International Journal of Innovative Computing, Information and Control
Volume **3**, Number **4**, August **2007**

ICIC International ©2007 ISSN 1349-4198
pp. 919–935

NEURAL NETWORK BASED DIAGNOSIS SYSTEM FOR LOOPER HEIGHT CONTROLLER OF HOT STRIP MILLS

Yoshihiro Abe, Masami Konishi and Jun Imai

Graduate School of Natural Science and Technology
Okayama University
3-1-1, Tsusima-Naka, Okayama 700-8530, Japan
y-abe@cntr.elec.okayama-u.ac.jp; konishi@elec.okayama-u.ac.jp

Received October 2006; revised February 2007

Abstract. *In this study, auto tuning of PID control gains in hot strip looper controller is made based on a recurrent neural network (RNN) model. Further, a neural network emulator (Neuro emulator) is employed to model the characteristics of looper dynamics. Combining Neuro emulator and the RNN model, an auto tuning system of PID control gains is constructed. As the inputs to RNN, plural evaluation functions which reflect individual preference of human experts. Self learning mechanism is embedded in the RNN model which enables adaptation both of rolling characteristics. However, over time, deterioration of mechanical characteristics and the control system will be induced. To overcome the problem, it is necessary to diagnose the true cause of failure and to compensate for it. For this purpose, the hierarchical neural network (HNN) is built into the auto tuning of PID control gains. The HNN model, which enables compensation to the deterioration of mill system, can estimate current system parameters such as control gains and mill constants. In developing the advanced control system combining HNN, RNN and Neuro Emulator, we aim for the realization of the simultaneous operations of tuning, diagnosis and estimation of the plant like skillful human experts. Through numerical experiments, the effect of the proposed method is ascertained.*

Keywords: Looper height control, Hot strip rolling, PID control, Recurrent neural network (RNN), Hierarchical neural network (HNN), Neural network emulator (Neuro emulator)

1. **Introduction.** Recently, various kinds of industrial machines have been automated using control technologies. However, it is unavoidable that the characteristics of machines and control parameters deteriorate due to aging. Further more, it's difficult to realize full automatization of plant operation in a nonstationary condition, because the concepts of the automatization method are not established adequately. Usually, human experts work to improve the total plant performance through checking and compensating. Thus, the solution of reducing the burden of the human experts is required. With this in mind, there exist incessant requirements for automatic diagnosis and autonomous compensation for the deterioration of control performances. PID control is widely applied to plant processes and some studies have been made for the determination of PID gains [10]. The main thrust of this paper is diagnosing and tuning looper height controllers of hot strip mills, improving transient characteristics of looper movement in threading.