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A FUZZY-NEURAL SYSTEM FOR SCHEDULING A WAFER FABRICATION FACTORY

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Abstract. *This paper presents a fuzzy-neural system to further improve the performance of scheduling jobs in a wafer fabrication factory. The fuzzy-neural system is modified from the well-known FSVCT rule with three innovative treatments. First, the remaining cycle time of a job is estimated by applying Chen et al's fuzzy-neural approach to improve the estimation accuracy. Second, the components of the FSVCT rule are normalized, and then the division operator is applied instead of the traditional subtraction operator to enhance the responsiveness of the rule. Third, the content of the fuzzy-neural system can be tailored for the wafer fabrication factory and be scheduled with two adjustment factors. To evaluate the effectiveness of the proposed methodology, production simulation was applied to generate some test data. According to the experimental results, the proposed methodology outperformed nine existing approaches in reducing the cycle time average and standard deviation. In addition, the fuzzy-neural system is shown to be a Pareto optimal solution for scheduling jobs in a semiconductor manufacturing factory.*
Keywords: Wafer fabrication, Scheduling, Fuzzy, Neural, Tailored, Simulation

1. **Introduction.** The process of semiconductor manufacturing typically consists of four phases: wafer fabrication, wafer probe, assembly, and final testing. The production system of a wafer fabrication factory is a very complicated with typical characteristics such as: fluctuating demand, jobs with various product types and priorities, un-balanced capacity, reentry of jobs into machines, hundreds of processing steps, alternative machines with unequal capacity, shifting bottlenecks, and others. This makes scheduling in a wafer fabrication factory a very difficult task. For example, although Wein [1] demonstrated that a good job release policy leads to a significant improvement in the average cycle time, many wafer fabrication factories (especially foundry factories) have to release the jobs associated with an order as soon as possible after the order is received. In addition, many studies have shown that applying general scheduling rules (such as first-in first out (FIFO), earliest due date (EDD), least slack (LS), shortest processing time (SPT), shortest remaining processing time (SRPT), critical ratio (CR) FIFO+, SRPT+, and SRPT++) to a wafer fabrication factory does not lead to very good results. These scheduling rules are "deterministic", meaning that the data used in these scheduling rules (e.g. the release time, the processing time at each step, the total processing time, and the due date of a job) do not change over time. Conversely, Lu *et al.* [2] proposed two "stochastic" scheduling rules, fluctuation smoothing policy for the variance of the cycle time (FSVCT) and a fluctuation smoothing policy for a mean cycle time (FSMCT), in which the remaining