Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 117 (2017) 209–215

Energy Procedia

www.elsevier.com/locate/procedia

1st International Conference on Power Engineering, Computing and CONtrol, PECCON-2017, 2-4 March 2017, VIT University, Chennai Campus

Voltage Profile Assessment in Power Distribution System Using Generalized Regression Neural Network

A.ShinyPradeepa[a] C.Vaithilingam[ab]

[a]*Ph.DResrach Scholar (Part-Time),School of Electrical Engineering,VIT University,chennai.*
[ab]*Associate Professor, School of Electrical Engineering,VIT University,chennai.*

Abstract

The planning and operation of distribution system requires the values of voltage magnitude at different sections of the system. Penetration of Distributed Energy Resources (DERs) in the power system improves the voltage profile especially during the peak load periods. The DERs in the conventional power system provides more options for voltage control mechanisms. The voltage control mechanism will be chosen based on the voltage profile of a particular section during given time period. Hence it is essential to estimate and update the voltage magnitudes of the system at pre specified time intervals. Many methods have been proposed to estimate the voltage profile of a radial distribution system. This paper proposes a new method for voltage profile assessment using Generalized Regression Neural Network (GRNN). The proposed method uses the influential load as inputs to estimate the voltage magnitudes with lesser computation time.

Peer-review under responsibility of the scientific committee of the 1st International Conference on Power Engineering, Computing and CONtrol.

Keywords: Distributed Energy Resources (DERs); Generalized Regression Neural Network (GRNN); voltage control mechanisms

Corresponding Author ; *vaithilingam.c@vit.ac.in*

1. Introduction

Planning and operation of electric power system requires information about the Power flow, voltage magnitude and power loss. Load flow analysis is a basic and necessary tool for any electrical system in order to carry out steady

1876-6102 © 2017 The Authors. Published by Elsevier Ltd.
Peer-review under responsibility of the scientific committee of the 1st International Conference on Power Engineering, Computing and CONtrol.
10.1016/j.egypro.2017.05.124

state operating condition. The load flow solution provide the real (kW) and reactive power (kVAr) losses of the system and voltage magnitudes and angles at different nodes of the system subject to the regulating capability of generators, condensers and tap changing of transformers under load as well as specified net interchange between individual operating systems. These analyses require the calculation of numerous load flows for both normal and emergency operating conditions. Short circuit analysis used for calculating the switch gear rating uses the load flow studies. These studies should also be used to confirm adequate voltage profiles during different operating conditions, such as heavily loaded and lightly loaded system conditions. Load flow studies can be used to determine the optimum size and location of capacitors for power factor correction. The results of load flow studies are also starting points for other system studies. The distribution power flow involves, first of all, finding all of the node voltage as given by Short T.A. From these voltages, it is possible to directly compute currents, power flows, system losses and other steady state quantities. Some applications, especially in the fields of optimization of power system, distribution automation (i.e., VAR planning, network optimization, state estimation, etc.) need repeated fast load flow solutions. In these applications it is important that the load flow problem is solved as efficiently as possible.

A method is proposed [1] a method for estimating voltage profile of unbalanced distribution systems using backward/forward sweep load-flow analysis method with secant predictor. A method for Voltage stability analysis of radial distribution networks using catastrophe theory is given in [2] . Probabilistic voltage stability assessment considering renewable sources with the help of the PV and QV curves is proposed in [3]. Voltage stability analysis in unbalanced power systems by optimal power flow is proposed in [4]. Real-Time Voltage Regulation in Power Distribution System Using Fuzzy Control is explained in [5]. Reliability assessment of electric distribution systems using fuzzy logic is proposed in [6,7]. The conventional methods reported in the literature uses complex computation whereas the AI based methods the number of input required is proportional to the system size. In this paper GRNN based method is proposed to estimate the voltage magnitude using few influential loads as inputs. GRNN model is developed using the data obtained from simple method for distribution load flow solution which solves a simple algebraic expression of voltage magnitude. The convergence characteristics and the effect of voltage dependency are analyzed. A simple algorithm based on circuit theory using algebraic recursive expression to solve radial distribution networks. Load flow solution to distribution system is obtained by using bus injection to branch current matrix and branch current to bus voltage matrix and a simple multiplication. A Load flow technique to solve distribution networks based on sequential branch numbering scheme by considering committed loads. A backward/ forward sweep load flow solution for three phase radial distribution systems is used. A load flow solution including voltage dependent load models based on forward – backward sweep method for solving the load flow problem of a distribution system. The proposed method is tested by taking 28 bus radial distribution systems by using backward forward sweep method of load flow for radial distribution system

2. The Distribution load flow

The effective active (P_i) and reactive (Q_i) powers that of flowing through branch ‘j’ from node ‘i' to node ‘i+1’ can be calculated backwards from the last node and is given as,

$$P_i = P'_{i+1} + r_j(P'^2_{i+1} + Q'^2_{i+1}) / V'^2_{i+1} \quad (1)$$

$$Q_i = Q'_{i+1} + r_j(P'^2_{i+1} + Q'^2_{i+1}) / V'^2_{i+1} \quad (2)$$

where $P_{i'+1} = P_{i+1} + P_{L\,i+1}$ and $Q'_{i+1} = Q_{i+1} + Q_{Li+1}$

P_{Li+1} and Q_{Li+1} are loads that are connected at node ‘i+1’.

P_{i+1} and Q_{i+1} are the effective real and reactive power flows from node ‘i+1’.

The voltage magnitude and angle at each node are calculated in forward direction. Consider a voltage $V_i \; \delta_i$ at node ‘i’ and $V_{i+1} \; \delta_{i+1}$ at node ‘i+1’, then the current flowing through the branch ‘j’ having an impedance, $z_j = r_j + j$