REAL-TIME OBJECT ANALYSIS USING HYPERSPECTRAL IMAGING SENSORS

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INTRODUCTION

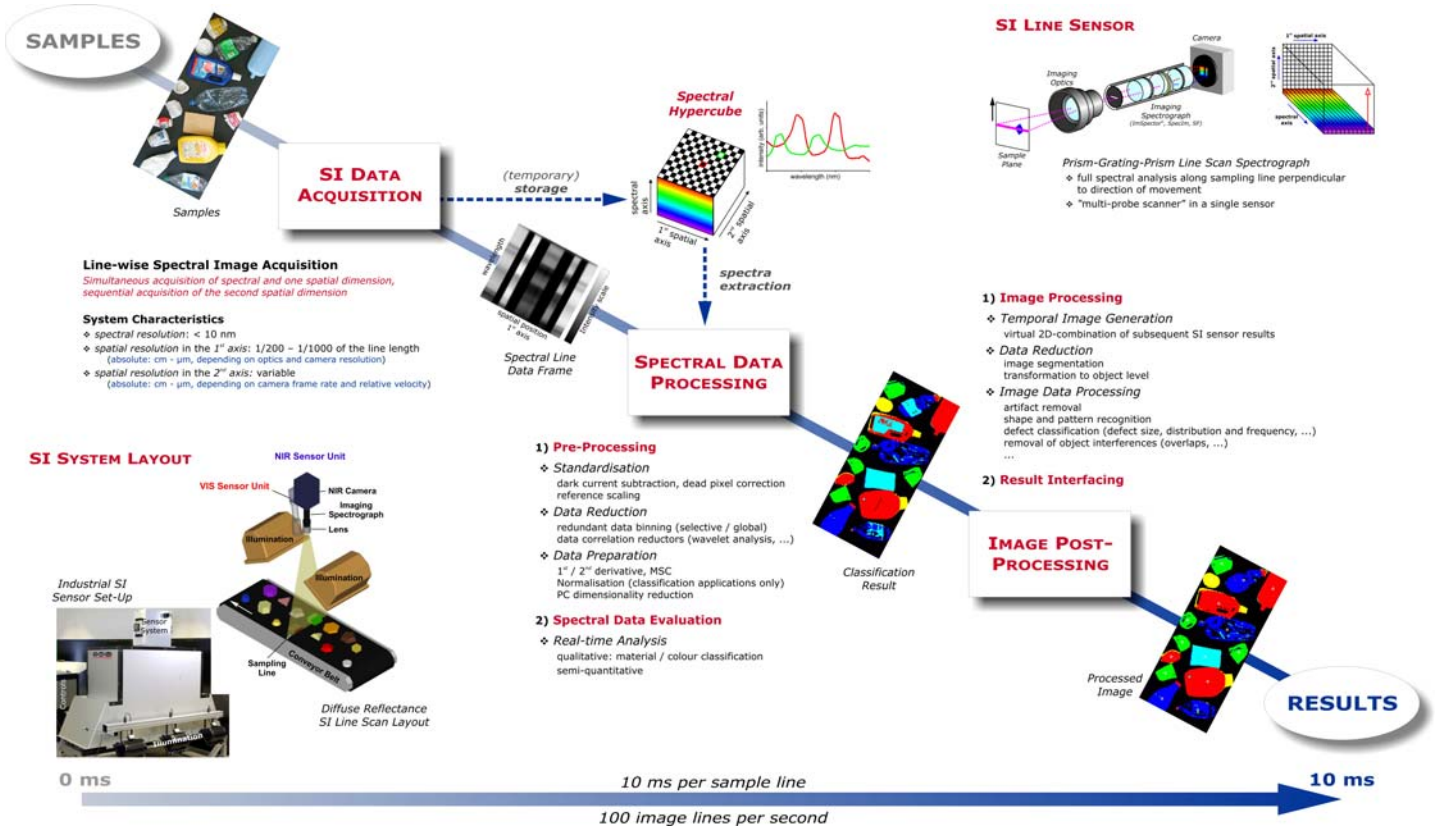
Most optical chemical sensors are restricted to single-point analysis. When measuring - potentially - inhomogeneous or overlapping samples, this results in an inherent uncertainty concerning the reliability of the results. Hence, for such applications systems capable of spatially distributed or resolved sensing would clearly have a significant advantage over traditional point probes. An occasionally used workaround would be sample mapping, using one or a few single point sensors. This method is flexible but time-consuming and hence unsuitable for (industrial) applications requiring real-time response.

Here, **Spectral Imaging sensors** can fill the gap.

Spectral Imaging (**SI**) simultaneously provides spectral and spatial information of the investigated object. Of the two fundamental principles, in particular **spatial scanning SI** has proven to be highly suitable for real-time sensor applications.

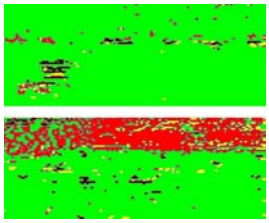
Based on an imaging line spectrograph in combination with a spectrally matched camera, these sensors are capable of scanning moving samples in real time with high spectral and 2-D spatial resolution. The method is basically suitable for the whole optical wavelength range, from the UV to the MIR, and can be operated in transmission, transflection, specular reflection or, most importantly, diffuse reflection layouts.

REAL-TIME SI SENSING



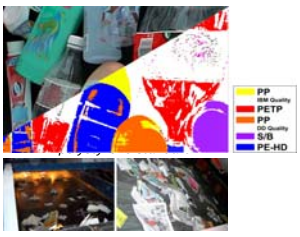
EXEMPLARY SI SENSOR APPLICATIONS

QUALITY CONTROL



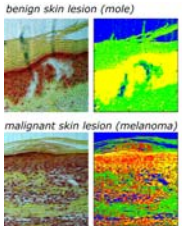
On-line defect classification and tracing: organic two-component coating on metal sheet substrate; *NIR transflection*

WASTE RECYCLING



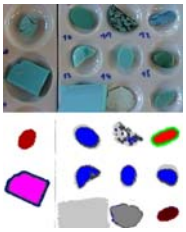
On-line material-specific classification and sorting: automatic material sorter for plastic and/or paper waste; *NIR diffuse reflection*

MEDICAL DIAGNOSTICS



Histology & tissue diagnostics: objectified detection of cancerous and pre-cancerous areas in tissue slide preparations; *VIS transmission*

MINERALOGY



Off-line material analytics: material and homogeneity analysis of turquoise samples; *NIR + VIS diffuse reflection*

CONCLUSION

The combination of hyperspectral imaging hardware with fast and powerful data processing algorithms enables real-time sensing in two spatial dimensions at high spectral and spatial resolution with a single sensor system. SI sensors provide a wealth of information inaccessible by any other sensing method, rendering them a valuable tool for process control and material analysis of (potentially) inhomogeneous samples, both on the micro- and the macro-scale.

At present, VIS systems and near-IR sensors are prevalently used, with the scope of applications ranging from sensors for fully automatic waste-sorting machines over bio-medical diagnosis systems to 100% quality control.

OUTLOOK

With automatic waste sorters based on the shown line-scan SI sensor principle already commercially available, ongoing work focuses on further applications and system improvement, in particular

- non-invasive in-vivo diagnostics
- quality control applications: foodstuff, pharmaceuticals, ...
- optimisation of spectral data pre-processing and evaluation routines
- implementation of advanced image processing methods
- extension of the spectral range towards UV / fluorescence and SW-MIR