Monitoring variability in complex manufacturing process: data analysis viewpoint with application

ABSTRACT

To relate the control limits of Shewharttype chart to the p-value, the control charting techniques were constructed based on statistical inference scheme. However, in daily practice of complex process variability (CPV) monitoring operation, these limits have nothing to do with the pvalue. We cannot put any number to p. Instead, p is just read as "most probably". These words mean that in practice we are finally working under data analysis scheme instead. For this reason, in this paper we introduce the application of STATIS in CPV monitoring operation. It is a data analysis method to label the sample(s) where anomalous covariance structure occurs. This method is algebraic in nature and dominated by principal component analysis (PCA) principles. The relative position of a covariance matrix among others is visually presented along the first two eigenvalues of the so-called "scalar product matrix among covariance matrices". Its strength will be illustrated by using a real industrial example and the results, compared with those given by the current methods, are very promising. Additionally, root causes analysis is also provided. However, since STATIS is a PCA-like, it does not provide any control chart, i.e., the history of process performance. It is to label the anomalous sample(s). To the knowledge of the authors, the application of STATIS in complex statistical process control is an unprecedented. Thus, it will enrich the literature of this field.