



1 Orthophoto of Heligoland.

2 Automatically marked area with artificial turf.

3 Automatically marked vegetation.

CLASSIFICATION OF HYPERSPECTRAL IMAGE SEQUENCES IN REALTIME

Background

The human eye perceives the electromagnetic spectrum with three broad band photoreceptors (red, green, blue). With this information the human can differentiate objects and materials by color and geometry. In contrast hyperspectral sensors sample certain ranges of the electromagnetic spectrum with many narrow bands. Thereby they allow to infer subtle material differences even if they affect only a narrow wavelength range.

The use of hyperspectral data for contactless material analysis is very promising because the high spectral resolution allows a robust differentiation between visually similar materials. Hyperspectral data analysis often represents large challenges for the evaluator. The more specific the problem, the less he can use standard methods from available analysis software. Their robustness and therefore acceptable results suffer with increasing complexity of the task. The analysis software developed by the Fraunhofer IOSB alleviates this and results in a considerable performance improvement.

The use of modern hyperspectral cameras in conjunction with efficient and innovative evaluation methods allows the analysis of material properties as well as a user friendly visualization. Thereby it is possible to supervise production processes as a whole and conduct condition and quality surveys. Applications are possible for example in the building inspection, remote sensing, medicine or assembly line production.

Evaluation System

- Hyperspectral video camera from Cubert GmbH
- Realtime enabled evaluation of hyperspectral video sequences

Optimal classification possible by manual readjusting of parameters

- Immediate visualization after parameter adjustment
- Intuitive handling without need for expert knowledge

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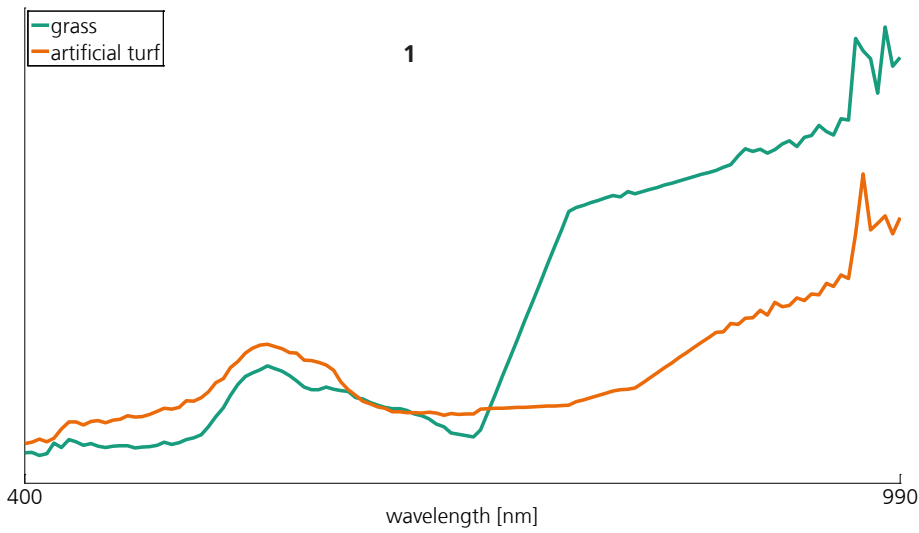
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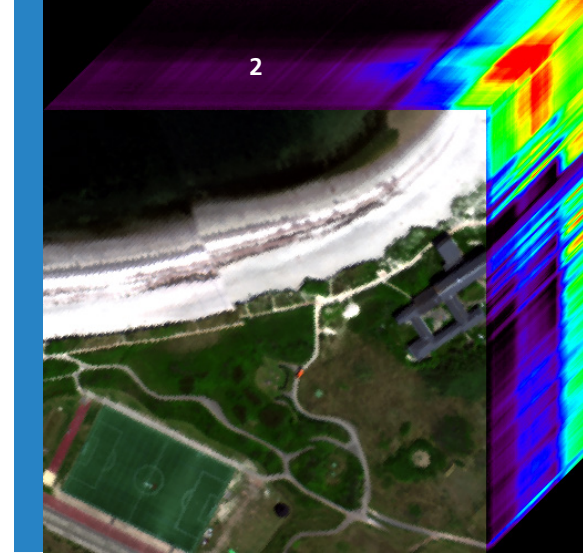
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1 Spectral signatures of grass and artificial turf.



2 Hyperspectral data cuboid with 120 channels.

Application

Hyperspectral techniques can be applied for mineral mapping, search for mineral resources or monitoring farming and forestry in order to localize spectra, that are typical for certain geological structures or vegetation conditions. The big amount of acquired data is no problem due to our efficient methods. In the field of medicine hyperspectral non-invasive tissue analysis is possible, that can be performed, due to the intuitive handling of the software, also by medical staff. In line production smallest pollution and material changes have to be detected very quickly. For the first time moving objects can be analysed hyperspectrally due to the camera's video capabilities. That is especially beneficial for sorting tasks and quality surveys in production processes or in food industry. Thanks to the online processing of the analysis software the production process can be optimized.

By its light and robust construction the hyperspectral camera of Cubert company is diversely applicable, e.g. on flying platforms like UAVs. Together with the real-time capability of the analysis methods this is an ideal basis for starting evaluation already during data acquisition. Thus acquisition parameters can be adjusted quickly e.g. due to changes in weather condition.

Development

In order to use hyperspectral data Fraunhofer IOSB has developed efficient and real-time capable classification methods. The development of an innovative hyperspectral camera by the company Cubert GmbH nowadays allows to capture hyperspectral video sequences and therefore to analyse movable objects. By the compact construction and light weight of the camera there are new fields of application, where hyperspectral data analysis was not yet possible. The software for material detection developed by Fraunhofer IOSB is used by selecting a material type in the user-interface and defining it as ground truth for the following classification. Afterwards the evaluation software marks automatically all remaining occurrences of the material in the current image sequence. Further methods still being developed deal with spectral unmixing and background suppression.

The Fraunhofer IOSB permanently does research on evaluation methods in order to accomplish our customers' high requirements. Our interest especially relates to solving difficult problems with purpose-developed robust methods.

Technical Facts

Hyperspectral classification

- **Easy-to-use** – Only one reference signature needed
- **Intuitive** – The software visualizes material differences in the ongoing video
- **Quick** – Online evaluation of the hyperspectral camera's videos

Sensor



The company Cubert GmbH offers two models of the full-frame hyperspectral camera:

- UHD 285 / UHD 185
- Wavelength interval 450 – 950 nm
- More than 130 spectral bands
- Simultaneous capture of the spectra
- No spectral blurring at quick movements
- Radiometric resolution of 14/12 bit
- Spatial resolution of 1 MP