RADHAWK: UAV FOR FAST-RESPONSE RADIOLOGICAL MAPPING

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Vertical take-off and landing of the Unmanned Aerial Vehicles (UAVs) employed for Gamma-Ray Surveys (GRS) extend the capability of environmental radioactivity mapping, combining the coverage of airborne methods with the flexibility of ground surveys. They operate without infrastructure for take-off or landing and allow data collection in hazardous areas while keeping operators at a safe distance. The need for rapid and safe radiological assessment makes these systems particularly relevant today.

RadHawk has been developed to address the insufficient integration between avionics and radiation detectors in existing UAV-based GRS systems. It combines a custom quadcopter with a GammaStream digital Multi-Channel Analyzer coupled to a 2-inch $CeBr_3$ scintillator, providing ~60% better energy resolution than NaI for ^{137}Cs detection. A dedicated protocol enables continuous exchange of telemetry and command signals between the onboard computer and the Pixhawk autopilot.

Data are acquired in list mode and processed in real time to yield georeferenced, energy-calibrated spectra. A radio-frequency downlink provides real-time transmission of georeferenced spectra and telemetry, ensuring continuous flight monitoring and timely detection of anthropogenic radionuclides. Post-processing with Full Spectrum Analysis – Maximum Likelihood Estimation enhances radionuclide identification and quantifies K, eTh and eU abundances. The algorithm defines the detector field of view as a function of altitude and links acquisition time to spectral count rate, enabling the analysis to be adapted to the prevailing radiometric conditions.

Efficiency calibration has been performed through Monte Carlo simulations at different altitudes, for both NORM and anthropogenic radionuclides.

The operational deployment of RadHawk demonstrates its effectiveness in delivering rapid and quantitatively reliable radiological surveys, proving its relevance for both emergency scenarios and environmental monitoring.