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Optimal constrained design of control charts using stochastic approximations

In statistical process monitoring, control charts typically depend on a set of tuning parameters besides its control limit(s). Proper selection of these tuning parameters is crucial to their performance. In a specific application, a control chart is often designed for detecting a target process distributional shift. In such cases, the tuning parameters should be chosen such that some characteristic of the out-of-control run length of the chart, such as its average, is minimized for detecting the target shift, while the control limit is set to maintain a desired in-control performance. However, explicit solutions for such a design are unavailable for most control charts, and thus numerical optimization methods are needed. In such cases, Monte Carlo-based methods are often a viable alternative for finding suitable design constants. The computational cost associated with such scenarios is often substantial, and thus computational efficiency is a key requirement. To address this problem, a two-step design based on stochastic approximations is presented, which is shown to be much more computationally efficient than some representative existing methods. A detailed discussion about the new algorithm's implementation along with some examples are provided to demonstrate the broad applicability of the proposed methodology for the optimal design of univariate and multivariate control charts.

Special/ Invited session

Classification

Both methodology and application

Keywords

Statistical process monitoring; Stochastic optimization; Control charts

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