

The experimental set up and the application of a marine mini gamma-ray spectrometer for the identification of radioactive objects

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The understanding and protection of human's due to the consequences of nuclear incidences has become an increasingly important scientific and technological challenge. This research focuses on quantification methods of underwater gamma-ray spectrometers to identify radioactive objects in aquatic systems. The work addresses the critical need for rapid, accurate, and non-invasive monitoring methods capable of identifying gamma-ray emitters that may be caused by various nuclear incidences. Previously, continuous monitoring activities have been conducted in the marine environment using low and medium resolution underwater gamma-ray spectrometers, such as the KATERINA and GeoMAREA detection systems. The experimental set up and the applications of a compact nuclear detection system with small dimensions is employed by its integration into robotic vehicles to collect data in controlled aquatic environments. The system utilizes a 2"×2" NaI (Tl) scintillation crystal coupled with a Silicon Photomultiplier, aiming to reduce size and weight while improving underwater maneuverability. The integrated system (sensor and drone) is applied in nuclear security needs identifying radioactive materials beneath ship hulls. An initial performance assessment was conducted in a water tank to investigate detection capabilities as a function of source-to-detector distance. Subsequently, field measurements were carried out in a marine environment to determine limits of detection using known radioactive simulant housed in a dedicated enclosure. Finally, an automated identification algorithm was also applied to detect potential threats originating from suspicious objects/sources and to generate corresponding alerts based on type of radioactivity (natural or anthropogenic).

Key Words: Nuclear maritime security, nuclear incidences, underwater gamma-ray spectrometer, radionuclide identification

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