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AN OPTIMAL FUZZY CONTROLLER FOR A HIGH-PERFORMANCE DRILLING PROCESS IMPLEMENTED OVER AN INDUSTRIAL NETWORK

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Abstract. *Network-based applications can provide intelligence to high-performance drilling (HPD) processes through networked control systems (NCS), with many advantages such as flexibility, and reduced maintenance time and cost. In order to improve drilling efficiency while preserving tool life, this study focuses on the design and implementation of an optimal fuzzy-control system for drilling force. This 49-rule controller is networked and operates on a computer numerical control (CNC) machine tool. It is optimally tuned using a known maximum allowable delay to deal with uncertainties in the drilling process and delays in the network-based application. Experimental results demonstrated that the proposed control strategy provides a good transient response (without overshoot) and better error-based performance indices than the CNC working alone (uncontrolled), two versions of a PID controller and a 9-rule fuzzy controller.*
Keywords: High-performance drilling process, Fuzzy control, Force

1. **Introduction.** Recent advances in communications, artificial intelligence based techniques and computing technologies have favoured an increasing trend in manufacturing towards the distribution of function and resources. Network-based control applications have been extensively applied to complex and large-scale processes. The principal characteristics of the next generation of manufacturing processes will be distinguished by four adjectives: adaptive, digital, networked and knowledge-based [1]. The link joining these characteristics is the network, which allows dynamic and value-added cooperation in a global production environment. Trends in this area have led to the use of networked intelligent control to increase productivity and performance – for example, in the high-performance machining processes which have become an integral part of manufacturing over the past decade [2].

In particular, high-performance drilling (HPD) processes have had a major impact on production technology in many areas, including the automotive, die/mould and aerospace