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Performance Improvement of Fuzzy Logic Controller using Neural Network

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Abstract

Classical control theory is based on the mathematical models of the physical plants. Getting an accurate model of the plant is a basic problem in designing controllers in process industries. The problems of classical control schemes can be solved by incorporating the artificial intelligence. The aim of this paper is to present a versatile technique, Fuzzy Logic which is simple and easy to understand. But the Fuzzy frame work is not formalized. An expert's knowledge is needed for the accurate tuning of Fuzzy Logic controller. This paper presents a method for tuning Fuzzy Logic controller. Tuning can be effectively done by using Neural network. In this research an attempt has been made to design a Fuzzy Logic controller for a coupled tank system, using neural network as a tuning tool. The simulation and real time responses shows the effectiveness of the proposed scheme..

Keywords: Fuzzy logic, Neural Network,Coupled Tank System

1. Introduction

Nowadays, the applications of level control in industries are growing. Most of the control loops in process control contains level control. An evaporator is one among that. In this level control is used to separate the chemical products. In the same way, mixing process also need level control for its proper working.

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Several researchers have designed controllers to solve the problem of controlling liquid level in single or multiple tank in recent years.Johanson has derived mathematical model of the quadruple tank system and designed a decentralized PI controller for this [1]. A distributed model predictive control (DMPC) system is proposed by Mehmet Mercango Z, Francis J. Doyle III [2]. The plant is divided into different nodes by making use of the physical structure and mathematical model of the plant. These nodes act as the control nodes. The plant state is calculated from the data obtained from the nodes. The control signal for the Model Predictive Controller is using these data. Model decomposing is difficult. Getting an accurate model is time consuming.

The way to solve the problems regarding control system is to incorporate the artificial intelligence in controllers [3]. Fuzzy logic controller is one among the intelligent controllers and is the exact replica of the human behaviour of the process operator [4]. Fuzzy logic controller gives the better performance than conventional controllers in case of settling time, overshoot and robustness [5]. But the designing of fuzzy logic controller is not formalized [6]. So methods for tuning Fuzzy Logic Controller are needed. In this paper, neural network [7] is used as a tuning tool for fuzzy logic controller.

This paper is organized as follows: section 2 describes the basic structure of coupled tank system, section 3describes Fuzzy logic controller, section 4 describes Neuro Fuzzy controller and conclusion is given in section 7.
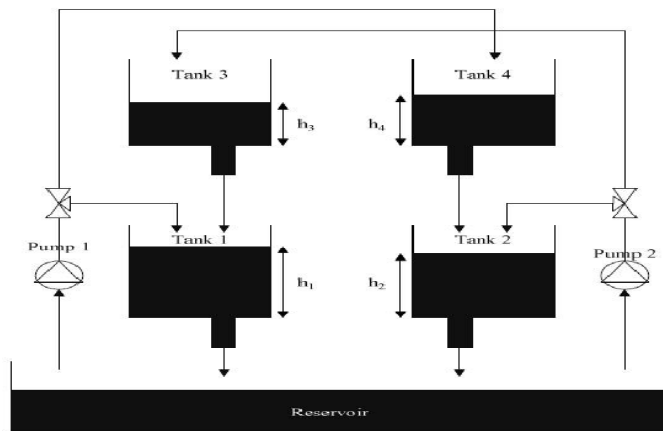

Fig 1. Coupled Tank System

Nomenclature	
E	Error
DE	Derivative Error
FLC	Fuzzy Logic Controller
NB	Negative Big
PB	Positive Big
Z	Zero