Determining the Sample Size for Achieving Asymptotic Stability of a Multivariate EWMA Controller

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Abstract: Many semi-conductor manufacturing processes have, by nature, Multiple Input and Multiple Output (MIMO) variables. The multivariate exponentially weighted moving average (MEWMA) feedback controller, a run-to-run control scheme, can adjust such a MIMO manufacturing process. The long-term stability conditions for this closed-loop system have been suggested in literature (Tseng *et al.*, 2002). These stability conditions can be expressed in terms of the predicted model assuming that an initial process input-output (I-O) predicted model can be obtained successfully in advance. However, the predicted model is constructed by a random sample of I-O variables and, therefore the strength of the linear relationship between I-O variables plays a major role in determining the validation of these stability conditions. In order to design a stable MEWMA control scheme, the covariance structure of I-O variables and the number of experiments should be simultaneously considered. By controlling a guaranteed probability of stability, this study first derives the formula for an adequate sample size required to construct the predicted model. Illustrative examples demonstrate the effectiveness of the covariance structure of I-O variables in determining the sample size.

References

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