

Hierarchical multivariate analysis of cockle phenomena

The phenomena called *cockle* are small wrinkles on the paper surface that appear during paper production. This condition poses significant economic and operability problems in the production of magazine paper as it deteriorates the printability of the paper. There are many and varied sources that can lead to cockle and their detection is often very complicated. In this work, a multivariate hierarchical approach is proposed to analyze the cause of cockle. The hierarchy has two levels, the first level is a 3-way decomposition and analysis of the data collected from sections of a paper machine. The second level is a two-way decomposition and analysis between the combined loadings from the 3-way decomposition and the measured cockle data. The results show that this approach is capable of identifying the important process sections and process variables, in spite of the large dimensionality of the problem. Data analyzed from two real industrial paper machines, involving several grades of paper, are used to demonstrate the proposed hierarchical approach.

KEYWORDS: Tucker3, PARAFAC, PLS, Monitoring, Paper machine

1 INTRODUCTION

The cockle phenomena are known to occur during the production of some lightweight papers such as coated magazine paper in the industrial case studied. Cockle are represented by machine direction oriented small wrinkles, usually much longer than wider, that occur on the paper surface. The