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Abstract (470 Kb)

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Abstract (1176 Kb)

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Application of ANN for Stability Assessment of Large Power System by Post-fault Rotor Angle Measurements

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***Abstract*—Dynamic Stability Assessment (DSA) of power system is a primary requirement in operation and control. Various methods of stability assessment have been reported in the past. In this paper, an Artificial Neural Network (ANN) based supervised learning architecture is presented to assess system stability. The architecture employs the post-fault values of generator rotor angle trajectory as input and predicts the final value of the rotor angle trajectory and time at which the critical generator will cross the system stability criteria. This supervised architecture assesses the radial basis function values of the input features and train the net for a large number of operating conditions with random duration fault at all bus and lines of the system. The results are validated on IEEE 10 Generator 39 bus test system. It is observed that the results obtained from this architecture are aligned with nonlinear simulation studies. The proposed method can be a beneficial tool for decision making at energy management center.**

***Index Terms*—Artificial neural network, Coherent generator, Dynamic security assessment, Preventive control, Radial basis function, Rotor angle trajectory.**

I. Introduction

Power system has emerged from vertically integrated structure to deregulated unbundled structure. This transformation enables consumers and generators to participate in competitive business environment. The exponential increment in the power demands has made power system stability an essential criterion for every operating condition. Maintaining power quality, ensuring reliability, risk management and system security have become prominent issues in the deregulated environment. Transient stability of power system is an important denominator and defined by CIGRE committee [1] as "the ability of an electric power system, for a given initial operating condition, to regain a state of operating equilibrium after being subjected to a physical disturbance, with most system variables bounded so that practically the entire system remains intact". Stability studies can be sub divided into two categories the first one is assessment and second one is control.

In modern power systems ensuring transient stability under any unseen contingency is a challenge for system operator. This fact initiated the research in the direction of assessment methods and on the basis of the assessment, eventually leading to preventive control methods. Assessment strategies are based on the behavior of generator under contingency conditions. The behavior of generator can be recognized by its rotor angle deviation with respect to Center of Inertia (COI). On the basis of rotor angle deviations formation of coherent groups can be done. Detection of coherent groups in a power network is fulcrum of assessment methods. The generators which show similar deviations or similar time domain characteristics fall in one group. After identification of these groups, control strategies can be applied on them.

In past, various methods have been applied by researchers to assess system stability. Stability assessment oriented research is mainly based on the evaluation of the violation of the power system quantities. Some methods proposed in latest literature are based on risk or probabilistic, pattern recognition and Time Domain Simulation (TDS) techniques. In [2]–[4] a risk-based methodology was proposed. Preece Robin et. al. [2] proposed a Probabilistic Small-disturbance Security Analysis (PSSA) method with uncertainties. In this approach the Probability Density Functions (PDFs) are designed for the damping of the critical oscillatory electro mechanical modes by modeling the stochastic variation of system uncertainties. Although this paper did not give any analysis for the large disturbances. DSA is directly concern to the large disturbance. In [3] linear function based technique is used to calculate a risk based index for DSA. A new technique to identify the severity of power substation under possible operating scenarios was proposed by Da Silva et.al. [4]. The research work as presented in [5] is based on the pattern discovery based fuzzy classification. The pattern identification algorithm is modified by using centroid deviation analysis and pre-disturbance information of the training data set. This centroid deviation analysis based technique is very difficult for practical implementation.

In [6] Lyapunov stability is given for differential/algebraic models of power systems which include the effect of generator damping and nonlinear loads. Cheung et.al. [7] investigated the

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