Next Generation Combat Aircraft Technologies - NGCAT

ACRONYM: TWS

Title: Threat Warning Sensor

Duration of the project: 01/05/2025 - 01/02/2028

Key words: Spectroscopic Imaging, Hyperspectral, Airborne Sensor, Threat Warning, MWIR, LWIR

Budget: 5.415.333 €

of which RHID contribution: 5.214.000 €

PROJECT DESCRIPTION

Spectroscopic Imaging adds a unique layer of information ("matter") that is definitely very useful as stand-alone information for a lot of applications, and invaluable in the sensor-fusion context of the next-generation NGWS/FCAS weapon system.

Invaluable… since this layer of information is simply not available today and complements information from RADAR, Electro-Optical and LiDAR sensors, transponders, datalinks, etc. to faster and more accurately identify the most diverse range of objects of interest.

An additional and very interesting characteristic of Spectroscopic Imaging technology is the fact that it is a passive sensor technology, "just" relying on the reflection of omnipresent energy in a certain band of the electromagnetic spectrum. This in contradiction to "active" sensing techniques like RADAR and LiDAR that need to emit electromagnetic energy in order to be able to detect the reflection of this specific frequency of electromagnetic energy, making the airborne platform vulnerable to detection.

In this project Team TWS primarily focuses on the detection and identification of "threats" to military airborne operations, using Spectroscopic Imaging technology. The idea and initiative for this project comes from 3 Belgian aerospace specialists, combining forces under the legal entity "Rien Sans Vent" (RSV) that managed to bring together a very capable and complementary consortium: Team TWS, comprising of:

- The Royal Military Academy (RMA), especially the 4D Perception Lab
- Vlaamse Instelling voor Technolgisch Onderzoek (VITO)
- Verhaert, Master in Innovation,

- FN Herstal, weapon system (integration) specialist
- RSV, Aerospace BD and Program Management

Although Spectroscopic Imaging already has been the subject of some research initiatives the past years, not in the least by the Belgian Team TWS partners Royal Military Academy (RMA) and Vlaamse Instelling voor Technolgisch Onderzoek (VITO), there are fundamental challenges that need to be overcome to consider mounting a Spectroscopic Imaging sensor on a manned fast-jet and/or remote carrier platform.

Team TWS identified the following major challenges:

- Profiling of "matter" out of Spectroscopic Imaging whole data under various environmental conditions is difficult.
- Spectroscopic Imaging sensors produce vast amounts of data for each pixel. To process this information "on-the-edge" in real-time is not a given.
- Current Spectroscopic Imaging sensors are bulky, heavy and expensive, not suitable for widespread airborne platform installation.

To make this research project as valuable as possible Team TWS decided to widen the view, not only focusing on Spectroscopic Imaging in the MWIR or LWIR bandwidth, but combining both MWIR+LWIR for a thorough wide-range analysis of the spectral profiles.

Please note: The TWS project brings together for the first time in Belgium both a scientific MWIR and a scientific LWIR Spectroscopic Imaging sensor for in-depth research. This is a unique capability that remains available at the Royal Military Academy (RMA), supporting the Belgian Defence Technological and Industrial Base (BDTIB) even beyond the TWS project duration.

As such, the objectives of the TWS research project are:

- Investigate the performance of the combined MWIR and LWIR Spectroscopic Imaging sensors and software to detect and categorize spectral signatures, also comparing traditional vs. AI driven compression and sensor data processing algorithms.
- Build a spectral imaging signature library structure and populate it with "profiles".
- Define the MWIR/LWIR Spectroscopic Imaging LRU (SWaP-C) that can be ported to an airborne platform.

Besides addressing the technological challenges Team TWS also intends to determine spill-over use cases for Spectroscopic Imaging based sensors, not in the least in the dual-use domain.

To achieve the set goals Team TWS comprises a series of MWIR+LWIR Spectroscopic Imaging measurement campaigns interleaved with iterations on sensor data compression algorithm and sensor data processing algorithm development evolutions.

Eventually this TWS research campaign will (or not, sic.):

- Confirm real-time profiling of defined types of "matter", with enough level of confidence, out of MWIR+LWIR Spectroscopic Imaging data.
- Establish a MWIR+LWIR Spectroscopic Imaging profile library in Belgium.
- Provide enough evidence to determine the definition of a Spectroscopic Imaging sensor focusing on threat detection for the FCAS platforms.

- Allow to understand the effort to develop Spectroscopic Imaging sensors for spill-over use-cases based on the TWS building blocks.

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