Complex Process Control using the Adaptive Neural Fuzzy Inference System

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Abstract

Since the heat exchange system, such as the boiler of power plant, gas turbine, and radiator require an application of intelligent control system for a high rate heat efficiency and the efficiency of these systems is depended on the control methods it is important for operator to understand control system of these systems and intelligent control technologies.

In order to properly apply control equipment and intelligent technology to these process control systems, it is necessary to understand fuzzy, neural network, genetics, and immune as well as the basic aspects and operation principle of the process that relate control, interrelationships of the process characteristics, and the dynamics that are involved.

Generally, since PID controllers are used in these systems it is difficult for engineer to understand both the complex dynamics and the intelligent control method.

In this paper, we design an effective experimental system for the intelligent control education and analyze its characteristics through experimental system and each intelligent method to study how they can learn intelligent control system by experiments.

1. Introduction

The heat exchange system such as the boiler of power plant, gas turbine, and radiator require a high rate heat efficiency. but these systems are depended on the control methods.

In order to properly apply control equipment to boilers or any other heat process, it is necessary to understand the basic aspects of the process that relate control, interrelationships of the process characteristics, and the dynamics that are involved. but it is difficult to understand these complex dynamics and the tuning method of controller

For proper control applications, it is necessary to understand the objectives of the control system. In the case of steam boilers, there are two basic objectives.

1) To cause the heat exchanger to provide a continuous supply of steam at the desired condition of pressure

and temperature

2) To continuously operate the boiler at the lowest cost for fuel and other boiler inputs consistent with high level of safety and fuel boiler design life.

It is a goal in the improvement of this type of control system to minimize these interactions. This requires the development of control logic that will not only perform the control functions but will also minimize the interaction between control loops. To perform there logic functions all the basic control functions, feedback (closed-loop), feedforward (open-loop), cascade, and ratio, are used individually and linked together in any needed combination.

But the fluid systems in the complex system, such as the power plant or the chemical plant give an important play on the effect of its system. These system purify, operate for process The consumption of electrical power in these systems has a great part of its load facility.

These fluid control system is a multivariable with two input-two output. So, It is a very important for energy saving to how we control the complicated system with two inputs. The two inputs in these processes must be varied to satisfy the demand conditions of the process, and also the values of these two inputs must be kept within the settling point or the prescribed values.

There are several approaches by which this can be accomplished for controlling the fluid system, each solution having advantages and disadvantage.

In the flow control system composed of main flow lines and injection flow lines the basic control performance between flow values is determined by the full scale ranges(accuracy) of the flow measuring systems used, the structure and control algorithm of controller, and the parameter tuned.

So, there are many methods for the improved performance in parallel flow control system but very simple scheme that can be used to accomplish this control function is to permit the master controller to position a value in main flow line. This method will regulate the flow of injector in accordance with the process demand. To establish a fixed ratio between the two flow rates, each flow must be measured and then main flow signal used as a setpoint to a flow controller in the second flow line(injector). So control system between the two flow lines is cascade structure.

This method accomplishes flow control of the second flow and will therefore vary the second flow as the first flow varies. In this case the full scale ranges of the flow measuring devices should be selected to provide the desired fixed ratio between flows.

Main flow is controlled by the master controller while chemical injector flow stream is controlled in a fixed ratio to main flow by the flow controller.

The ratio of injector flow to main flow is fixed by the full scale ranges of the measuring systems. So, there are problems that cannot be changed except by changing the range of the measuring systems.

Especially, to control this fluid system effectively the flow distribution status, average velocity, viscosity, pipe diameter etc must be considered but there are many problems that don't control effectively because up to now a single loop PI controller is used in these systems.

In this paper we apply a 2-DOF(2-Degree of Freedom) PID controller to the heat exchange systems such as the power plant, boiler control systems. The 2-DOF PID controller is tuned by a neural network and a backpropagation method is used in the leaning algorithms.

2. Control method and Problems in heat exchange system