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A high resolution γ-ray imaging spectrometer for radioactive waste characterization

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Electricity generation from nuclear plants has consistently increased since the establishment of the first facility in 1954. This growth cashort-lived andn be attributed mainly to its significant advantage in reducing greenhouse gas emissions through uranium fission. However, nuclear energy comes with significant drawbacks, notably the production and management of radioactive waste. The latter, varying in levels of radioactivity and longevity, necessitate disposal in specialized facilities for thousands of years. This underscores the importance of refining the classification process to minimize disposal needs, achieved by segregating very low level waste (VLLW), low level waste (LLW) and intermediate level waste (ILW) from high level waste (HLW).

To such aim we have explored the applicability of a high resolution γ-ray imaging spectrometer, called i-TED, which was initially developed for nuclear astrophysics experiments at CERN n_TOF [1]. Essentially, i-TED is a modular Compton camera with a very broad Field of View (FoV) and large efficiency, a high image- and energy-resolution, while still portable and scalable.

In this work, we present the first results obtained after applying i-TED to measure radioactive residues of low- and medium-activity at the disposal center of El Cabril (Cordoba, Spain). Five radioactive drums were arranged in a specific configuration, with i-TED positioned in front of them at eight different locations for data collection. Additionally, an RGB commercial camera was attached to i-TED to capture the surrounding environment. This integration allows us to create an image of the observed scene, incorporating the radioactivity data provided by i-TED through the application of computer vision techniques, such as fiducial marker detection and segmentation. In summary, a comprehensive spatial assessment of radioactivity within a scene can be achieved using i-TED, whose main advantages are related to its portability, scalability, a wide field of view (FoV) and high detection efficiency.

[1] Domingo-Pardo, C.: i-TED: A novel concept for high-sensitivity (n,γ) cross-section measurements. Nuclear Instruments and Methods in Physics Research A 825, 78–86 (2016)

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