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#7-31 Automated Maximum a Posteriori Localization of a Radioactive Source using an UAS

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The objective of this work is to develop techniques that allow for a rapid and accurate localization of radioactive sources in a large area using a highly automated unmanned aerial system. It is proposed that searching for sources using paths generated by probabilistic methods can leading to significant reductions in the time taken to localize a source. Additionally, it is also proposed that a new localization method that exploits a priori knowledge on the source activity can improve localization accuracy, which also leads to a faster localization. The proposed methods are tested in trials comprising a Cs-137 emitter that must be detected and localized using a DJI M600 equipped with a radionuclide sensor and a processing unit. During the trials, first, a fixed exploration path was followed. After hitting a radiation threshold, the source was localized using paths generated by a non-probabilistic and a probabilistic method. It was found that the probabilistic method was able to localize the emitter in less than 5 minutes in a 400 x 400 m area, with a localization time depending on the position of the source relative to the starting point of the unmanned aerial vehicle. To compare the performance of the new localization method with previous works, multiple state-of-the-art algorithms are implemented and evaluated on the real measurement data with respect to real-time capability, runtime complexity and localization accuracy. It was found that the novel estimator equals or surpassed the localization accuracy achieved by previous works in all tested scenarios. These results indicate that unmanned aerial vehicles that utilize these proposed techniques to enable online path planning, instead of relying on the conventional approach of predefined search patterns. In contrast to predefined search patterns, significant improvements in the time to localization and the localization accuracy can be achieved with these methods in comparison to the state of the art.

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