ABSTRACT

ARTIFICIAL NEURAL NETWORK APPROACHES TO DEVELOP ROBUST DIMENSIONAL DATA ANALYSIS IN AUTOMOTIVE ASSEMBLY PROCESS

by

KHI-YOUNG JANG

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Advisor: Dr. Kai Yang

Major: Industrial Engineering, Wayne State University

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With the advent of a number of technological advances in the field of measurement system in auto body assembly process, automated in-line measuring machines are capable of measuring the dimensions of every automobile Body-in-White (BIW) produced. Current PCA and SPC methods are not efficient to deal with high dimensional data and the environment where 100% data is being collected automatically in auto body assembly process. In the thesis, systematic approaches are represented for improving current data analysis using artificial neural network.

This dissertation presents the developed data analysis methodology using artificial neural network to handle huge volume of dataset for the automotive assembly process. A distinguished feature of the proposed algorithm is that it allows robust data analysis without any interruption from outliers, which can deteriorate the result of PCA in automotive assembly process. It also provides favorable solution for the calculations limitations of standard numerical algorithms in extracting principal components from dataset and for losing information due to missing data in the dataset.

This dissertation also presents the developed methodology using artificial neural network to identify nonrandom variation patterns on control chart. The proposed pattern recognition algorithms integrated with the process knowledge basis are designed not only to detect variation patterns, but also to address the identification of unacceptable variation manifested by nonrandom, or unnatural, patterns on the control chart. Once any nonrandom patterns occur on the control chart, the root causes of dimensional variations can be located systematically by investigating each possible cause based on the knowledge of the assembly process. This information will help to make process modifications that reduce dimensional variability for automotive body assembly process in real time. Therefore, it can be expected that the control chart with the proposed pattern recognition algorithm will play a more important role as a systematic diagnosis tool rather than only as a statistical monitoring tool.