AVAILABLE TRANSFER CAPABILITY DETERMINATION USING ARTIFICIAL NEURAL NETWORK

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ABSTRACT

Open access to the transmission systems places a new emphasis on the more intensive shared use of the interconnected networks reliably by utilities and independent power producers. Therefore, as a measure of the network capability for further commercial activity over and above already committed uses, the concept of available transfer capability (ATC) was proposed and defined by the Federal Energy Regulatory Commission (FERC) in 1995. This study proposes the use of an Artificial Neural Networks (ANN) to determine ATC in an interconnected power system. The ANN is a multilayer feedforward network employing Levenberg-Marquardt training algorithm. Newton-Raphson load flow solution incorporating Continuation Power Flow (CPF) method was used to gather the training and test data. The inputs to the ANN are the load level and line flow in the power system. Only thermal limits are taken into consideration. The method was tested with 4 buses system and TNB Southern Region 25 buses system. Comparison with CPF method shows that the ANN is a feasible alternative method to determine ATC.

CONTENTS

CHAPTER I

INTRODUCTION

1.1 Background

Historically, power generation and transmission is a regulated industry. However, in the modern days, the move towards open electricity market is gaining a lot of interests in several places around the world. The move is motivated by the desire of seeking competitive prices, improved services, and better utilization of system capabilities, as promoted by the economists and political analysts. Current scenario has shown that the nature of wholesale and retail power sales and purchases are increasingly traveling beyond the political boundaries of states on the onset of competition and the need for fuel source diversification.

With the advent of open transmission access, electric power market players are striking more and more deals on an inter-regional basis exempt. Open access to the transmission systems places a new emphasis on the more intensive shared use of the interconnected networks reliably by utilities and independent power producers. The Federal Energy Regulatory Commission orders 888 and 889 [1] require that Available Transfer Capability (ATC) information be made available publicly through Open Access Same-time Information System (OASIS). Such information will help power marketers, sellers and buyers in reserving transmission services.

The North American Electric Reliability Council (NERC) had proposed and defined the term ATC in 1996 [2]. It is a measure of capability remaining in a physical transmission network for further commercial activity over and above already committed uses. The ATC depends on a number of factors such as system generation dispatch, system load level, load distribution in the network, power transfers between areas, network topology, and the limits imposed on the transmission network due to thermal, voltage and stability considerations.

The base case to compute ATC may be from real-time estimate, a contingency case, or future operating condition, taking into account Current Operating Plan (COP). Utilities must determine their ATC adequately while serving a wide range of transaction. This is to ensure that system reliability is maintained. In other words, ATC is sensitive to the changes in system condition and therefore must be continuously updated. ATC calculation is usually based on off-line computer simulation under a specific set of assumed operating condition. Several methods have been proposed to calculate the ATC including Continuation Power Flow, Linear ATC and newly developed software.

1.2 Significance of Study

Conventional methods in determining ATC involves CPF method which is iterative method. At each iteration, usually a power flow solution is required, which is an iterative method itself. Therefore, the computational time is long. For on-line application, it is vital to reduce computation time, since the ATC value need to be determined as quick as possible. Artificial Neural Networks (ANN) is a suitable alternative method. ANN will enhance the speed in calculating the ATC since no calculation based on the mathematical model of the power system is required. The ANN will read the value of parameters in the power system and outputs ATC value. Successful implementation of ANN in determining ATC will provides another promising means of ATC determination.

1.3 Objectives

The ATC definition and determination guidelines approved by NERC are used throughout this study. The objectives of this study are listed below:

1. To determine the parameters and constrains involved in ATC calculations and using them to evaluate ATC using load flow method.
2. To identify suitable structure, training algorithm and input feature of the ANN.
3. To test the ANN performance in determining ATC of never seen case (generalization).
4. To discuss the results and the potential of using ANN to determine ATC.

1.4 Scope of Study

The scope and limitation of the study are as follow:

1. The ATC determination is limited to the steady state operation of the power system.
2. The ATC determination will consider the thermal limit of transmission lines.
3. This ANN will be tested with 4 bus system and Tenaga Nasional Berhad (TNB) Southern Region 25 buses system.

1.5 Thesis Organization

This thesis is divided into six chapters. The first chapter is the introduction of the study, followed by Chapter II, which discuss the ATC concepts and definition. Chapter III covers a literature review on ATC determination methods. Chapter IV describes about the ANN implementation methodology. The result and discussion will be placed in Chapter V. The last chapter provides the conclusion of the study and suggestions for future work.

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