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Decomposition of Serially Dependent Data into Static and Dynamic Latent Structures

In many industrial settings, data is collected over time causing a serial dependence among the observations. Many chemometric methods, such as Principal Component Analysis (PCA), function under the assumption of time independence. This assumption is violated for most industrial data, creating challenges for both descriptive modelling as well as fault detection.
Dynamic PCA (DPCA), which employs lagged augmentations of the data matrix to capture serial relationships, has been proposed for multivariate statistical process control (MSPC). An integral step in DPCA is the definition of the lag structure, for which multiple algorithms have been proposed. However, none of the lag selection algorithms inherently limits the number of lags, so the dimensionality of the resulting DPCA model may be inflated. Furthermore, DPCA leads to latent directions that mix static and dynamic relationships, which may complicate interpretation.
In this presentation, we propose formulating vector autoregressive models as latent directions to achieve a latent space that consists of both static and dynamic components but strictly separates them. This simplifies interpretation and limits the maximum number of latent directions. We apply the methodology to data generated from the Tennessee Eastman Process simulator.

Special/ Invited session

Classification

Mainly methodology

Keywords

Autocorrelation, Time Series, Multivariate Data

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