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Optimal Design of T2 Multivariate Statistical Chart for Process Monitoring

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Abstract

The objective of this paper is to design the T^2 statistical control chart based on the economical criterion to monitor product quality of the Tennessee Eastman process. An optimization algorithm is proposed to minimize monitoring costs. A sensitivity analysis is conducted on the cost parameters of the economical algorithm to determine their effect on the cost function. The implementation of a multivariate economical criterion on the design of T^2 control chart provides an improved basis for the evaluation and repair of out of control states and result in monitoring cost minimization via optimal sampling schedules. These benefits are in addition to those that exist in the utilization of a statistical model that are currently utilized. To develop the economic design of the T^2 monitoring chart, an expected cost function pioneered by Douglas Montgomery was used in this investigation to estimate monitoring costs and optimize the upper control limit. Next the chart was modified for the Tennessee Eastman Plant and a preliminary estimate of $290 of savings per cycle was realized. Sensitivity analysis was performed on the expected cost function parameters and decision variables. Sampling costs were determined to correlate positively with cost savings per cycle, while penalty costs associated with out-of-control operation correlated negatively with savings. Analysis on the decision variable n (the number of samples per cycle), indicates that the expected cost function optimization resulted in the same convergence point; a global minimum may have been achieved.

Keywords
X-bar control charts, Multivariate model, T^2 Control Charts

Biography

M.A. Binshams holds a Bachelor degree and a Master degree in Process Engineering from the University of Bahrain and the University of Manchester, respectively. He got his Ph.D. degree in Chemical Engineering from the University of Waterloo. At Waterloo, he conducted research on Process Control and Fault detection and diagnosis. He is currently an Assistant Professor in the Department of Chemical Engineering at the University of Bahrain. He has also experience as a process engineer at Yokogawa (a leading manufacturer and supplier of industrial automation & process control, test & measurement, information systems and industrial services). His research interests are in process control, systems engineering, and fault detection and diagnosis with applications to the oil and gas industry.

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