Integration of Sequential Process Adjustment and Process Monitoring Techniques

Rong Pan and Enrique del Castillo

Abstract

When a manufacturing process is subject to random shocks, detecting the changes in the process and adjusting an out-of-target process are two essential functions of process quality control. Traditional SPC techniques emphasize process change detection, but do not provide an explicit process adjustment method. This paper discusses a general sequential adjustment procedure based on Stochastic Approximation techniques and combines it with several commonly used control charts. The performance of these methods depends on the sensitivity of the control chart to detect shifts in the process mean, on the accuracy of the initial estimate of shift size, and on the number of sequential adjustments that are made. It is shown that sequential adjustments are superior to single adjustment strategies for almost all types of process shifts and magnitudes considered. A combined CUSUM chart used in conjunction with our sequential adjustment approach can improve the average squared deviations, the performance index considered herein, more than any other combined scheme unless the shift size is very large. The proposed integrated approach is compared to always applying a standard integral (EWMA) controller with no monitoring component. The number of adjustments in the proposed approach is justified by comparing the cost and the benefit of the adjustment. We show that this strategy – combining control charts and sequential adjustments – is recommended for monitoring and adjusting a process when random shocks occur infrequently in time.