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Process Monitoring Based on Parameterless Self-Organizing Map

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Abstract : Statistical Process Control (SPC) is a popular technique for process monitoring. A widely used tool in SPC is a control chart, which is used to detect the abnormal status of a process and maintain the controlled status of the process. Traditional control charts, such as Hotelling's T2 control chart, are effective techniques to detect abnormal observations and monitor processes. However, many complicated manufacturing systems exhibit nonlinearity because of the different demands of the market. In this case, the unregulated use of a traditional linear modeling approach may not be effective. In reality, many industrial processes contain the nonlinear and time-varying properties because of the fluctuation of process raw materials, slowing shift of the set points, aging of the main process components, seasoning effects, and catalyst deactivation. The use of traditional SPC techniques with time-varying data will degrade the performance of the monitoring scheme. To address these issues, in the present study, we propose a parameterless self-organizing map (PLSOM)-based control chart. The PLSOM-based control chart not only can manage a situation where the distribution or parameter of the target observations changes, but also address the nonlinearity of modern manufacturing systems. The control limits of the proposed PLSOM chart are established by estimating the empirical level of significance on the percentile using a bootstrap method. Experimental results with simulated data and actual process data from a thin-film transistor-liquid crystal display process demonstrated the effectiveness and usefulness of the proposed chart.

Keywords : control chart, parameter-less self-organizing map, self-organizing map, time-varying property
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