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OO/UC3M/54- MULTI AND HYPER-SPECTRAL PASSIVE INFRARED (IR) SENSORS FOR RELIABLE DETECTION OF THREATS.

The IR Imaging and Remote Sensing Laboratory – **LIR-UC3M** of Universidad Carlos III, has developed IR multi and hyper spectral analysis techniques for passive (no emitters) and reliable (low false alarm rate) threat sensing. Specifically, they are based on sensors development and spectral processing for classifying the scene to optimize the discrimination of threats from backgrounds, decoys or other spurious emitting sources, for a dramatic decrease of false alarm rate.

Description and special features

The problem of detecting a threat without it being counter-measured by the menace is one of the key elements of any sensor system applied to Security. Maintaining the sensor in the "darkness" during its operation and its efficiency in the face of decoys and background emissions or clutter is crucial for the efficiency of sensors in Security or Military applications. This is even more important when the tendency is for the threat to be dispersed in the environment.

Within this framework, the need for robust systems with a low false alarm rate is important since a mistake may imply disastrous consequences for the Allies and civilians. Multi and Hyper spectral sensors are of the utmost importance to increase the chance of early and reliable detection of hidden threats on our own environment (Hostile Fire Indicators-HFI).

Numerous sensors, for instance Radar, Lidar, etc., are active and therefore they can not be in darkness while operating. On the other hand, some IR passive sensors have their main disadvantage on the existence of innumerable emitters, that may or may not correspond to countermeasures and that usually operate on the field of view of an IR sensor.

Multi and Hyper spectral IR passive sensors have as their main features, on the one hand, the capability of operating in the darkness (no emitting), and on the other hand, an important capability for avoiding the counter-measures of the menace or of the IR background itself by means of techniques of classification based on the analysis of distinctive spectral characteristics between both kinds of emitters. These sensors not only analyse the signal integrated on a band emitted by the scene through a focal plane array to obtain an IR image, but they also obtain several, or even lots of, images of the same scene on different IR bands. The scene classification techniques through "pixel-by-pixel" techniques offer a very robust and reliable procedure of classification and therefore of threat detection, whereas not being detectable due to their passiveness.

LIR has got experience on, or has already implemented, different multi or hyper spectral detection techniques for supporting:

- Passive and early Multispectral IR detection systems for anti-ship and anti-aircraft threats
- Increase of Survival capacity, decrease of vulnerability and susceptibility using Techniques of IR spectral analysis of aviation turbine jets.
- Low observability and darkening of IR plumes.
- Simulation of synthetic image of scenes and radiometric embedding of targets
- Code validation of IR simulation

LIR possesses the experience and capacity for the spectral processing of IR signals as well as specific instrumentation such as multispectral IR cameras in the bands of 3-5 and 8-12 microns, IR spectroradiometers for 2-16 microns, as well as hyperspectral imaging systems for different IR regions. Nowadays LIR is a National University Laboratory with a unique capacity for the spectral analysis of the IR scene.

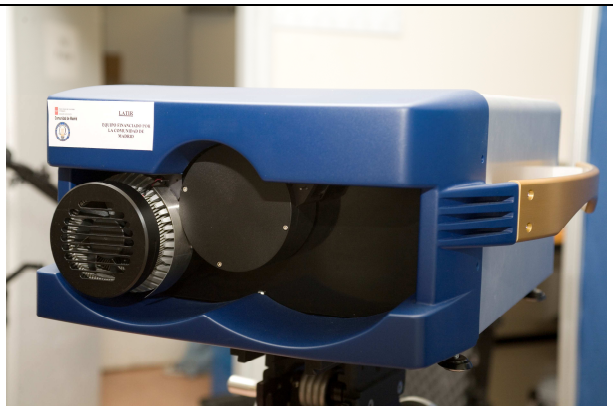

Fig. 1. Hyperspectral sensor: high resolution imaging spectrometer on the mid IR (2-5 □m).

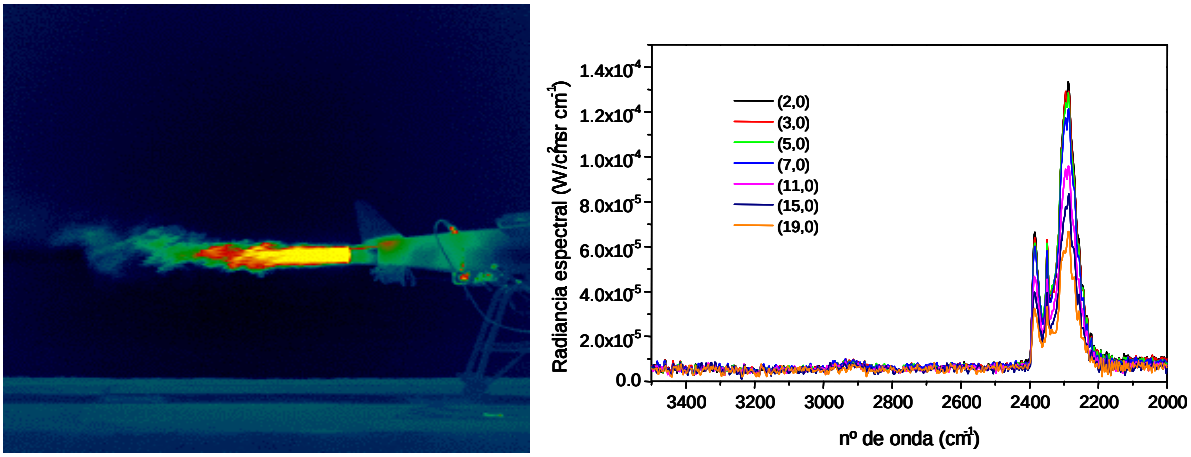

Fig. 2. Mapping of the spectral signature of an aviation turbine jet: image on the mid infrared and spectral radiance obtained with FTIR spectroradiometer and comparison with the image obtained by simulation on different conditions

Innovative aspects
A sensing model and a dedicated sensor for each type of threat can be configured. Each threat is characterized by its “distinctive spectral features” and by the difference against the background

Competitive advantages
Dramatic increase of early detection probability of threats compared to current systems, by lowering the false alarms rate and creating a detection model specifically defined for and in view of each type of threat. Capability for the simulation of IR codes and radiometric experimental validation

Technology Keywords
Hyperspectral sensors; multispectral sensors; hyper and multi spectral processing; spectral and spatial

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processing; IR cameras; IR passive sensors; IR gas signature; Sensors / Multisensor Technology, Instrumentation; Optical technology related to measurements; Sensor Technology related to measurements; spectral signature of combustions;

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