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1 *HawkSpex®, a flexibly configurable hyperspectral camera. Photo: Udo Seiffert*

# HAWKSPEX®: A FLEXIBLY CONFIGURABLE HYPERSPECTRAL CAMERA


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Quality assurance frequently entails specific, clearly defined and recurring measuring tasks for manufacturers. Raw coffee during roasting, preprocessed meat during sausage production or recyclables in waste management – primary, semi-finished and finished products as well as different production systems make different demands on measurement systems. Generally, they can be met with hyperspectral cameras.

The sensors used can, however, only be optimized for spectral and/or spatial resolution to a limited extent when universal hyperspectral cameras are employed. Flexible configuration of these parameters as part of a solution customized for the concrete measuring task would be desirable.

## Information from Light: Spectral Fingerprints

Hyperspectral imaging can be used, for instance, when the chemical composition is of interest for quality assurance. HawkSpex® employs the principle of spectral analysis of continuously distributed light reflected by the surface of the objects measured. This spatially resolved, quantitative analysis factors in the objects' locally variable chemical composition.

Object reflectance contains a molecule-specific spectrally encoded absorption pattern. A special combination of optical elements transmits the absorbed light to a light-sensitive chip where the intensity of the light is correlated to spectrally resolved information as a wavelength, just as our namesake Joseph von Fraunhofer established. The correlation of intensity and wavelength is characteristic of the chemical composition

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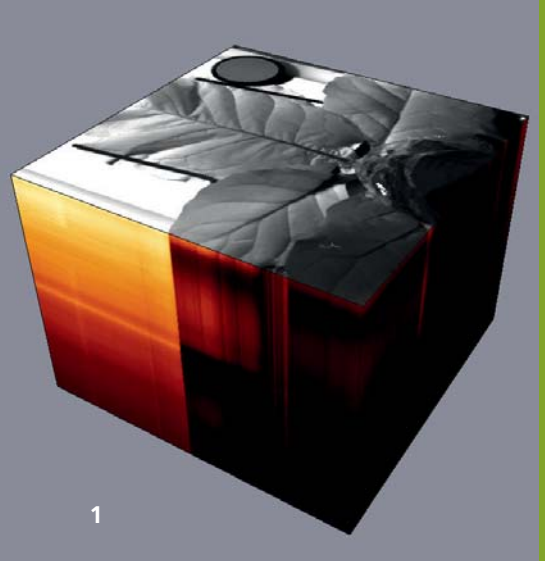

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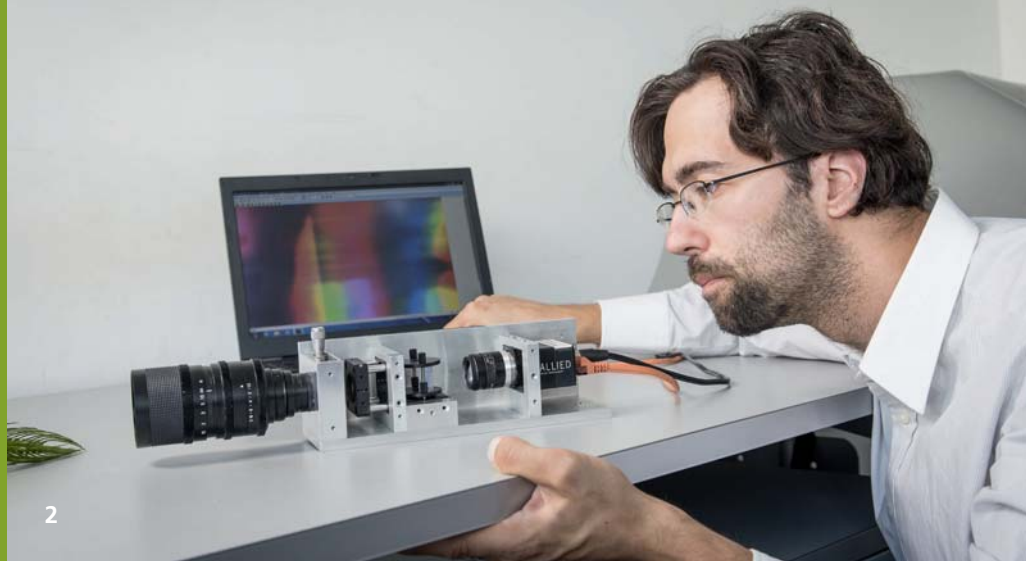

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of a point on the reflective surface. In short, different ranges of the spectrum can be correlated to the classes of substances measured – the spectral fingerprint is produced.

## Smart Evaluation of Spectral Fingerprints

The correlation between the spectral fingerprint and the desired target is usually non-trivial. Thus, it cannot be covered by simple calibration methods such as two-point measurement of selected spectral channels.

That is why the Fraunhofer IFF relies on solutions from the field of machine learning. The measuring task is completed by combining reference readings taken one time, e.g. material categories and laboratory results, and supporting information from experts in adaptive systems. The modeling is driven entirely by measured data and does not need any other assumptions for the measuring task. The analysis of the reference data additionally provides information on the range of the spectrum required by the sensor. Building upon this, the optical architecture of HawkSpex® is modified for the spectral alignment of the bands absorbed and the analysis software is modified for the specific measuring task – thus eliminating unnecessarily recorded data.

## Flexible Architecture: For Your Measurement Needs

The range of the spectrum and the spectral distribution of the absorbed bands can be configured virtually as desired by exchanging the dispersing element. Spectral parameters, resolution and luminous intensity can thus be selected before a HawkSpex® is built.

What is more, HawkSpex® has a compact, lightweight design. The anodized aluminum housing is mechanically stable and looks elegant.

## Versatility: More Than Color and Shape

A custom hardware and software solution, the HawkSpex® camera system has versatile uses from classifying different materials to grading, e.g. for quality assurance in production or waste management, through quantifying the material composition of a product or a material by means of optical chemometrics.

As your technology partner, the Fraunhofer IFF will help you develop and validate a HawkSpex® camera system modified for your measurement needs, from the first feasibility study through its prototyping and implementation in your production system.

## HawkSpex® – Benefits at a Glance

1. Optical chemometrics: Measurement of the chemical composition of substance with optical measurements.
2. Material identification: Classification of materials with information beyond the three channel color information of CCD chips.
3. Integration: The compact and robust camera system is integrated in the production process.
4. Online: Results of measurements are delivered in real time for existing data acquisition and control systems.
5. Non-invasiveness: The method of measurement does not affect your product.
6. Optimization: You get a measurement system with hardware and software customized to your needs.

*1 Hyperspectral data structure: The two-dimensional local information is available in a multitude of spectral channels.*
*2 Fine adjustment of the optical elements configured for a specific client. Photo: Dirk Mahler*