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An entropy-based distribution-free approach for statistical process monitoring of industrial processes.

Statistical process monitoring (SPM) is used widely to detect changes or faults in industrial processes as quickly as possible. Most of the approaches applied in industry are based on assuming that the data follows some parametric distribution (e.g., normality). However, in industry this assumption is not always feasible and limits the application and usefulness of SPM for fault detection. In this presentation, a new method for univariate SPM is introduced based on permutation entropy (PE), which is a time series analysis tool that identifies unusual patterns in a series. PE is distribution-free and robust to outliers. The power of PE is illustrated using simulation study for different fault magnitudes and sample sizes. The simulation study confirms that PE can accurately detect shifts and deviations from in-control conditions in a process. In addition, the effectiveness of PE is discussed using the Tennessee Eastman process (TEP) as a case study for the detection of various types of faults. From the application of PE to the TEP, it is shown that that PE is effective in detecting faults in processes, even when there is no immediate change to the behaviour of the process. Therefore, the PE method can be applied practically to industrial processes for the purpose of fault detection.

Special/ Invited session

Classification

Both methodology and application

Keywords

distribution-free, permutation entropy, statistical process monitoring, Tennessee Eastman process.

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