Development of 4pi Compton Imaging System With Mobile Robot

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Abstract

Compton imaging is essential for ensuring nuclear safety, security and surveillance. This technique borrows the kinematic Compton scattering principle for reconstruction gamma radiation source into an image. We are currently developing a Compton imaging device to localize the position of an unknown radiation source. The combination of a gamma ray detector and the mobile robot will be helpful for measuring radioactive substances over a wide area or in a location where it's dangerous to access by a human.

Keywords: Compton imaging, Detector, Mobile Robot

Development of Compton Imaging detector

Gamma-ray imaging took an important role in nuclear safety and security. It's used to detect and localize the radiation source. Compton camera is one of the advanced detectors used to perform gamma-ray imaging by applying the Compton principle. For monitoring the radiation, a 360 surveillance is needed. In this research, we develop a Compton camera that can be utilized with a mobile robot. This Compton camera is moved by remote control; therefore, it can measure the radioactive substance over a wide area or in a location where it's dangerous to access by a human.

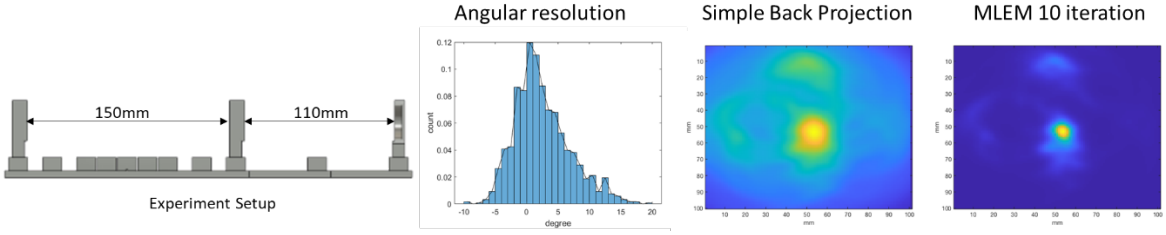

Figure 1. Compton imaging experiment setup, angular resolution, image reconstruction result.

Compton imaging experiment was conducted to test the performance of the detector system. Two detectors with the same properties are located at a 150mm distance, and the ^{137}Cs (662 keV) source is located in the front of the first detector at a distance of 110mm. The energy deposit in the scatterer was set from 10 to 100 keV. The coincident event used for the image reconstruction is the energy that has a total energy deposit in the scatterer and absorber detector equal to 662 keV±10%. The reconstructed image processing using the simple back projection method and with list mode Maximum Likelihood Expectation Maximization (MLEM) algorithm. Using the MLEM algorithm, the position of the point source is more precise, and the artifact reduces significantly. The angular resolution of the detector show 10º (FWHM). The angular resolution is determined by the alignment of the detector and the energy resolution.