A Fuzzy-Neural Approach with Collaboration Mechanisms for Semiconductor Yield Forecasting

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ABSTRACT

Yield forecasting is critical to a semiconductor manufacturing factory. To further enhance the effectiveness of semiconductor yield forecasting, a fuzzy-neural approach with collaboration mechanisms is proposed in this study. The proposed methodology is modified from Chen and Lin’s approach by incorporating two collaboration mechanisms: favoring mechanism and disfavoring mechanism. The former helps to achieve the consensus among multiple experts to avoid the missing of actual yield, while the latter shrinks the search region to increase the probability of finding out actual yield. To evaluate the effectiveness of the proposed methodology, it was applied to some real cases. According to experimental results, the proposed methodology improved both precision and accuracy of semiconductor yield forecasting by 58% and 35%, respectively.

Keywords: Collaborative, Expert System, Fuzzy Neural, Semiconductor, Yield Forecasting

INTRODUCTION

The number one index of success in semiconductor manufacturing is yield. Although yield is not the only source of competitiveness, it does play a critical role in evaluating and improving the mid-term or long-term competitiveness (Chen & Wang, 2008).

Yield forecasting is very important to a semiconductor manufacturing factory. In capacity planning, the majority of capacity should be devoted to products with high yields and prices. Incorrectly releasing raw wafers to produce low-yield products will inevitably increase the average unit cost. Thus accurate yield forecasting is critical when making a production plan.

In order to further enhance the effectiveness of semiconductor yield forecasting, a fuzzy-neural approach with collaboration mechanisms is proposed in this study. The proposed methodology is modified from Chen and Lin’s approach (Chen & Lin, 2008) by incorporating two collaboration mechanisms:

1. Favoring mechanism: During collaborative semiconductor yield forecasting, some experts favor other experts’ opinions, and modify their previous opinions to be as close as possible. For facilitating such actions, a favoring mechanism is designed.

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A favoring mechanism helps to achieve the consensus among multiple experts, so as to avoid the missing of actual yield (see Figure 1).

(2) Disfavoring mechanism: Conversely, some experts disfavor other experts’ opinions, and modify their opinions to be as far as possible. For facilitating such actions, a disfavoring mechanism is designed. If the consensus among experts is already high, then a disfavoring mechanism helps to shrink the region of searching for actual yield, so as to improve both precision and accuracy of forecasting (see Figure 2). First, the range of a fuzzy forecast narrows as search region shrinks, which increases precision. Second, the shrinkage in search region increases the probability of finding out actual yield, which enhances accuracy.

To prove the usefulness of the proposed methodology, some real cases containing the data collected from a random access memory manufacturing factory will be investigated.

The remainder of this paper is organized as follows. The second section reviews the related work. The fuzzy-neural approach with collaboration mechanisms is then introduced in the third section. To evaluate the effectiveness of the proposed methodology, it was applied to some real cases in the fourth section. Finally, concluding remarks and directions for future research are given in the last section.

Figure 1. Effects of a favoring mechanism

Figure 2. Effects of a disfavoring mechanism
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