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Design and preliminary performance of scintillators-based unmanned aerial vehicle for multiple radiation detection

ABSTRACT

Unmanned aerial vehicles (UAVs) provide an efficient method of remotely sensing environments that humans cannot approach with conventional aircraft due to serious hazard or access limit. The use of UAVs has been suggested as suitable solution in numerous disciplines, including wildfire thermal imaging, radiological survey and radiation activity monitoring since the Fukushima nuclear accident. Many researches have adopted different types of UAVs and radiation detection sensors and have proposed various radiation monitoring systems and data management systems in a site.

In this work, we propose a novel method of using a commercially available drone for aerial's multiple radiation detection, which consists of a high-resolution image camera for environmental observation. We have designed and developed the remote multiple radiation monitoring system with different types of scintillating screens for radiation detection tasks. A latest compact drone (model: mavic 2 pro) with 322(L) x 242(W) x 84(H) mm dimension consists of CMOS image array for vision imaging acquisition. Different commercial scintillation screens such as CsI:Tl, GAGG(Ce) and FOS(Fiber Optic Scintilator) with Gd2O2S:Tb materials were applied to measure the X-ray exposure dose, gamma ray activity and neutron reaction. The various design parameters such as scintillator types and radiation types were selected and investigated for preliminary possibility under practical X-ray, gamma-ray condition and neutron conditions.

For evaluation and optimization of the various situations about multiple radiations, different configuration parameters are investigated. The characteristics of the CMOS image sensors with and without scintillator in a drone, such as dose response linearity, dose rate dependence, and minimum detectable activity were evaluated. This result has demonstrated that the unmanned aerial vehicle with a camera and scintillator can be used as a low sensitivity dose rate meter in a situation to detect various types of radiations.

Submission declaration

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