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Maximum likelihood positioning for gamma ray imaging detectors with depth of interactions measurement

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The center of gravity algorithm leads to strong artifacts for gamma-ray imaging detectors that are based on monolithic scintillation crystals and position sensitive photo-detectors. This is a consequence of using the centroids as position estimates. The charge division circuits which are used to compute the centroids can also be used to compute the standard deviation of the scintillation light distribution. We studied the feasibility of maximum likelihood estimation for computing the true gamma ray photo conversion position from the centroids and the standard deviation of the light distribution. We used an analytic model for the scintillation light distribution based on the inverse square law for predicting the light response function of the scintillation detector and used this model together with maximum likelihood estimation to reconstruct the true impact positions from simulated photo-conversion events. Preliminary results were obtained with Monte Carlo simulation. These results suggest that the maximum likelihood positioning is feasible and partially removes the strong artifacts of the center of gravity algorithm. We also show that the method produces good estimates for the depth of interaction.

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