International Journal of Innovative
Computing, Information and Control
Volume **7**, Number **7(B)**, July **2011**

 ISSN 1349-4198
pp. 4171–4182

STUDY ON NOVEL PLASMA ARC CUTTING TECHNOLOGY BASED ON PIDNN-FUZZY CONTROLLER

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Received April 2010; revised August 2010

Abstract. *Adopting digital inverted plasma arc cutting power as a hardware platform and focusing on its strong nonlinearity and time-varying property, this paper puts forward a variable interval fuzzy-PI double-mode quantification algorithm with a self-adjustable factor in the full domain. The introduction of the PID neural network is for decoupling such parameter variables as the cutting speed and torch height in the multi-parameter hybrid coupling cutting process. This control strategy reduces the complex nonlinear system modeling and realizes real-time and effective online control for the cutting process by combining the advantages of fuzzy control and PID neural network control. Furthermore, the optimized fuzzy control improves the steady-state precision and the dynamic performance of the system simultaneously. The experimental result shows that this control improves the precision, ripples, finish and other comprehensive indexes of the workpiece compared with conventional PI control, and that plasma arc cutting power supply based on the fuzzy-neural network has excellent control performance.*
Keywords: Electric arc, Plasma arc cutting, Fuzzy control, Neural network

1. **Introduction.** Plasma cutting technology is one in which argon, nitrogen and compressed air are used to generate a plasma jet and then nonferrous metal, stainless steel and black metal are cut by the high-temperature heat of highly-compressed plasma arc and the mechanical erosion of the fast plasma jet. It has been used widely for such processes as material falling, rough machining and components stocking in the shipbuilding industry, machine manufacturing industry [1-4]. However, it is hard to establish a mathematical model to accurately describe the cutting characteristics, because the power has nonlinearity and cutting parameters have dynamic coupling and static superposition in cutting process.

In the welding and cutting field, the fuzzy neural network has been a research hotspot and achieved a lot. It combines the advantages of fuzzy inference system and neural network and is applied into process control, performance prediction and defect detection. In the work of [5], neural network-fuzzy control technology is applied into the GTAW (gas tungsten arc welding) process for studying its deep penetration modeling and control. The weld width and information about the weld seam are extracted by a model algorithm of neural network adaptive resonance theory, input into a three-layer BP neural network with the weld current, and calculated to obtain deep penetration value. Then, the difference and rate between actual and expected deep penetrations are input into fuzzy controller to adjust weld current, thereby achieving adjustment goal. Based on [5], with the addition of a genetic algorithm, the work of [6] builds a novel fuzzy-neural network controller based on the genetic algorithm with pre-obtained manual weld data. However, the huge volume and high cost of these systems limit their application.