

IRIS projector model for monolithic detector based systems: proof of concept using a dedicated brain PET/MR device

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We present a simple but accurate model to compute the uncertainty regions of impact coordinates measured in monolithic crystals. The proposed model considers the scintillation crystal, internal reflection, crystal coating, the presence of a surface retroreflective structure, and the pixel detector layout. This model is used to estimate the uncertainty in the LOR vertex location, and incorporated through the IRIS projector for the image reconstruction of data acquired using monolithic crystal detectors. The model has been validated with Monte Carlo simulations showing good correspondence with measured data. More than 85% of the data accurately matched the predictions. The model has been tested with real data from the dedicated brain PET insert MindView. In this case, the IRIS projector implemented with the proposed model resulted in an average SNR gain of approximately 30% compared with reconstructions based on standard, experimentally decompressed, point of interaction determination. The proposed uncertainty estimation method in combination with the IRIS projector are independent of the reconstruction process and could be incorporated within any image reconstruction algorithm.

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