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MIO Radiation Detection using Radio Controlled Helicopter Transporting a Small Sodium Iodide-Based Sensor System

D. G. Trombino, A. D. Dougan

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New for MIO 10-2 was the introduction of the possibility of conducting a radiation search using a small remotely operated unmanned aerial vehicle, a radio controlled (RC) helicopter. With the payload limit of three (3) kilograms, fitting a detector, power supply, multi-channel analyzer, computer, and GPS into a waterproof container was a challenge. The detector used was a 4 x 4 cm NaI(Tl) powered by an Ortec DigiBASE. That was connected to an Artigo picoITX computer with a Li-ion battery. Also attached to the computer by USB cable was a Garmin GPS antenna. This stand-alone system was placed in a clear plastic dry bag (Figure 1) to protect it since the flight would be over water.

Figure 1. Detector package prepared for flight.

After a test flight behind the NMIOTC building to confirm the system was indeed below the maximum payload weight limit, the detector system was started up and sealed in the dry bag for flight. Prototype software developed at LLNL was used to capture GPS time and location stamped radiation count rate and spectra. Though not used for this demonstration experiment, the system is also capable of data telemetry via USB wireless (WiFi 802.11) communication.

Photographs and video were taken of the flight and chase of the target (Figure 2). Video was also captured with an onboard camera from the helicopter. Video images were viewed in real time via the helicopter operator's laptop computer and were available as a head up display on specially developed goggles (Figure 3). With other information displayed on the head up display, there is a potential for incorporating a radiation count rate bar to enhance the video search capabilities.

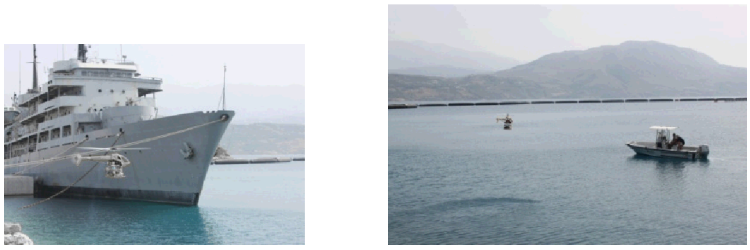

Figure 2. Helicopter heads for target boat.

Figure 3. Head up display goggles and their view.

The helicopter and the radiation detection system performed well during the demonstration experiment. At the conclusion of the flight in which multiple passes, chases, and attempts at overhead stationary hovering, the helicopter landed and the sensor package was removed for data download. As can be seen from the GPS track (Figure 4), the computer did not collect complete data from the entire flight.

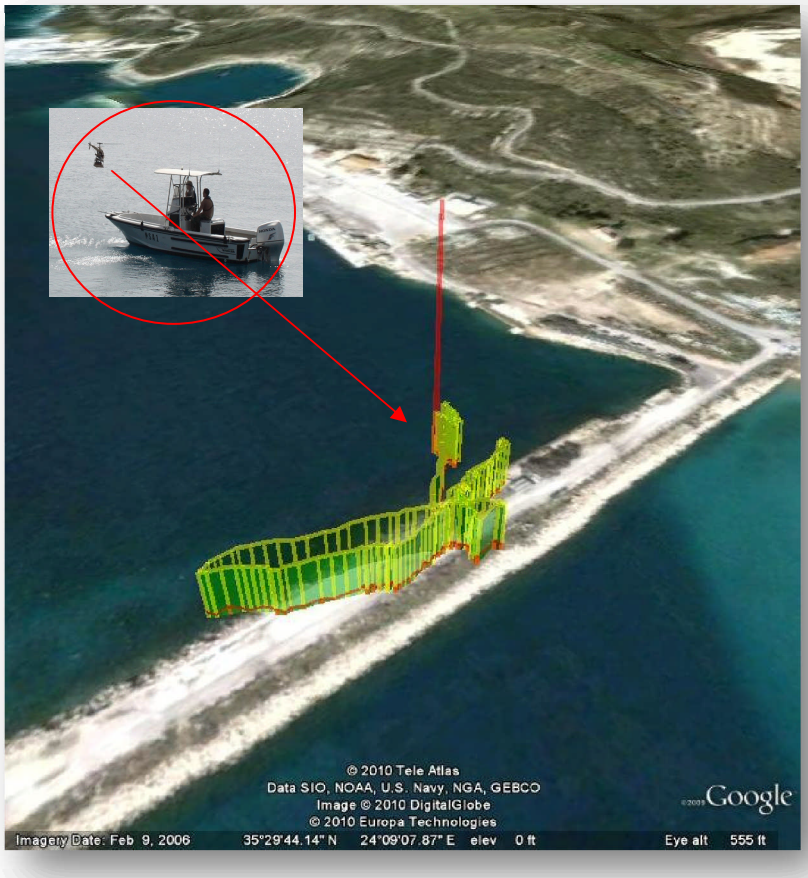

Figure 4.Target acquired!
Yellow shows the detector onboard the helicopter GPS track.
Red shows the detector radiation level detected.

The system did capture a total of 28 events, triggered by a count rate above a predetermined statistic. Of the events, spectra from 23 could clearly be used to identify the target source, ^{241}Am (Figure 5).

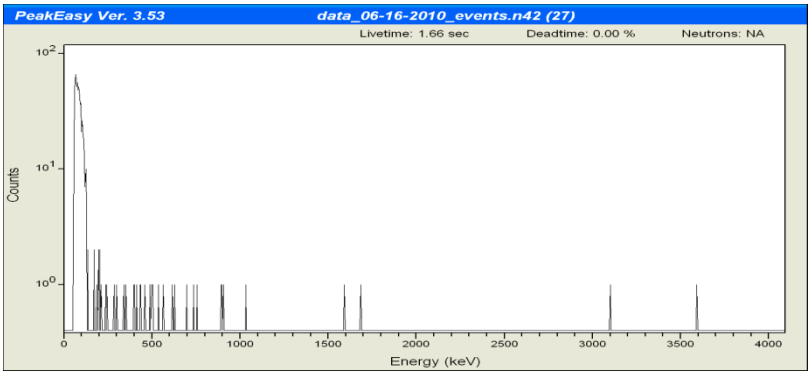

Figure 5. Individual helicopter event spectrum.
The large peak to the left, near 60 keV is from the target source, Am-241.

The system did have a difficult time due to the external temperature during the experiment. After the helicopter landed and the dry bag assembly was removed, the system was too hot to touch and would not communicate via ethernet cable to the external computer (the unit that had been used for preflight startup). Data files saved during the flight were only able to be retrieved after the system had cooled down later that evening.

The experiment was a success in demonstrating that a small radiation sensor could be deployed on a small UAV. The total cost of the sensor package and the helicopter was less than $30k (20k €). There are several key areas for improvement and further development of this potentially valuable tool as an asset to maritime interdiction operations. The most important function to add would be real time communications and telemetry from the radiation sensor to the operator and to the command center. Environmental protection for the sensor computer and battery would also be necessary for continued experimentation. Incorporating radiation data into the head up display would enhance the operator's awareness and would improve the ability to search an area where the operator cannot see the helicopter.

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