Documents

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Linear dynamic model identification and data reconciliation using dynamic iterative PCA (DIPCA)
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Abstract
Identification of input-output models from data is of utmost relevance in chemical process industries and has applications in process monitoring, control and fault diagnosis. Input-output data used in such identification exercises often has measurement errors in both the variables. Model identification under such conditions translates to solving an errors-in-variables (EIV) problem which is difficult to solve using classical system identification techniques. A recently proposed method - Dynamic Iterative Principal Component Analysis (DIPCA) uses PCA framework to identify the process order, delay, model parameters, and error variances. DIPCA, however, has certain shortcomings under small sample conditions which limit its practical applications. In this work, we address these shortcomings, namely ambiguity in order determination under small sample cases and arbitrary selection of stacking lag which leads to sub-optimal parameter estimates. We define a metric called 'd-selective eigenvalue ratio', or d-SEVR that sharply identifies the true order even for small sample cases. We also demonstrate the existence of an optimal stacking lag corresponding to the lowest error in estimation of error-covariance matrix. Finally, we use the identified model to obtain reconciled estimates of variables using Kalman Filter.

Author Keywords
Errors-in-variables; Identification; Kalman filter; Principal component analysis

Index Keywords
Chemical industry, Covariance matrix, Eigenvalues and eigenfunctions, Errors, Fault detection, Identification (control systems), Iterative methods, Kalman filters, Process monitoring; Chemical process industry, Data reconciliation, Error covariance matrix, Errors in variables, In-process monitoring, Linear dynamic model, Model identification, Order determination; Principal component analysis

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