DESIGN OF ACTIVE HEAT DISSIPATION SYSTEM FOR ADAPTIVE WAVELET NEURAL NETWORK CONTROL

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Abstract: This paper develops an Adaptive Wavelet Neural Network Control (AWNNC) algorithm for radar active heat dissipation system. The radar core processor belongs to a highly precision component which consists of the electronic device of radio frequency integrated circuit (RFIC) with high power and high performance. The radar core processor should be operated in a narrowly closed environment without convection, which will increase the heat sink effect inside the core processor and further affect its reliability and life-time. The AWNNC comprises a wavelet neural network (WNN) controller and a robust compensator. The WNN controller is a principal tracking controller which is utilized to mimic an ideal controller; and the parameters of WNN are online tuned by the derived adaptation laws based on the gradient descent method. The robust compensator is designed to dispel the approximation error between the ideal controller and the WNN controller, thus the asymptotic stability of the closed–loop system can be achieved. Based on National Instruments-PCI extensions for Instrumentation (NI-PXI) system, combined the Thermo Electric Cooler (TEC) with a duct heater, active heat dissipation intelligent control system is designed to fix the problem of heat dissipation in long distance in a narrowly closed environment without convection. According to the amount of thermal source and thermal energy, the smart control system can help to adjust the rate of heat dissipation by taking advantage of an adaptive control so that the performance of heat dissipation may be accumulated by its numbers. Last but not least, compared the traditional analog circuit controller with adaptive wavelet neural network controller, the research proves that its proposed active heat dissipation intelligent control system can reach an excellent and accurate temperature control. Speaking more precisely, adaptive wavelet neural network controller can be easily adaptive to any environment. It is equipped with a good capability of tracking and searching; and in terms of the effect of temperature control, it never actually jitters due to an input of voltage saturation compared with traditional analog circuit controller. All these can make chips able to adjust its adaptive rate of heat dissipation in accordance with the thermal source of the chips in a narrowly closed environment without convection.

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1. Introduction

During the past few years, neural network based on control technique has attracted increasing attentions, for it has provided an efficient and effective way for controlling the complex nonlinear or ill-defined systems. The key element to success is the approximation capabilities of the neural networks (NN). Hence, the parameterized NN can approximate any unknown system dynamics or the ideal tracking controller with arbitrarily accurate degree after learning. The basic concepts in neural network based on feedback control methods are to provide online learning algorithms that do not require preliminary offline tuning. Some of these online learning algorithms are based on the back propagation learning algorithm [3, 7], and some on the Lyapunov stability theorem [5, 8, 10, 11]. A number of researches have been done on the applications of wavelet neural networks (WNN) by combining the learning ability of NNs and the capability of wavelet decomposition [12]. Unlike the sigmoidal functions used in conventional neural networks, wavelet functions are spatially localized, so that the learning capability of WNN is more efficient than the conventional sigmoidal function neural network for system identification and control. The training algorithms for WNN typically converge in a smaller number of iterations than the conventional NNs [12]. Thus, WNN has been proved to be better than the other neural networks in that its structure can provide more potential for enriching the mapping relationship between inputs and outputs [12]. As a result, there has been considerable interest in exploring the applications of WNN to deal with the non-linearity and uncertainty of control systems [1,6]. Many experts and scholars value the neural network (NN) based on smart control strategy through promotion in recent years. NN mainly does not need an accurate mathematical model of the system. Meanwhile, it can be similar to any non-linear system with better efficiency. Among various wavelet artificial neural networks the excellent dynamic properties allow the structure to be widely used in a non-linear dynamic system for identification to assist in solving the control problem. The core idea of the research is to incorporate the wavelet theory into the traditional NN. The selection with the original NN excitation function shall be completed by a wavelet function so that it is more equipped with the capability similar to a better function. Compared with the S-excitation function, wavelet has more features shared with regional space properties. It can provide a copious input-output mapping. Therefore, it can be further applied to deal with system identification and control problem. In a non-linear ergonomic system model with time variance, the research introduces the adaptive property and learning abilities into the wavelet neural network. To build up the identification and control of a system, the research shows the input-output relation of a system so that it is believed that this method can help to improve the traditional way of identification