HAWKEYE Report Summary

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Country: France

Remote sensing as a tool for homeland security

Partnership and starting point

Five SMEs, specialised in the development, use and processing of hyper spectral data have implemented ground and airborne experiments, building and using a prototype sensor unit which is able to detect traces of gases and solid materials typical of clandestine activities. This work has been done in partnership with JRC and King's College London who have defined the targets particularly in the clandestine weapon surveillance field.

This new technology has been developed and patented by ATIS, before the beginning of the Hawkeye project, and has obtained very promising detection performances on gases and some solid materials. The need to detect a new spectrum of chemical species makes it necessary to adapt the existing technology (both hardware and software) to meet a new set of performances. Pepite, Actimar and Keyobs provide complementary expertise in terms of signal processing, over and above the solutions already implemented by ATIS.

The expertise of Spacebel has been used to show how the results could be retrieved and managed through a catalogue integrated in SSE. On the basis of the experimental results, Thales Alenia Space (TAS) has performed a preliminary evaluation study of a space borne sensing unit, comparing the costs and benefits of such a solution.

Project history

The Hawkeye project was launched in August 2005 starting with a one year specification phase that tried to identify possible target cases of use. Within the broader scope of what the project is directly related to, project partners have identified areas of interest for TIHSI in a non proliferation enforcement context together with already known scenarios in homeland security applications. A list of scenarios and detectable products has been identified and discussed during an advisory board gathering six experts in various fields.

The two following years has been dedicated mainly to the development phase:

- Methods for validating and extrapolating actual results have been described; a simulator giving realistic data has been developed and validated. Performance assessment of existing or under development algorithms has been conducted using both this synthetic data and real data.
- Specifications of the prototype to be used in the airborne experiments has been set up taking into account the various performance requirements needed compared to the previous, ground based sensor.
- - Software related work has demonstrated that an increase in performance is achievable using classical algorithms (classical in the sense of non AI algorithms). For each scenario of use a specific 'best suited algorithm for detection' has been identified.

The manufacture of an airborne device then take place, taking into account the results and efforts put together in order to improve hardware performance, both for raw sensitivity and to adapt the device to specific constraints related to flight. Tests on a cooled sensor have been done to compare results from different bolometric sensors and too confirm the reliability of our model.

The last year of the project (total 47 months) has been dedicated to the preparation and the exploitation of the flight tests that took place between August and October 2008. Results obtained have been used to check that simulation model where correct and also as an input for space application extrapolation.

Results summary

The feasibility of airborne infrared hyper spectral gas detection has been demonstrated through flies over various sites (industry, zones with controlled releases, natural zones,). The results obtained show that the required performance for practical applications can be achieved using of the shelves existing sensors.

These practical applications cover the fields of clandestine weapon activities (nuclear and chemical) and general

homeland security problems.

- For Nuclear applications it has been shown that some of the gases that enter in the nuclear fuel cycle are detectable. Both ground and airborne surveillance are of interest. In the course of the project we have shown that TBP can be detected in hot environmental condition and HF is probably detectable in the 3-5 Fm band (no direct measurement on this product has been done).
- For chemical weapon applications, if most of the products used are quite easily detectable, the scenario of use is not clear mainly because the products used are also of interest in 'normal' chemical industry. TBP is also used to simulate chemical weapon, so the results obtained during the project on this product validate TIHSI for chemical weapon detection.

- In homeland field many applications can be found:

a. detection of leaks in gas pipes
b. global remote pollution survey at industrial sites
c. crisis management during industrial accident.

The various flies over industrial sites and previous ground experimentation have demonstrated that all these fields could be successfully addressed.

Space born extrapolations show that long term monitoring application are achievable, NPN and NPC application seem out of reach because of revisiting time limits. Airborne and ground applications are more promising because they are more numerous and also more in reach.

With the help of European Community through the FP6 program, the Hawkeye project has fulfilled its aims: show the feasibility and the usefulness of an airborne infrared imaging spectrometer.

Related information

Result In Brief	Improved surveillance technologies in support of security
Documents and Publications	Final Report - HAWKEYE (Thermal infra red hyperspectral sensing assistance to clandestine weapon surveillance under working conditions linking fixed airborne or space borne systems)

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Subjects

Aerospace Technology - Information Processing and Information Systems

Collaboration sought: Further research or development support
Stage of development: Prototype/demonstrator available for testing

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