

What is a Light Field and How is it Used in Spectral Imaging?

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The latest, high resolution hyperspectral "snapshot" camera from Cubert GmbH – the 20 Megapixel ULTRIS-20 – employs light field technology for image capture. So does the LightShift LVIRA plenoptic multispectral camera from Surface Optics. But what is a "light field" and how is it used in spectral imaging?

What is a Light Field?

Conventional digital or film photography captures a 2D image of an object or scene based upon the reflected luminance distribution. Light field photography captures more data, not just the intensity. A light field captures the orientation, direction, colour and intensity of all rays of light within a scene. A light field camera preserves the direction of each ray of light entering the camera and captures all that information in one image (see Figure 1).

Using a microlens array, the angular dimension of light intensity can be captured and a three-dimensional (3D) model of the scene can be constructed. The microlens array is installed between the main camera lens and the camera sensor/detector (see Figure 2).

The concept of light field photography has been around for a long time. The term was first used in 1936. However, it wasn't until 2005 that the first handheld light field camera was developed. These commercial cameras allowed the user to change

focus and shift perspective of an image post capture.

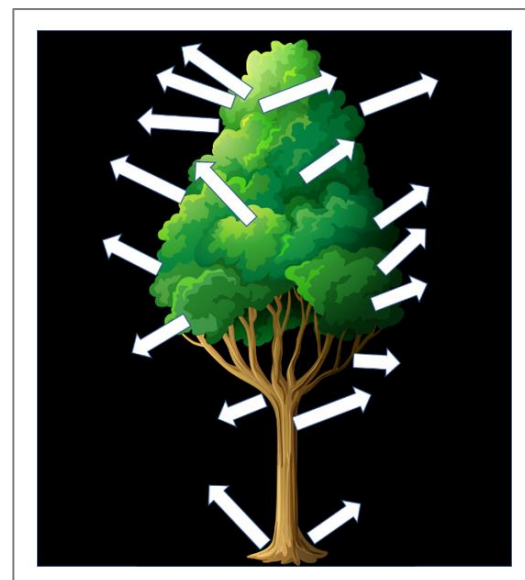


Figure 1: Visualisation of a "Light Field"

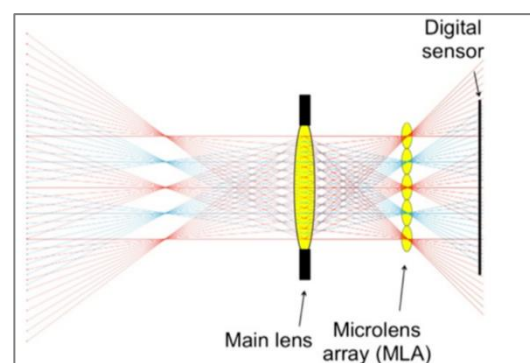
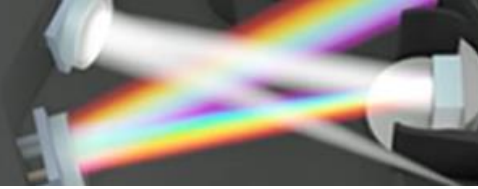


Figure 2: A Microlens Array Imager



Light Field As Applied to a Spectral Imager

The light field concept is now also being used by Cubert GmbH for its ULTRIS-20 "snapshot" spectral imager where the entire spectral dataset is obtained during a single detector integration period (see Figure 3).



Figure 4: Cubert ULTRIS-20 Snapshot Hyperspectral Imager

This approach has distinct advantages in spectral imaging of fast changing phenomena. By placing a filter array or continuously variable bandpass filter at the camera's front aperture, these spectral cameras allow the multiple filters in the array to be imaged to the same point in a scene. The result is a multi- or hyper-spectral image of a scene with data from all pixels captured simultaneously and with the possibility of video-rate spectral imaging (see Figure 4).

For example, if the filter array contains 16 filter wavebands, images from these filters are projected onto the camera sensor by the microlens array (MLA) in the form of an array of super-pixels (see Figures 5 & 6). The 16 filter array with microlens array is sometimes referred to as "plenoptic imaging" and is the technique employed in the LightShift LVIRA multispectral camera from Surface Optics.

Filters containing a larger number of bandpass filters can be used to produce hyperspectral images with over 100 spectral bands creating 400 x 400 super-pixels resulting in 160,000 spectra in a snapshot!

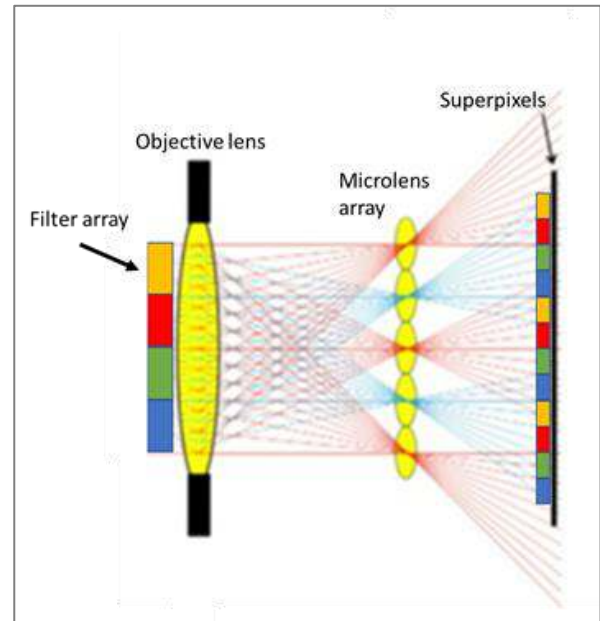


Figure 3: Light Field Imaging Schematic



Figure 5: 4 x 4 Filter Array

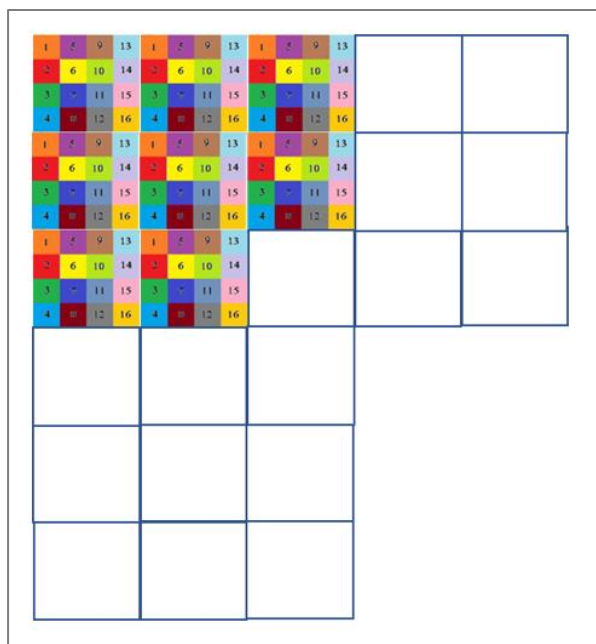
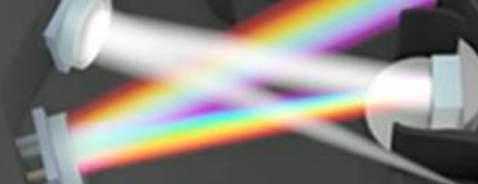


Figure 6: “Super-Pixels” Generated on the Camera Sensor

Welcome to the ULTRIS-20, 20 Megapixel, light field, snapshot hyperspectral imager by Cubert: <https://bit.ly/2l7hKOz> (see below). Details on the Surface Optics LVIRA multispectral camera can be found here: <https://bit.ly/2nPYZF>.

20 Megapixel

3D Hyperspectral Snapshot Camera



ULTRIS Q20

**400*400 pixel.
100 spectral bands.
1 snapshot image.**

Ultra HD Sensor Technology

Meet the new Cubert **ULTRIS Q20** – the world's highest resolved hyperspectral imager using an UHD sensor – inspired by light field technology.



VNIR hyperspectral snapshot camera
450-850 nm

**100 bands,
160,000 pixel**

light field technology

No scanning,
no pan-sharpening,
no motion artifacts

Complete data cube
in a **split second**



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**Complete data cube
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no pan-sharpening
no scanning



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