

DOI estimation using cartesianDETECT2

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1. Introduction

cartesianDETECT2 is a dedicated Monte Carlo optical transport code for modeling pixelated scintillator structures. It is based on DETECT2 (the optical transport code for MANTIS) but has been specifically tailored for use with pixelated detector structures.

We have used cartesianDETECT2 to obtain estimates of depth-of-interaction (DOI) for improving spatial resolution of nuclear imaging applications. The simulations results from cartesianDETECT2 are analyzed to model and establish patterns between DOI and photon scattering. Our findings indicate that DOI estimates can be extracted from a double-Gaussian model of the detector response.

The main developer of cartesianDETECT2 and additional codes written for estimating DOI is **Diksha Sharma**, at the U.S. Food and Drug Administration. The source code is free and open software in the public domain, as explained in the Disclaimer section below.

More details on the DOI estimation model can be found at the reference below, which should be used for citing this work also.

D. Sharma, C. Sze, H. Bhandari, V. Nagarakar and A. Badano. Depth-of-interaction estimates in pixelated scintillator sensors using Monte Carlo techniques, submitted to Medical Physics, 2013.

This code is still under development; please report to the author any issue or bug that you may encounter. Feel free to suggest any improvements in the code too.

2. Disclaimer

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3. Code details

The following five programs written in MatLab (version R2013 a) are included:

- `new_ab_fit.m`: Fits the radial responses at various depths and returns plots for parameters a and b and coefficients m_0 , m_1 , m_2 , n_0 , n_1 and n_2 . This uses functions `GaussianFit_ab.m` and `FitAB_coeffM0M1M2.m` internally. `GaussianFit_ab.m` fits a double Gaussian on the radial response and returns a , b . `FitAB_coeffM0M1M2.m` fits these parameters using a polynomial fit and returns coefficients m_0 , m_1 , m_2 , n_0 , n_1 and n_2 , which are then used for estimating unknown DOI.
- `new_bin_and_fit.m`: Plots the radial response and fit it using a Gaussian function.
- `new_estimateDOI.m`: It uses coefficients m_0 , m_1 , m_2 , n_0 , n_1 , n_2 , and estimates the DOI. The code `new_ab_fit.m` should be run before running this code since it uses the coefficients m , n generated by `new_ab_fit.m`. It returns two plots – comparing the actual versus estimated DOI, and the error in μm .
- `*.out` files: sample input data files for the DOI estimation codes.