Comparing Statistical Feature and Artificial Neural Networks for Control Chart Pattern Recognition: A Case Study

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Abstract. Control chart has been widely used for monitoring production process, especially in evaluating the quality performance of a product. An uncontrolled process is usually known by recognizing its chart pattern, and then performing some actions to overcome the problems. In high speed production process, real-time data is recorded and plotted almost automatically, and the control chart pattern needs to be recognized immediately for detecting any unusual process behavior. Neural networks for automatic control chart recognition have been studied in detecting its pattern. In the field of computer science, the performance of its automatic and fast recognition ability can be a substitution for a conventional method by human. Some researchers even have developed newer algorithm to increase the recognition process of this neural networks control chart. However, artificial approaches have some difficulties in implementation, especially due to its sophisticated programming algorithm. Another competing method, based on statistical feature also has been considered in recognition process. Control chart is related to applied statistical method, so it is not unreasonable if statistical properties are developed for its pattern recognition. Correlation coefficient, one of classic statistical features, can be applied in control chart recognition. It is a simpler approach than the artificial one. In this paper, the comparison between these two methods starts by evaluating the behavior of control chart time series point, and measured for its closeness to some training data that are generated by simulation and followed some unusual control chart pattern. For both methods, the performance is evaluated by comparing their ability in detecting the pattern of generated control chart points. As a sophisticated method, neural networks give better recognition ability. The statistical features method simply calculate the correlation coefficient, even with small differences in recognizing the generated pattern compared to neural networks, but provides easy interpretation to justify the unusual control chart pattern. Both methods are then applied in a case study and performances are then measured.

Keywords: Control chart, pattern recognition, neural network, correlation, back propagation

1. Introduction

One of main tools in Statistical Process Control (SPC) is control chart, which gives information of production process behaviour. Mean shift, unusual, cyclical and increasing mean patterns of the control chart could be detected as informative feedback for later improvement. Manual detection for unusual process behaviour integrated with some statistical package (i.e. Minitab or SPSS) can be handled for normal production speed, with the real-time data taken from process can be manually inputted to. Of course, for the high speed production, this semi-manual real-data input could be particular problem, especially when there are numerous data to be plotted in control chart. Automatic real-data retrieve control chart has been widely used to capture production process behaviour pattern, as developed firstly by Wiel et al. [8] that was applying visual pattern monitoring manner. As the technology increases, recent methods for recognizing the control chart pattern have been developed and replaced the manually visual monitoring way.

Artificial intelligence for pattern recognition has been being a key in the recognition process and producing many multi-discipline researches on it. Anagun [2] and Ghanim [1] have applied standard feed forward neural networks for control chart pattern recognition and showed its ability in pattern detection. Some researchers even combine neural networks optimization algorithm with some features to increase the recognition process, such as statistics Hassan et al. [5], and genetic algorithm Ebrahimzadeh and Ranaee [3]. Further, the learning process in neural networks also improved by featuring the data inputted to, see Masood and Hassan [6]. All those researches deal with the advanced method requiring complicated programming ability.