ON-LINE FAULT DETECTION ON A PILOT FLOTATION COLUMN USING LINEAR PCA MODELS

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ABSTRACT

On-line fault detection, for instrumentation and process operation, has become important part of industrial programs leading to improve process operation and therefore product quality over time. Today, great amount of process variables are routinely collected at high frequency by Distributed Control Systems (DCS). However, many variables, mainly related to the quality of a product, such as the concentrate grade and process recovery in the flotation processes are infrequently available. High problem dimensionality, highly correlated process input variables, rather low signal/noise ratios and missing data are some of the main difficulties found in modelling the process for monitoring and diagnosis purposes. Multivariate statistical projection methods, such as Principal Component Analysis (PCA), have been proposed to effectively deal with these situations.

In this work, a pilot flotation column is operated under distributed control of froth depth, gas holdup and bias, to experimentally collect operation data at steady state, to build a PCA model. The basic control is implemented in a PLC, and all data is communicated to a PC network for displaying and further processing, under Intouch software. The column is operated in a hybrid form, for the air water system, while concentrate and tailing grades are obtained by on line predictions by using a static metallurgical model. A steady state on-line detector has been implemented on the PC to test when the collected data met the requirements to be used to build a PCA model.

A PCA model, with 6 principal components, was found to explain almost 92% of the variability observed in the collected data. When the operating data collected on line passes the steady state test, the data is used to estimate the Hotteling T^2 and Q residual statistics. These values are compared to those limit values found when the PCA model was built. By these means, instrumentation failure or abnormal operating conditions can be detected. Furthermore, the implemented test is able to identify the combination of variable deviations causing the problem. Several examples are discussed, detecting both particular instrumentation failures and abnormal operating conditions, and how using the system suggestions the metallurgical objectives of the process are met again.