Pattern Classification for Partially Masked Images Using Bimodal Convolutional Neural Network

Shuen-Lin Jeng

Department of Statistics, Institute of Data Science and Center for Innovative FinTech Business Models, National Cheng Kung University

Abstract

The wafer bin map (WBM) is an image output from the sequential circuit probe test (CP) tests in the final stage of front-end process in semiconductor manufacturing. A WBM records the locations of defect chips and the types of defects. Experienced engineers are trained to examine the defect patterns of WBMs and connect possible root causes for defects with the machines or parameters in the front-end process. This is one of the crucial practices for quality and yield improvement in semiconductor manufacturing. In the early stage of manufacturing for a new chip product, the WBMs are typically masked by a lot of noise with pattern in random, specific, or both. The partially masked defect pattern in a WBM covered by the specific noise mainly dues to the consequence of the sequential CP tests. The large amount of noise in WBMs brings up a severe challenge in defect pattern classification. The other critical issue requires careful attention is caused by batch manufacturing. The typical chip manufacture is processed in batches of wafers. Certain new defect patterns of WBMs may appear in the later batches. This leads to the demand of identifying new defect pattern in the upcoming batches. We have built novel bimodal convolutional neural networks to classify the masked specific defect patterns trained by the early batches of WBMs and to identify the new masked defect patterns of WBMs in the later batches. For the WBMs masked by specific noise, an iterative interpolation is implemented to restore the masked defect pattern and a J-transform, extended from Radon transform, is used to extract the features of interpolated WBMs. The simulation data are generated by imitating the WBMs from a real batch process in semiconductor manufacturing.

Keywords: batch, convolutional neural network, image classification, masked defect pattern, Radon transform, wafer bin map