VF-P008

Recurrent Neural Network Modeling of Etch Tool Data: a Preliminary for Fault Inference via Bayesian Networks

Javeria Nawaz[1], Muhammad Zeeshan Arshad[1],Jinsu Park[2],
Sungwon Shin[2], and Sang Jeen Hong[1]

[1]Department of Electronic Engineering, Myongji University, [2]SDC EESPD Team, Bistel Inc.

With advancements in semiconductor device technologies, manufacturing processes are getting more complex and it became more difficult to maintain tighter process control. As the number of processing step increased for fabricating complex chip structure, potential fault inducing factors are prevail and their allowable margins are continuously reduced. Therefore, one of the key to success in semiconductor manufacturing is highly accurate and fast fault detection and classification at each stage to reduce any undesired variation and identify the cause of the fault. Sensors in the equipment are used to monitor the state of the process. The idea is that whenever there is a fault in the process, it appears as some variation in the output from any of the sensors monitoring the process. These sensors may refer to information about pressure, RF power or gas flow and etc. in the equipment. By relating the data from these sensors to the process condition, any abnormality in the process can be identified, but it still holds some degree of certainty. Our hypothesis in this research is to capture the features of equipment condition data from healthy process library. We can use the health data as a reference for upcoming processes and this is made possible by mathematically modeling of the acquired data. In this work we demonstrate the use of recurrent neural network (RNN) has been used. RNN is a dynamic neural network that makes the output as a function of previous inputs. In our case we have etch equipment tool set data, consisting of 22 parameters and 9 runs. This data was first synchronized using the Dynamic Time Warping (DTW) algorithm. The synchronized data from the sensors in the form of time series is then provided to RNN which trains and restructures itself according to the input and then predicts a value, one step ahead in time, which depends on the past values of data. Eight runs of process data were used to train the network, while in order to check the performance of the network, one run was used as a test input. Next, a mean squared error based probability generating function was used to assign probability of fault in each parameter by comparing the predicted and actual values of the data. In the future we will make use of the Bayesian

Networks to classify the detected faults. Bayesian Networks use directed acyclic graphs that relate different parameters through their conditional dependencies in order to find inference among them. The relationships between parameters from the data will be used to generate the structure of Bayesian Network and then posterior probability of different faults will be calculated using inference algorithms.

Keywords: Fault detection and classification, Dynamic time warping, Recurrent Neural Network