Fault Location Method for Distribution Networks Using Smart Meters

Sadegh Jamali, Alireza Bahmanyar, Ettore Bompard

PII: S0263-2241(17)30103-3
DOI: http://dx.doi.org/10.1016/j.measurement.2017.02.008
Reference: MEASUR 4593

To appear in: *Measurement*

Received Date: 1 November 2016
Revised Date: 1 February 2017
Accepted Date: 6 February 2017

Please cite this article as: S. Jamali, A. Bahmanyar, E. Bompard, Fault Location Method for Distribution Networks Using Smart Meters, *Measurement* (2017), doi: http://dx.doi.org/10.1016/j.measurement.2017.02.008

Fault Location Method for Distribution Networks Using Smart Meters

Sadegh Jamali[a*], Alireza Bahmanyar[b], Ettore Bompard[c]

[a,b] Centre of Excellence for Power System Automation and Operation, School of Electrical Engineering, Iran University of Science and Technology, P.O. Box: 16846-13114, Tehran, Iran
[c] Dipartimento Energia, Politecnico di Torino, Corso Duca degli Abruzzi, 24, 10129 Torino, Italy
[a*] Corresponding Author: sjamali@iust.ac.ir
[b] bahmanyar@iust.ac.ir, [c] ettore.bompard@polito.it

Abstract: The ongoing deployment of smart meters, with data processing and communication features, has provided the opportunity to improve distribution systems performance. This paper presents a state estimation-based method for fault location in distribution networks using the measurements provided by the smart meters. During the normal operation of the system, state estimation methods can handle the errors in real or pseudo-measurements to give the best estimate of the system state and to identify large measurement errors, called bad data. This concept is extended in this paper under fault conditions where the fault is considered as an unknown and temporarily connected load which can be dealt with as bad data. The proposed method uses the changeable weighting matrix bad data identification technique to find the fault location. The method is algorithmically simple and does not require the fault type. The fault location accuracy is verified by extensive simulation tests on a real 13.8 kV, 134-node distribution network for different fault scenarios. The results indicate that the method has a good performance under measurement and load data errors and for different number and locations of the smart meters in the network.

Keywords: Bad data identification; Distribution networks; Fault location; Smart meters; State estimation.

1. Introduction

It is known that over 60% of customer power outages are due to the faults on medium voltage distribution networks. In contrast to transmission lines, distribution networks have several branches and tapped laterals dispersing over vast rural and/or urban areas with much fewer measuring and relaying points. These networks are vulnerable to different types of faults arising from a variety of causes such as adverse weather conditions, equipment failure, bird contacts and vegetation growth [**1**]. In European networks, durations of supply outages are generally low, ranging from about 15 minutes to 400 minutes per customer in a year [1]; however, as societies become more dependent on electrical energy, a higher level of supply continuity is demanded. In this context, fault location offers significant benefits for distribution system operator (DSO) by narrowing down the search area to find the fault point. This potentially improves the continuity of supply and lowers the network operation costs.

Traditional fault location techniques for distribution networks are based on activities such as grouping of customer trouble calls. Then, a repair crew patrols the area looking