*Chapter 12*
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# Design of Adaptive Neuro-Fuzzy Controller for Load Frequency Control of Two-Area Power System Using Clustering Algorithm

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## ABSTRACT

To fullfil of increasing power demands and reduce carbon emission additional renewable sources of power are added to existing thermal unit. Interconnection of hydro units to existing thermal system can allow to system to operate at full capacity. The aim of this research is to study LFC by adding non-linearity's to the thermal - thermal and hydro-thermal systems. Further this work investigates the modeling of hydro thermal systems and use of Adaptive Neuro-fuzzy controllers (ANFC) in these models. Network frequency change due to change in speed, may result in loss of synchronization with the rest of power system and finally resulting in power system black-out. In this research a multi section steam turbine with re-heater was used for a single area system modeled in MATLAB, later two single area systems were combined to create a two area system, and its dynamics are studied by creating load perturbations. The proposed frequency controller was able to attain a setting time of 10 Sec which is comparatively lower than other existing speed controllers. . The time domain response result of hydropower system proves the benefit of Neuro-fuzzy system, i.e. more rapid output response and minimal overshoot.

*Keywords: Adaptive fuzzy; frequency control; fuzzy control; neuro-fuzzy control; speed control; steam turbine speed; two area system.*

## 1. INTRODUCTION

### 1.1 Overview

The steam turbine is the prime mover for synchronous generators in thermal power stations. The speed in which the turbine rotates is controlled by a governor and it associated control system, this decides the output frequency of the generator (Fig. 1). The frequency of electric power generated is related to the speed of the turbine by the expression, Ns=120 *F/P, Where, Ns is the speed of the turbine, P is the number of poles and F is the frequency.

Load Frequency Control of a power system is concerned with the following objectives:

- Match the power generation as per the load
- Maintain the System frequency (F)
- Maintain Tie line power scheduled within the restraining values

The steam inlet level is adjusted by the control value, thereby controlling the speed of the turbine. Due to the complexity involved in steam turbine control and the related electrical generator, conventional speed regulation systems can no longer afford fast dynamic response. This has led to the design of robust controllers with superior dynamic response.

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