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   Abstract (470 Kb)

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   Abstract (1176 Kb)

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Voltage Stability Assessment using Artificial Neural Network

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***Abstract*—In deregulated environment voltage stability has become very important factor for the purpose of analysis. In this paper some important features associated with voltage stability use in power system have discussed. Line Stability index is used for estimation of the maximum loadability and in other words index is used to recognise the weak bus in electrical power system. In this paper Artificial Neural Networks (ANNs) are used for assessment of voltage stability or to confirm secure and insecure mode of the power system. The input data of neural network are yield from the Newton-Raphson (NR) load flow analysis in the platform of MATLAB R2015b. The result obtained from the N-R method also validates through Feed-Forward Back Propagation (FFBP) Layer Recurrent (LR) and Radial Basis Function Network (RBFN) in terms of accuracy to foresee the status of the power system. The effectiveness of the analyzed methods is validated through IEEE 14 test system and IEEE 30 test bus system, using Fast Voltage Stability Index (FVSI).**

***Index Terms*—ANN, FVSI, FFBPN, LR, RBFN, IEEE Bus Test System, MSE, Regression.**

I. Introduction

Voltage instability is expound as the potential of the power system to maintain sustainable voltages at all buses in electrical power system under the normal as well as disruptive loading conditions such as gradually increase in load or in case of outages of any critical lines or generating units. The general attributes of voltage instability is that after the disruption the level of voltage at different locations in electrical power system moderately changes and in the future it may be near to subside. Therefore, the given voltage level itself is not a better indicator of stability so the system operator needs performance indices in online as well as offline modes to determine the collapse point and also show the present states of stability of the power system. The use of line index termed as Fast Voltage Stability Index (FVSI) in order to determine the maximum loadability as well as system healths in the power system. Analysis of voltage stability advocated by using Fast Voltage Stability Index (FVSI) to know the stress of a line in power transmission system. The reactive power at specific bus is increased until it grab the point of instability. At this condition, the load connected at the specific bus is known as maximum loadability. The maximum loadability for each load bus will be sort/arranged in ascending order with smallest value being ranked on top of the sorted list. The top rank implies the weak bus in the system that has the lowest acceptable load. The whole process is done by using offline N-R method [1].

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In this paper, Feed Forward Neural Networks are used to compute the line voltage stability index for variable load conditions. In the suggested scheme, ANN has been used to foresee the FVSI simulation results for any unknown loading scenario of the system. In the section of ANN designing, both the real and reactive load at all buses are varied randomly and assessed the performance of line voltage stability indices. The assessment of voltage stability using line voltage stability index is foist to the IEEE 14 and IEEE 30 test bus systems, and the test results are presented in Table **??** and Table II. Various analytical methods are reported in the literature [2] to measure voltage stability margin. Conventional method uses P-V and Q-V curves [3], [4] to find static voltage collapse point but this requires a large amount of computation time. Near the nose point of P-V curve, load flow diverges; this problem of diversion was solved by Continuation Power Flow (CPF) [5]. This fact motivated to the development of voltage stability indices for quick estimation of point of voltage collapse. These indices provide authentic information about the closeness of voltage collapse with locations [6]. The indices used for analysis of voltage instability may be classified as: Jacobian Matrix Based Indices [7]–[9], Bus Voltage Stability Indices [10]–[14] and Line Voltage Stability Indices [15]–[17]. Line Voltage Stability Indices can be used to find critical lines and to monitor their stressed conditions. Many other line stability indices [15]–[17] have been proposed in literature to find the current operating status of the power system. In this paper Global Voltage Stability Margin (GVSM) [18], which is a Jacobian Matrix Based Index is used to find the system health. Computation of these indices needs more time as compare to system variable based online indicators. However, jacobian based index is used for determination of stability margin.

Voltage Stability Assessment using Global Voltage Stability Margin (GVSM) and Preventive Control using SVC using N-R method discussed in [19], Radial Basis Function Neural Network (RBFNN) in [20], [21] and also discussed the Weak Bus identification using Line Stability Indices (FVSI, Lmn) with