OT-26

CEBRA-H AND CEBRA-M | Low-cost spectral cameras for airborne applications

ULPGC Universidad de Las Palmas de Gran Canaria | Fundación Parque Científico Tecnológico | OTRI Oficina de Transferencia de Resultados de Investigación

TYPE OF RESULT

New technology
New product
New service
New knowledge or skill

COMMERCIAL MATURITY LEVEL

Conceptual idea
Proof of concept (design)
Validated in a controlled environment
Validated in a real environment
Successfully implanted

PROTECTION LEVEL

Non- applicable
Patent
Software
Know - how
Utility model

Description of the solution. Problem solved

The increasing popularity of spectral technology coupled with major research and development efforts in the latest years have allowed to bring it closer to more commercial and industrial fields. In fact, it has been observed an increase in the capital invested in the related markets (see Figure 1.) One of its main features is wide spectral information covering beyond the visible range of electromagnetic spectrum, that is provided by this type of sensors, which enables to identify and characterise objects and materials in a quick, convenient and non-intrusive way.

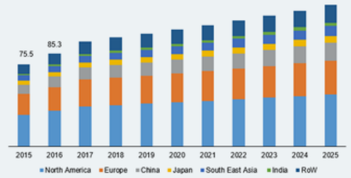

Figure 1. Evolution of hyperspectral technology market by regions (in $US).

These are the most common spectral cameras that can be found in the current market: hyperspectral and multispectral. Hyperspectral cameras are able to catch hundreds of electromagnetic waves from the electromagnetic radiation reflected by the objects under study. Although this provides a very detailed spectral analysis of the sampled object, treating the data obtained represents a high computational cost and, besides, buying this equipment implies high expenses. For this reason, multispectral cameras are a good alternative in those applications where not so much spectral information is needed, since they reduce the amount of information in less of 10 spectral bands distributed over a defined range of the electromagnetic spectrum. This implies less complexity when processing data and less expensive equipment, although it can be high for some final users of this type of technology.

Because of the aforementioned, low-cost technology solutions are needed in order to become more affordable commercial alternatives. Reduction of such costs would make possible a bigger number of users to buy this type of cameras, which would also benefit their final clients since costs of the services would be reduced.

In this context, several low-cost multispectral cameras have been developed (CEBRA-M) (see figure 2) with similar features as the ones existing in current market. In this sense, a snapshot solution (see Figure 2.1) and a staring solution (see Figure 2.2) have been developed. In snapshot cameras there are as many sensors and optic filters as the number of wavelengths that want to be obtained from the scene to be analysed, allowing to catch all the spectral information in one only instant. However, staring cameras are compounded by one only sensor with a mechanical wheel that transports optic filters to catch the desired spectral information of each wavelength. This is captured as each specific filter is placed under the sensor. Thus, this implies a extended capture time of images, but less manufacturing costs.

Por otro lado, también se están estudiando nuevas alternativas en el sector de la tecnología hiperespectral (CEBRA-H) (ver Figura 3).

Figure 2: Low-cost multispectral cameras developed (CEBRA-M.).
Figure 2.1. Snapshot camera (left) Figure.
Figura 2.2. Staring camera (right).
Figure 3: Hyperspectral camera in Process of development (CEBRA- H.)

Additionally, the previous cameras can be installed not only in industries or in any other type of ground installations, but also, they can be installed in unmanned aerial vehicles (UAV) or drones. This way, potential applications of both types of technologies (UAV and spectral sensors) would be significantly extended. It also should be noted that both multi and hyperspectral cameras have been traditionally installed in other type of aerial platforms such as satellites or manned aircraft. However, drones offer numerous advantages over those ones in relation to costs, celerity and mobility, among others.

So, Figure 4 shows a map of the vegetation index, known as normalised difference vegetation index (NDVI) that has been generated by the aforementioned staring camera, while it was carried by an unmanned aerial vehicle.

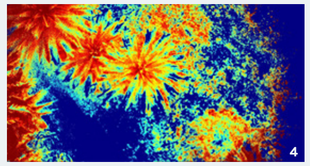

Figure 4. NDVI collected by the CEBRA-M camera from a drone

Fields of commercial application

Multi and hyperspectral cameras installed on UAV are of high interest for the following sectors:

- Precision agriculture: CEBRA-M and CEBRA-h allow to generate a colour map of a determinate land representing different vegetation indexes related to the strength of the crops, proportion of nutrients or existence of pests in early stages.
- Environmental monitoring: CEBRA-M and CEBRA-H enable identification of different components in nature, as it occurs with certain plastics and hydrocarbons on the sea, or early detection of environmental accidents such as fires or oil spills in the sea, among others, once these cameras have been installed in airborne platforms.
- Security, monitoring and defence: CEBRA- is a technology that can detect objects that are camouflaged or components that can be dangerous for safety and integrity of people.

Other: mineralogy, archaeology, and so on.

- In addition to this, in other fields of application not based on airborne systems, the solutions here developed can also be commercially exploited in the following fields:
- Quality control in food industries: by CEBRA-M and CEBRA-H products that do not comply with quality requirements of different industrial sectors, such as rotten food.
- Classification of different types of materials: thanks to the spectral analysis provided by CEBRA-M and CEBRA-H several types of plastics can be identified and clustered by their chemical composition and colour before the recycling process. It also makes easier identification of adulterated, manipulated or defective products that cannot be detected by the naked eye.

Market opportunity

Market opportunities for these multi and hyperspectral cameras are numerous. Main specific fields for action range from teledetection applications for those cases where traditional cameras would not provide enough information for an exhaustive analysing of the scene, or studying those processes that need to be monitored periodically, including those industrial sectors where such cameras are included in production processes.

Competitive advantage

Their high level of customisation and low weight are the main advantages of this type of cameras on unmanned aerial platforms, since they can be easily integrated in any type of drone.

This way, the low weight of these cameras is a desirable characteristic because one of the biggest limitations of UAV is their limited flight autonomy. It is directly affected by their load all the time and, therefore, the lighter the camera's weight is, the longer will be the flight duration of the drone.

On the other side, since these are easy to integrate solutions, they can be installed in any type of UAV as long as they are not commercial solutions that cannot be customised. This way, unmanned aerial platforms already property of final users could be reused, and no specific UAV model would be would be necessary to buy. Also, it is possible to adapt cameras type CEBRA to the aerial platform that better fits with a specific application. This way, user determines which drone is needed and then the camera will be adapted to it for installation.

Concerning to the high customisation, this type of camera allows to assemble the necessary filters for each specific application. This way the electromagnetic spectrum is covered, so users can use the system in an optimal way according to their needs. Also, this would allow to use the same airborne platform for different applications by just simply adapting the type of spectral camera that would use the most suitable configuration for each moment. This feature turn CEBRA cameras into adaptable technologies suitable for any industry. Their use would not be exclusive in UAV and thanks to their versatility they can cover a high number of different applications.

AUTHOR
José Francisco López Feliciano; Pablo Horstrand Andaluz; Raúl Guerra Hernández; María Díaz Martín; Alejandro Morales Carreño; Sebastián López Suárez; José María Melián Álamo; Ámbar Pérez García

CONTACT
Oficina Transferencia de Resultados de Investigación (OTRI)
arivero@fpct.ulpgc.es
928 45 99 56 / 43
https://otri.ulpgc.es/

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