Location Identification Of Distribution Network Events Using Synchrophasor Data

Tech ID: 32637 / UC Case 2017-862-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,211,800	12/28/2021	2017-862

FULL DESCRIPTION

Background

Electric utilities are increasingly interested in location identification of not only emergency events (such as permanent faults) but also various less severe yet informative events (such as voltage sag and swell, capacitor bank switching, load switching, transformer tap changing, and different types of incipient faults). Existing methods to identify event locations are either impedance based or based on wide area monitoring methods. The drawbacks with these approaches are that:

- They work only for severe events, mainly permanent faults.
- Results are rarely precise and highly prone to errors (for the impedance-based approach).
- They are not intended for the identification of power quality events and incipient faults.

Current Invention

UCR faculty, Prof. Hamed Mohsenian-Rad and his team, has developed an innovative algorithm, using compensation theorem, that uses synchronized voltage and current phasor measurements data from micro-phasor measurement units (micro-PMU) to identify with high accuracy the location of events in a distribution grid – with as little as 2 micro-PMUs. In addition to the data from micro-PMUs, their algorithm only requires access to basic grid topology and line impedance data – data that is readily available in the electric utility databases.
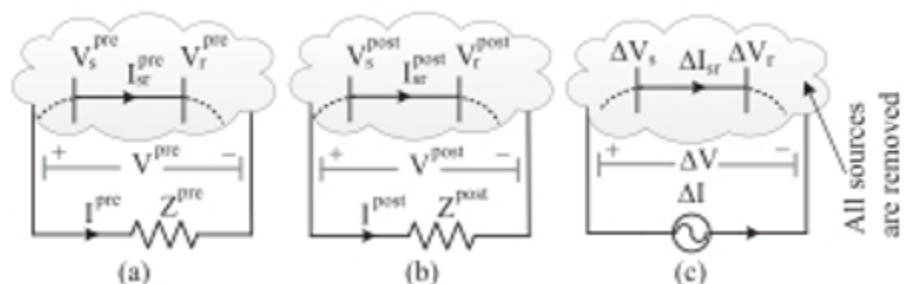

Illustration of the compensation theorem – (a) pre-event network, (b) post-event network and (c) equivalent circuit based on compensation theorem.

CONTACT

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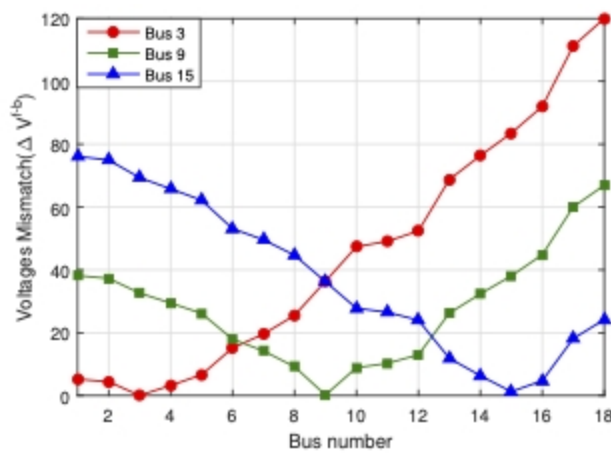venkata.krishnamurty@ucr.edu

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OTHER INFORMATION

KEYWORDS

Power distribution, Synchrophasors, Event source location, Data analytics, Smart grid

CATEGORIZED AS

▶ **Computer**
  ▶ Software
▶ **Energy**
  ▶ Transmission
▶ **Engineering**
  ▶ Engineering

RELATED CASES

2017-862-0

Results using the algorithm for 3 different events; the minimum of each curve indicates the location (bus number) of the event.

ADVANTAGES

The uniqueness or novelty of their invention is:

▶ Faster, more reliable, robust, and precise identification of events.

▶ Applicable to a wider variety of events beyond only major, permanent faults.

▶ Robust against errors in pseudo-measurements – highly important for networks with only a few micro-PMUs, and/or when the loading of network at different buses are unknown.

SUGGESTED USES

▶ Power engineering and smart grid.

▶ Data analytics in electric power distribution system management.

▶ Asset and equipment monitoring, incipient fault analysis, distribution system state estimation, event-triggered state estimation, power quality analysis, physics-informed cyber-security.

RELATED MATERIALS

▶ Location Identification of Distribution Network Events Using Synchrophasor Data - Presented at the North American Power Symposium in 2017