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NEUROFUZZY DRILLING FORCE-BASED CONTROL IN AN ETHERNET-BASED APPLICATION

Agustín Gajate[1], Rodolfo E. Haber[1,2] and Raúl M. del Toro[1]

[1]Instituto de Automática Industrial
Consejo Superior de Investigaciones Científicas
Campo Real km 0.200, Arganda del Rey, Madrid E-28500, Spain
{ agajate; rhaber; rmario }@iai.csic.es

[2]Escuela Politécnica Superior
Universidad Autónoma de Madrid
Ciudad Universitaria de Cantoblanco Madrid 28049, Spain
rodolfo.haber@uam.es

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Abstract. *This paper reports on the design and implementation of a neurofuzzy system for modelling and controlling drilling processes in an Ethernet-based application. The neurofuzzy system in question is an Adaptive Network based Fuzzy Inference System (ANFIS), where fuzzy rules are obtained from input/output data. The design of the control system is based on the internal model control paradigm. The main advantages of the suggested approach are that its use of a neurofuzzy system to deal with nonlinear drilling process behaviour and process uncertainty eliminates the need for an exact mathematical model to design and tune the control system, and that it offers a simple and computationally efficient procedure for real-time applications. The results are positive in both simulation and in the real-time application of networked control. The case study indicates that the proposed method outperforms a PID control strategy and an optimal fuzzy controller. This improved behaviour is verified by several performance indices.*
Keywords: Neurofuzzy systems, Internal model control, Networked control, Ethernet, Drilling process

1. **Introduction.** The drilling process is one of the most common machining operations used in manufacturing, comprising up to 50% of all machining work [1]. Drilling has had a major impact on production technology in many industries, such as the automotive, die/mould and aerospace industries. However, it is one of the processes that has received the least attention with regard to its improvement through the application of control techniques. Any improvement through new control and monitoring systems is reflected in a higher production rate and increased economic efficiency. Indeed, advancement in new control systems can yield many benefits, such as reduced cycle time, tool breakage prevention and cost efficiency, in addition to improved part quality.

Using a network based control strategy is one way of increasing productivity and improving efficiency [2-4]. The network architecture is essential for providing the machining platform with intelligence through a networked control system (NCS); the advantages inherent in such a system are many, such as flexibility, low maintenance time and low cost. Moreover, Artificial Intelligence (AI) techniques as well as methods inspired by biology and physics are dramatically improving the methods for designing and implementing new networked control systems for improving processes [5-7]. Currently, AI based control techniques and networked control systems are being addressed separately, but methods need to be developed that exploit the synergy between artificial intelligence techniques,