Title:
Combined stability analysis of wet end processes and quality parameters as a tool for improving paper quality uniformity

Background/Problem area
In view of increasing machine speeds and the demands for consistently high efficiency, the stability of paper production processes is gaining increasing importance. Good process stabilization allows high process flexibility to be achieved. First of all, a stable process is a precondition for producing paper within accepted quality tolerances. All relevant paper quality parameters can be affected by instabilities. Causes can often be found in the wet end. The frequency of typical paper machine disturbances ranges from $10^{-3}$ to $10^3$ Hz.

Objectives/Research results
The combined stability analysis of wet end processes and selected paper quality parameters aims at increasing the uniformity of product quality parameters in the machine direction. As a result, the share of low quality production and the probability of process disturbances are reduced. The aim of the systematic combination of stability analyses from the sub-hertz up to the 1000 hertz range as a structured chain of analytical methods is to increase the transparency of complex error chains and their causality in papermaking.

In the research project, tools for stability analysis were chosen and combined with each other. They were tested for functionality, validity and efficiency. Different data sources from reference productions for graphical paper lines were recorded: offline high resolution paper quality data (TAPIO analysis), machinery vibration and pulsation signals, DCS and QCS data and rotating equipment circumferences. Furthermore, controller inputs and outputs were scanned for control loop performance. Frequency analysis computations for up to 350 process signals for one paper machine were performed automatically, evaluated and visualized in a parameter-frequency synopsis diagram. In this way, correlations between periodic process fluctuations (e.g. roll shaft damage, couch pit periodic dumping and additive dosage periodicity) and paper quality were revealed.

Application/Economic benefits
The stability of the paper production process is gaining increasing importance. It is a precondition for producing within specification. Furthermore, reduced quality variations allow decreasing safety margins in terms of resources applied, e.g. fibre stock amount or drying energy. The methodology developed establishes a cost-effective way to stabilize process management and product quality with a significant savings potential. A structured and target-oriented methodology for optimizing stability is of great importance especially for SMEs since these enterprises usually do not own extensive process sensor systems. However, they often produce specialty papers which demand high quality standards.

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Remarks
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