Hyperspectral imaging device providing simultaneous high spectral and high spatial resolution.

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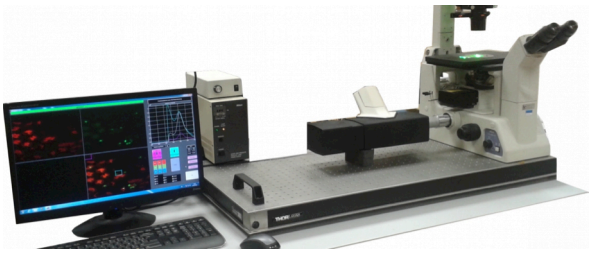

Hyperspectral module add-on for classical optical microscopes

Abstract

This device – developed by a Belgian optical engineering firm – is able to measure hyperspectral image data (1900x1140 pixels) in the range of 400 nanometer up to 1 micrometer, with 2 nanometer resolution. It currently is developed as an add-on for classical optical microscopes (simple and cost-effective), but the technology is applicable in other configurations as well.

It functions at low light levels without the need for filters, and with careful attention to the optical design resulting in high-quality images. The acquisition speed at full capability (both high spatial and spectral resolution) is 7 seconds.

Description

A Fourier transform hyperspectral imaging device has been developed with dimensions 500x250x150mm. Currently it is designed as an add-on module for classical microscopes. The combination of careful optical design with sensitive low-light sensors allows high spatial resolution, the highest spectral resolution, and crystal clear imaging. Using the module, a classical microscope turns into a high-quality wide-field fluorescence microscope, with linear unmixing of fluorophore data in the accompanying software. The image pixel size is independent of the module and entirely dependent on the microscope objective to which it is coupled: for instance 4.1µm/pixel for a 40X objective.

The system generates a set of images that are processed with Fourier analysis to extract the full spectrum for each image pixel.

The hyperspectral add-on module is based on an original configuration (patent pending) that combines high spectral resolution (up to 2nm) and mechanical stability. It is well adapted to low-light conditions, which is critical for measuring fluorophore bleaching/depletion. The spectral range spans the Visible to Near Infrared range (400nm-1µm) but can be extended to the Short Wavelength Infrared range (0.9-1.7µm) by modification of the incorporated 2D sensor.

The hyperspectral module can be applied in many fields, like medical applications (e.g. dermatology), environment monitoring, process control, food or agricultural concerns.

The technology provider is a growing and experienced optical engineering firm from Belgium, with roots in, and still active in, space optics.

Innovations and advantages of the offer

The hyperspectral head functions at very low-light intensities and without filters; thus with less fluorophore degradation. It has a spectral range of 400nm up to 1µm (with a resolution of 2nm), i.e. VIS and NIR imaging. All this is combined with high spatial resolution as well: a 1900x1140 low-noise CMOS camera.

Another major advantage is its compatibility with any classical optical microscopic system. The microscope to which the add-on module is coupled thus determines the optical resolution and field of view.

Further Information

The data acquisition time is 7 seconds at full frame, full spectral range and highest spectral resolution.

A time of 7 seconds in this configuration limits the use of the device to slow/static recordings. Faster imaging is possible by reducing the number of pixels, and/or reducing spectral range and/or lowering spectral resolution.

The device achieves high signal-to-noise ratio and gets around auto-fluorescence.

Application

Currently the device is designed as an add-on module for classical microscopes, effectively turning the classical microscope into a high-quality wide-field fluorescence microscope, allowing exact 2D pinpointing of biomarkers.

The patent-pending technology is however easily applied to any other field benefiting from hyperspectral image data in high spatial resolution (and fairly short acquisition time).

Description of Space Heritage

Most of the technology for the hyperspectral device has been developed in the ESA project “Intelligent spectroscopic device coupled with high-speed cameras” (2009). This project aimed to perform a chemical analysis of the re-entry of space debris.

Comments on the technology by the broker

Very accurate spectral analyses are already possible, as well as high spatial resolutions of a few wavelengths (using filters). However, high spectral and spatial resolution combined in one device is unique. Currently it is ready to be commercialised as a classical optical microscope add-on but many more potential applications exist.