A SIMPLIFIED RECURSIVE DYNAMIC PCA BASED MONITORING SCHEME FOR IMPERIAL SMELTING PROCESS

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ABSTRACT. Imperial Smelting Process (ISP) is one of the main methods for Zinc and Lead smelting. Its operating conditions change very frequently due to the changes of work points, which always lead to false alarms. We focus on this issue and present a recursive Dynamic PCA (RPCA) based monitoring scheme for ISP to adapt process changes. We present a simplified RPCA algorithm based on first-order perturbation analysis (FOP), which is a rank-one update of eigenvalues and their corresponding eigenvectors of an observation covariance matrix. The computation cost is greatly decreased. We also present two new statistics for process monitoring in ISP to avoid numerical computation difficulty induced by the traditional statistics. Finally, we apply the proposed method to real data from ISP. The results show that the proposed scheme can be able to eliminate false alarms and detect faults efficiently.

Keywords: Recursive principal component analysis, Imperial smelting process, Fault detection, First-order perturbation analysis

1. Introduction. Imperial Smelting Process (ISP) is one of the main methods for Zinc and Lead smelting, the objective of which is to obtain maximal output, especially the maximal zinc output because zinc is more expensive than lead [1]. There are so many abnormal conditions or faults in the process because its operational conditions change very frequently, so it is very important to online detect the abnormal conditions or faults of the process. Over the past two decades, model based fault diagnosis techniques have made significant progress and received considerable attention in both research and application domains. It is most important for model based fault diagnosis to obtain a mathematic model, for example observer based scheme or Markove model based scheme for fault detection [2, 3]. However, ISP is such a complex process that we cannot build mathematical model for process monitoring and fault diagnosis (PM-FD). Fortunately, there is huge data collected and stored in this process, and lots of data-driven methods are used for