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A Dynamic EWMA Monitoring Scheme Incorporating Support Vector Regression and a Piecewise Linear Strategy for Variable Sample Sizes

Communication Info

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- (1) Exponentially Weighted Moving Average
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Abstract

This research proposes a novel Variable Adaptive EWMA (VAEWMA) control chart that incorporates Support Vector Regression (SVR) to improve process monitoring performance. In contrast to traditional control charts that rely on fixed or rule-based parameters, the proposed method employs a piecewise linear function—trained via SVR—to dynamically adjust sample sizes. This adaptive mechanism enhances the chart's responsiveness and accuracy in identifying shifts in the process mean. Simulation results demonstrate that the VAEWMA chart consistently outperforms conventional Adaptive EWMA (AEWMA) methods, particularly in detecting small to moderate shifts, as evidenced by reduced Average Run Lengths (ARLs), lower standard deviations of run lengths (SDRLs), and narrower run length distributions. Among the kernel functions tested, the Radial Basis Function (RBF) kernel exhibited superior performance, effectively capturing complex process behavior patterns. Additionally, the adaptive sampling strategy promotes resource efficiency by increasing sample sizes only when necessary, making the approach both sensitive and cost-effective. Overall, the proposed SVR-VAEWMA control chart offers a robust, intelligent, and flexible solution for quality monitoring in dynamic industrial environments and holds potential for future extensions incorporating other machine learning techniques or hybrid adaptive control strategies.

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