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Artificial Intelligence Techniques based on aquaculture solar thermal water heating system control

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Abstract. The One of the most promising applications of hot water is aquaculture. Temperature is one of the most principle parameters affects aquaculture life. It can cause stress and mortality or superior environment for growth and reproduction. Shrimp is warm water aquaculture type need hot water supply. To increase pond production it is necessary to keep water temperature at 34oC. Artificial intelligence (AI) techniques are becoming useful as alternate approaches to conventional techniques or as components of integrated systems. They have been used to solve complicated practical problems in various areas and are becoming more and more popular nowadays. In this paper a control system using artificial neural network control (NNC) either adaptive fuzzy logic control (AFLC) are design to control the hot water temperature. A comparison study is applied between the performance of FLC and NNC. The performance of NNC is the best because the control design takes into consideration different variables which give an accurate output than FLC. Also this paper introduces a complete mathematical modeling and MATLAB SIMULINK model for the proposed aquaculture heating system.

Key words

aquaculture, forced circulation hot water system, Artificial intelligence (AI) techniques, neural networks control, fuzzy logic control.

1. Introduction

Recently Intensive aquaculture is a modern cultivation way because it develops fast in many countries. Today, People pay more and more attention on aquaculture for its advantages of high yield, no-time-limit, low-feed and high-utilization of water and renewable energy sources [1]. The purpose for applying process control technology to aquaculture in developed countries encompasses many socioeconomic factors, including variable climate. Anticipated benefits for aquaculture process control systems are to be increased process efficiency, reduced energy and water losses, reduced labor costs, reduced stress and disease, improved accounting, improved understanding of the process [2].

The study of artificial neural networks (ANN) and fuzzy logic control (FLC) are the two major branches of intelligence control, which is based on the concept of artificial intelligence (AI). AI can be defined as computer emulation of the human thinking process. During the last ten years, there has been a substantial increase in the interest on artificial neural networks. During the last ten years, there has been a substantial increase in the interest on artificial neural networks. Specifically, they are good for tasks involving incomplete data sets, fuzzy or incomplete information and for highly complex and ill-defined problems, where humans usually decide on an intuitional basis [3-5]. In this paper the mathematical modeling of solar thermal water heating system for aquaculture pond is suggested and control of water temperature of aquaculture system is achieved using AI techniques. Finally a comparison study is applied between the performance of FLC and NNC.

2. Proposed Aquaculture System

The proposed system consists of solar collector unit to supply hot water during the day hours, biogas heater as auxiliary unit during night and cloudy days, storage tank to keep water temperature at high degree, thermostatic valve to control hot water flow rate to the pond. As depicted in Fig. 1.