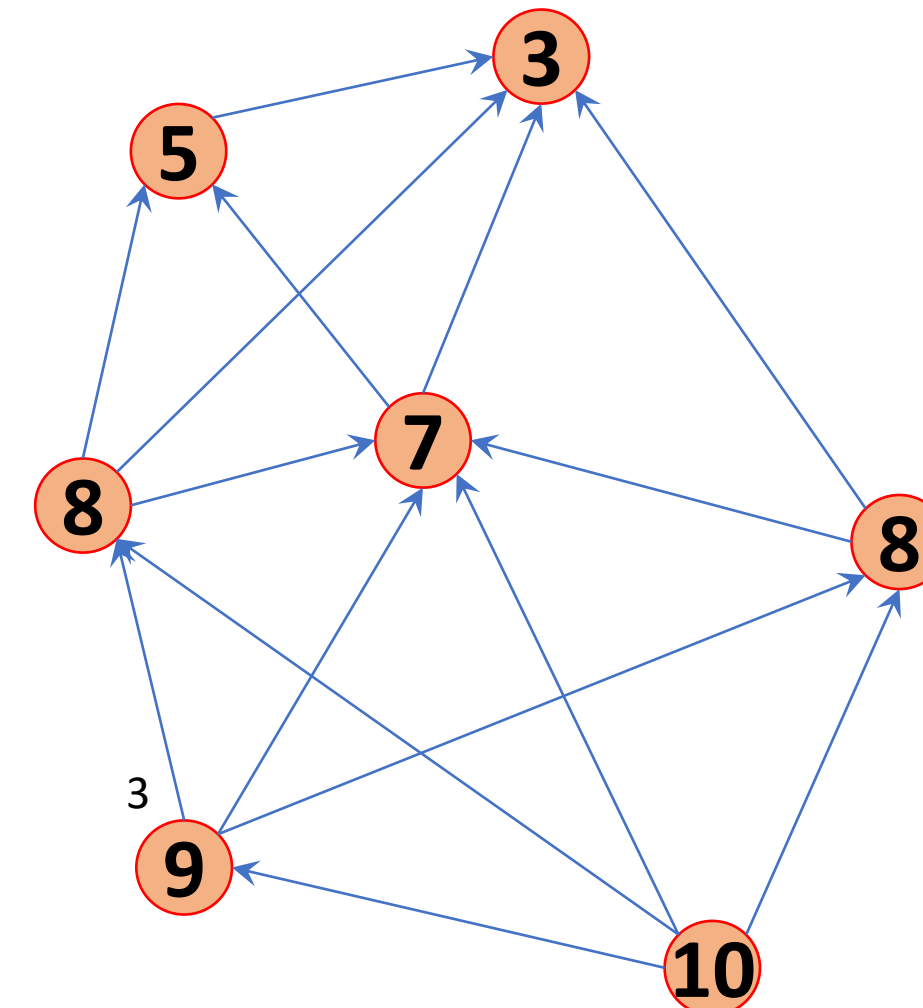
$$\rightarrow DE_{ij} \approx \sum(\Delta A_i - \Delta A_j)\Delta f_i$$

Dissipating energy flow **estimation** does NOT requires topology or grid full observation.



$$DP_i - DP_j \approx DE_{ij}$$

Find a **best set of potential** to fit the energy flow;

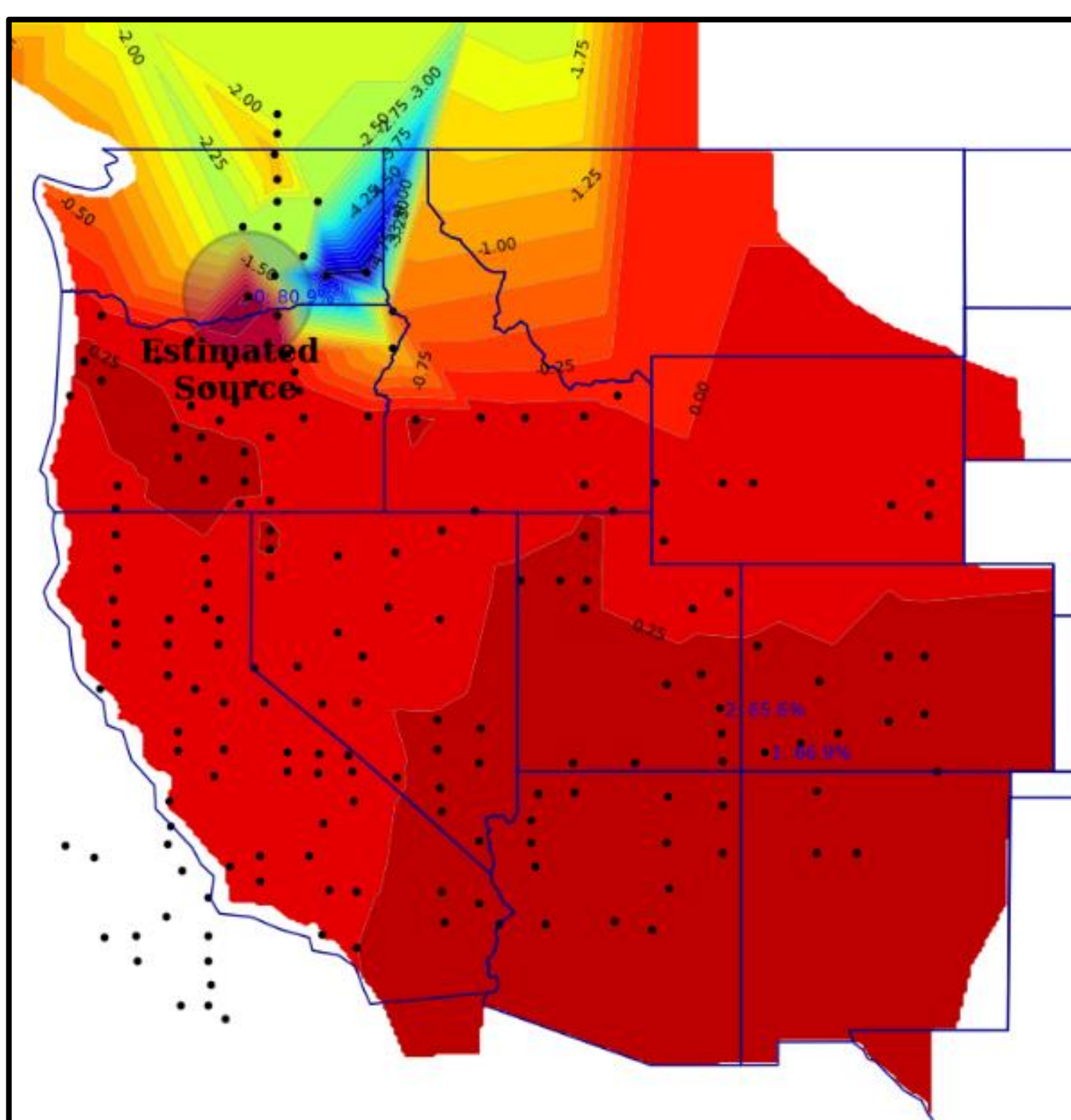


Estimated Dissipating Energy flow

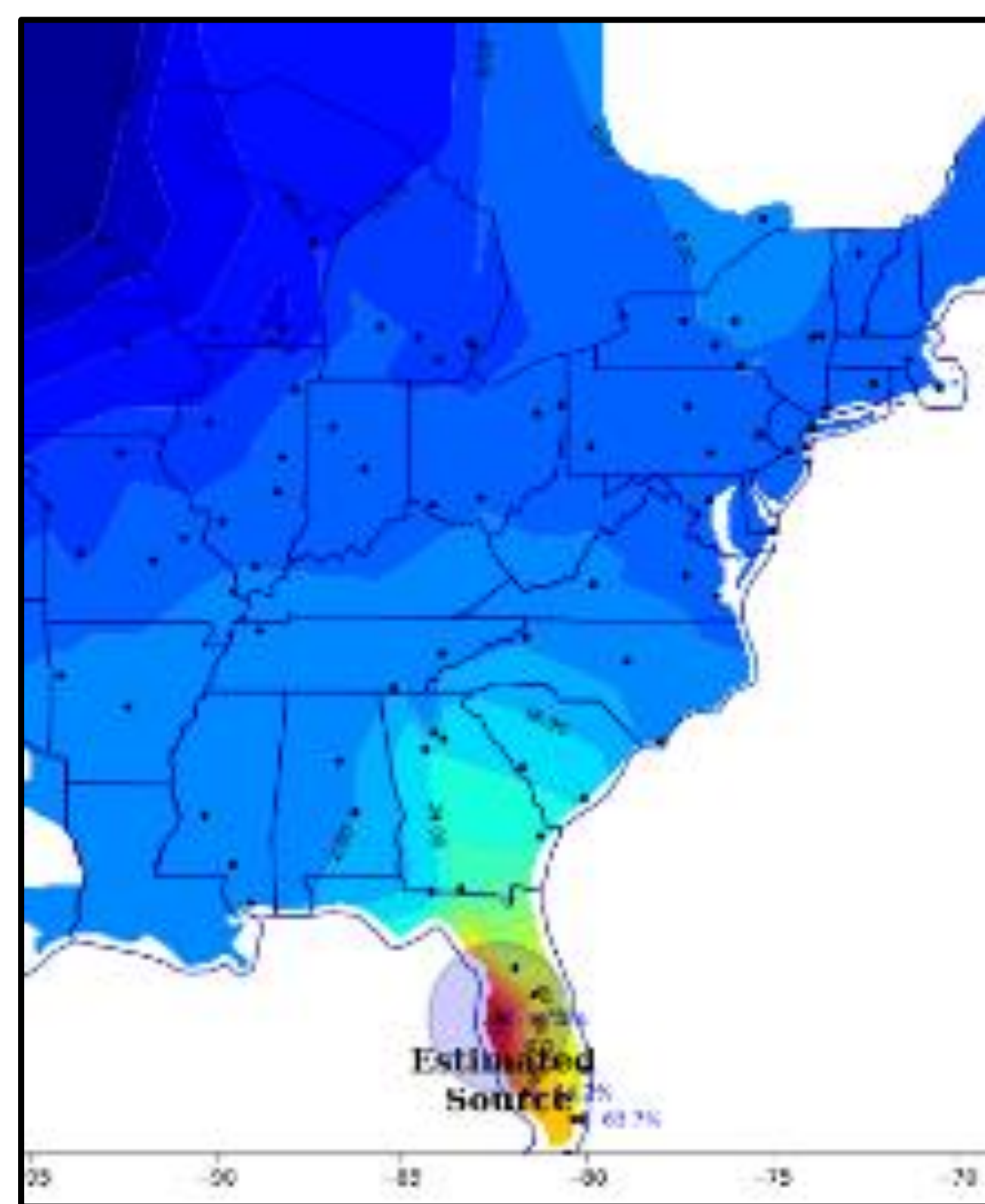
Estimated Dissipating Energy Potential

Estimate dissipating potential according to estimated dissipating energy flow.

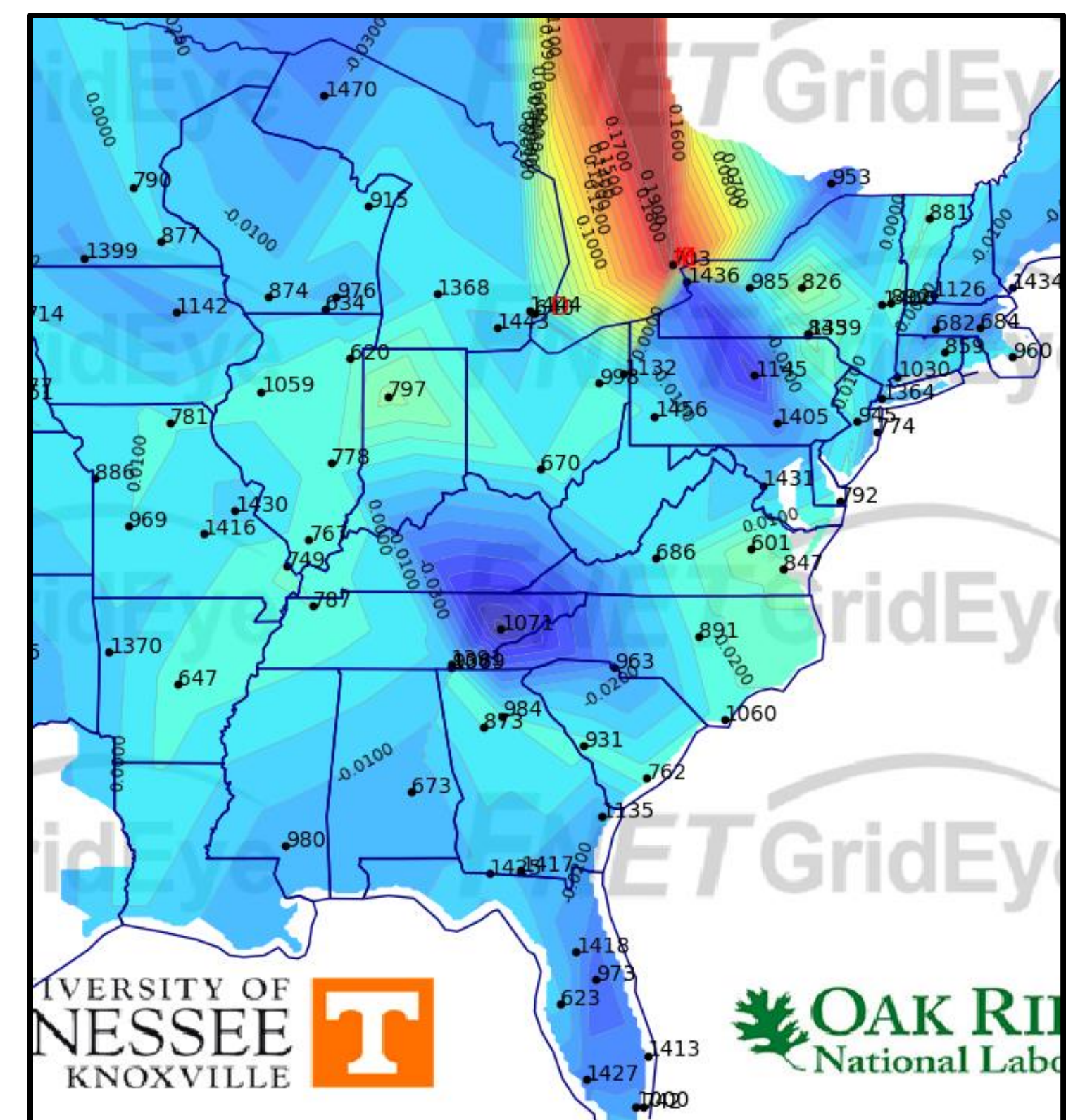
Testing with Simulation Case and Real Forced Oscillation Cases



WECC 240-bus Simulation Case



10/11/2019 EI forced oscillation event



04/2020 EI forced oscillation event

