

自我相關多變量製程之統計製程管制與工程製程管制流程

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摘要

管制圖(control chart)是業界最常用來監控制程之統計製程管制工具(Statistical Process Control, SPC)，可以有效地偵測出影響製程的非機遇原因(assignable cause)。但是當製程資料具有顯著的自我相關(autocorrelated)時，使用傳統的管制圖將會產生錯誤的訊息，造成企業成本的損失。此外，隨著科技的進步，產品的功能越來越多，一個產品往往需要同時監控數個品質特性才能確保其品質，而這些品質特性彼此間並不完全獨立。因此，如果把這些品質特性視為獨立變數而分別繪製管制圖予以監控，則誤判的機率會大為增加。在工程製程管制(Engineering Process Control, EPC)方面，當製程工程師發現製程輸出觀測值有顯著偏離目標值的情形時，大多會使用工程製程管制來進行回饋控制，以使輸出製程回歸到目標值。而在實際的高科技產業中，製程的品質特性通常均多達數十種以上，所以傳統的單變量工程製程管制方法將不再適用。因此，本研究之主要目的是針對具自我相關的多變量製程建構出一套完整的統計製程管制流程與工程製程管制流程。本研究利用倒傳遞神經網路(backpropagation neural network) 模式來處理兩個部分：1.利用此模式來求得輸出變數的殘差，接著利用殘差來建立多變量管制圖以消除自我相關性對輸出製程的影響；2.當製程發生失控的情形，利用倒傳遞網路控制器(backpropagation network controller)進行多變量製程的回饋控制，使製程量測值接近目標值。應用本研究所建立之管制流程可以提供製程工程師一套有效且準確之自我相關多變量製程管制程序。

【關鍵詞】自我相關性、多變量製程、統計製程管制、工程製程管制、倒傳遞網路預測模式、倒傳遞網路控制器

SPC and EPC Procedure for Autocorrelated Multivariate Process

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Abstract

Control chart is a popular statistical process(SPC) control tool for monitoring process. It can detect the assignable cause effectively. However, if the process has significant autocorrelation, the traditional SPC procedure would cause suspicious information. Additionally, a process usually has multiple quality characteristics related to it. These quality characteristics are correlated among each other. If monitoring these quality characteristics using individual control charts, the chance of false alarms would increase. Moreover, EPC was developed for univariate process and cannot be employed for multivariate process. This study presents an integrated SPC and EPC procedure for autocorrelated multivariate process. Backpropagation neural network model was applied in this study to 1. calculate the residual of output-variation and Hotelling's T^2 control chart of residuals was established to eliminate the autocorrelation effect; 2. When the multivariate process is out-of-control, the backpropagation network controller is utilized to adjust the process mean to the target value. This study provides an effective SPC and EPC procedure for the autocorrelated multivariate process.

【Key Words】 Autocorrelation, Multivariate Process, SPC, EPC, Backpropagation Neural Network, Backpropagation Network Controller