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3D Mapping and Visualization of Radioactive Sources for Nuclear Safeguards Applications

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At Lawrence Berkeley National Laboratory, we have developed the nuclear Scene Data Fusion (SDF) capability, which enables visualization of radioactivity in indoor and outdoor environments. By generating a 3D map of a scene using the compact, lightweight system, Localization and Mapping Platform (LAMP), SDF detects and characterizes gamma-ray radiation sources (compact or distributed). LAMP and SDG have been integrated with two commercial gamma-ray imagers to enable demonstration of this advanced capability in safeguards scenarios. The 3D model, produced onboard using contextual sensors (e.g., LiDAR) and Simultaneous Localization and Mapping (SLAM) algorithms, will enable IAEA inspectors to easily orient their location relative to the location of radioactive sources within a given environment. For example, characterization and change detection (i.e., establishing a baseline radioactivity map on an initial inspection, then in subsequent inspections determining whether there are any differences) of waste pits, design information verification (DIV), mapping and detecting anomalies in storage vaults, locating voids in UF₆ cylinders, characterization of waste drums, and materials accountancy are all likely applications where SDF will provide significant advanced capability. We have successfully demonstrated this mapping and visualization concept in various environments, including UF₆ cylinders in a fuel fabrication facility, mapping contamination in evacuated Fukushima Prefecture communities and within the Fukushima Dai-ichi Nuclear Power Plant. In addition, SDF has been demonstrated with a number of gamma-ray imagers and detectors deployed on a range of platforms including hand carried, and unmanned ground and unmanned aerial vehicles. Our current integration of SDF/LAMP with commercial gamma-ray imaging systems demonstrates the flexibility of this technology and will enable the advanced mapping and visualization approach for international nuclear safeguards applications to be explored.

Which "Key Question" does your Abstract address?

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Topics

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