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Implementation of an Adaptive Neural Network Identifier for Effective Control of Turbogenerators

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Abstract – This paper describes an on-line identification technique for modelling a turbogenerator system. The dynamics of a single turbogenerator infinite bus system are modelled using an Adaptive Artificial Neural Network Identifier (AANNI) based on Continually Online Training (COT). This paper goes further to show that multilayered perceptrons with deviation signals as inputs and outputs trained using the standard backpropagation algorithm retain past learned information despite COT. Simulation and practical results are presented.

Keywords: Multilayered perceptrons; artificial neural network; on-line identification; deviation signals; power plant control.

I. INTRODUCTION

Adaptive controllers for turbogenerators are usually designed using linear models. However, due to the nonlinear time varying nature of a turbogenerator, it cannot be accurately modelled as a linear system. This paper extends previous work [1] carried out using an Artificial Neural Network (ANN) to identify the speed deviations and the terminal voltage deviations of a turbogenerator infinite bus system, to now include a third parameter, namely the rotor angle and uses a bigger neural network.

Refs. [2,3] have reported that online trained Multilayer Perceptrons (MLPs) do not retain past learned information because of their key feature that the neurons are globally generalizing, with the result that a change in weights associated with a particular neuron will perturb the network response globally. This paper proves that this is only partially true. Results of simulation studies using two different sets of input and output signals for the AANNI are presented in this paper. With the first set of ANNI signals, the results are in agreement with [2,3]. For the second set of AANNI signals, the MLP network can also track, albeit with reduced accuracy, the speed deviations, the terminal voltage deviations and the rotor angle deviations of the turbogenerator even when the training is terminated and, the operating point and system topology are changed.

II. LABORATORY TURBOGENERATOR SYSTEM

The adaptive ANN identifier is tested and proved conceptually on the 3 kW micro-alternator [4] shown in Fig. 1, which is first simulated, and the simulated results are then verified by practical measurements. The micro-alternator has per-unit parameters which are typical of those normally expected of 30 – 1000 MW generators.

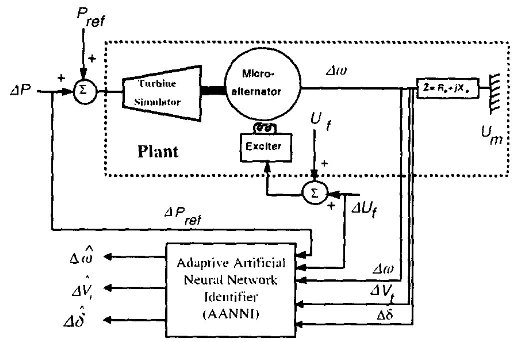

Fig.1. A laboratory single machine infinite bus system with a short transmission line and the AANNI

III. CONCLUSIONS

This paper has extended previous work [1] by adding deviation in rotor angle to deviations in speed and terminal voltage, and has shown that an adaptive artificial neural network with multilayered perceptrons can *correctly identify* the turbogenerator dynamics under different network configurations and system operating points even when the on-line training is terminated. The successful identification of the turbogenerator dynamics by the AANNI occurs because the *deviation* signals are used instead of the *actual* signals.

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