Drone for 3D Radiation Mapping With Radioactive Source NaI-Spectroscopy Identification, and Polyurethane Decontamination & LiPo Battery Neutron-Shielding Using 5% Borated Polyethelene

Mohammed, Ahmed (School: Applied Technology School for Nuclear Energy in El-Dabaa)
Harby Wannas Sharmoukh, Youssef (School: Applied Technology School for Nuclear Energy in El-Dabaa)

Since 1993, the IAEA and UNSCEAR have reported 4,243 radioactive incidents, each caused deaths and hundreds of contamination. Therefore, surveying extensive areas during radiation leaks and radioactive lost/stolen sources using UAV-based platform is vital. Existing literature shows that current radiation mapping drone (RMDs) systems cost exceeded $35,000, achieved 1°–5° directional accuracy with Gamma thresholds 0.01 μSv/h—yet lack integrated shielding and decontamination techniques. We introduce a 3D Radiation Localization and Mapping Platform (LAMP) with NaI Spectroscopy identification and Decontamination systems mounted on a DJI F450 Drone-body founded from scratch; speeds 30:60-km/H, altitudes 120 meters, 2.5 kg payload, and 30-minute flight time. The LAMP is based on an optimization problem considering background radiation and CNN model. Supported by extensive experiments, we demonstrate that our airborne system reliably locates category 3–4 radioactive sources (Co-60/Cs-137 mixed nuclide) per IAEA standards at EAEA Research Centre. A sensor bundle—comprising a NaI Scintillator, NightVision IR Camera—Uses monocular depth estimation (MDE) and deep learning path planning to mitigate LiDAR gamma interference while the SDF|CNN boosts UFOV from 60.32% to 93.44% with 2.3–10.1 meters accuracy based altitude. A 250 ml polyurethane (NHCOO) foam generator decontaminated the highest hot spot with up to 95% Co-60 removal, reducing exposure and airborne contamination. Designing a 5% borated PE|(289.9g/x=1.5cm) shielded the Li Battery from neutron capture induced capacity loss; 92.1% MCNP efficiency, with 93–96% experimentally. achieving 94.2%|$2,000 cost efficiency, Implications in nuclear remediation, and lost/stolen source with decontamination, shielding, and MDE techniques.

Awards Won: