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**New Control Charts for Monitoring Frequency and Magnitude of Critical Events**

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Abstract

Nowadays quality is an extremely important tool for satisfying customers and winning market shares. When a quality problem occurs, it is crucial to detect it quickly in order to avoid serious economic loss. Control chart is a powerful method of Statistical Process Control (SPC) to monitor and diagnose the processes.

The time-between-event (TBE) control charts are particularly effective for high yield production line with very low defect rate. Its applications can be extended to many non-manufacturing sectors, such as the healthcare industry. This research proposes several new TBE control charts to achieve the highest overall detection effectiveness. An optimal model which uses an overall performance measure, Average loss (*AL*), as the objective function is adopted to design these charts. The performance of these charts is compared with that of the most effective TBE charts that can be found in current literature. The proposed new control charts convincingly outperform the existing charts in overall detection effectiveness.

The researches fall mainly into four categories including: (1) The combination of the Shewhart T chart and CUSUM T chart; (2) The TBE charts under sampling inspection; (3) The two-sided CUSUM TBE chart; (4) The TBE charts monitoring event both frequency and magnitude. For details is followed:

1. Integrating the T chart and CUSUM T chart

While the Shewhart T chart is simple for design and implementation and has high detection effectiveness against large T shifts (change of the mean of T from its normal or in-control level), the CUSUM T charts have been well recognized to has a high detection effectiveness against small and moderate T shifts. This research combines these two kinds of charts and aims at achieving the high effectiveness.

1. Proposing the TBE control charts for sampling inspection

Almost all the TBE charts are designed for and applied to 100% inspections. But due to the inevitable limitation of resources, such as manpower and instrument, the sampling inspection is adopted to TBE charts. Also, the incorporation of curtailment technique with sequential analysis can enhance the detection effectives.

1. Modifying the two-sided CUSUM chart

This research proposes a balanced two-sided CUSUM chart to enhance the traditional two-sided CUSUM chart. The new chart has achieved the highest overall detection effectiveness through the minimization of an asymmetrical loss function.

1. Proposing new control charts for monitoring the event frequency and magnitude

This research proposes a single chart (the G chart) that is able to monitor the time interval T between two events and the magnitude X of each event. The G chart works on a synthetic statistic G that contains the information about T and X. The results show that the G chart is more effective than any other Shewhart TBE chart. Based on the Shewhart G chart, the CUSUM G chart is also proposed. This CUSUM chart stands as the best chart for detecting shifts in both *T* and *X*.

**About the speaker**

The speaker received bachelor's degree of Thermal Energy and Power Engineering, Harbin Institute Technology University, China in 2006. Then from September 2006 to July 2008, the speaker received mater's degree in Power Machinery Engineering, Harbin Institute Technology University. The speaker enrolled as a PhD candidate under the supervision of Assoc. Prof. Wu Zhang in the school of Mechanical and Aerospace Engineering, NTU in August 2008.