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**Research area: Genaral aims**

Production economy // Monitoring and control systems

**Key words:**

Near infrared spectroscopy, chemical imaging, paper analysis

**TITLE:**

## Application of Near Infrared Chemical Imaging Techniques to Paper Analysis

### Background/Problem area

Spectral Imaging, also called Chemical Imaging, is a new emerging analytical technique that integrates conventional imaging and spectroscopy. By combining the chemical selectivity of vibrational spectroscopy with the spatial information of image visualisation, spectral imaging enables a more complete evaluation and description of the composition of material samples. Using this technique the commonly asked analytical questions: what chemical substances are in a sample, how much of each is present and most importantly where are they located, can be answered by only one measurement.

Near infrared (NIR) spectral imaging is especially suited for the analysis of paper and paper board samples. The NIR measurements in reflectance mode are fast, they need no or minimal sample preparation and they are non-destructive. Modern NIR cameras with a broad spectral range (up to 2300 nm) are able to measure large areas of paper samples with high speed and with a high spatial resolution at the range of microns. Thus, this new spectroscopic method meets the two important demands on analytical measurements for the analysis and quality control of large surfaces on paper and board products: 1. direct and fast measurements and 2. selective analysis in high spatial or lateral resolution.

### Objectives/Research results

The NIR measurements will be performed by means of a NIR camera KUSTA2.2MSI (LLA Instruments GmbH) having a spectral range from 1229 to 2157 nm. The InGaAs detector of the camera has 320 spatial pixels and 256 spectral pixels resulting in a spectral resolution of about 4 nm. The used frame frequency is 160 Hz. The resulting spatial resolution can be up to 150 µm.

The following subjects have been investigated:

- Determination of resolution and detection limits of NIR Imaging on paper systems
- Development of measurement methods for precise, reproducible and representative analysis results
- Development of two standard analysis methods for
  - Detection, identification and quantification of particles in paper
  - Coating analysis and evaluation (spatial distribution of coating components)
- Development of other chemometric analysis software tools for classification and quantification of components in paper

The results of the project were presented at the 16th International Conference on Near Infrared Spectroscopy NIR 2013 at La Grande Miotte (France) from 2 to 7 June 2103. The title of the presentation was "Applications of NIR Spectral Imaging Techniques to Paper Analysis".

### Application/Economic benefits

The use of the NIR imaging technique for the micro analysis of paper offers new promising possibilities to investigate the distribution of chemical particles and components in paper and to evaluate coatings. Until now, NIR imaging has mostly been used for product and process control in the pharmaceutical industry. Applications in the paper industry still have to be explored and developed.

The imaging technique represents a major enhancement to the capabilities of conventional NIR spectroscopy through the introduction of lateral dimensions with a high density of spectral and chemical information. The use of these information will be the key to the understanding of the bulk chemical and physical properties of paper products and consequently how these parameters influence their intended functionality.

**Period of time: 01.01.2012 – 31.12.2013**

### Remarks

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