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A NEW ALGORITHM FOR USING DEPTH-OF-INTERACTION MEASUREMENT INFORMATION IN PET DATA ACQUISITION.

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We have devised a new method for incorporating depth of interaction measurement information into PET reconstruction algorithms on an event by event basis. This method improves on a previously published method (W.W. Moses, *et al.*, J. Nuc. Med. 31, p. 749, 1990) by including the 511 keV photon penetration probability in the reconstruction. The previous algorithm, which rebinned the data based only on the measured depth of interaction, exaggerated the radial elongation (compared to not including this measurement information) if the measurement was sufficiently inaccurate. The new algorithm avoids this degradation by computing the joint probability that the 511 keV photon penetrates to the 'true' position x_t and that an interaction at this 'true' position yields the measured position of interaction. This probability is then maximized by varying x_t and the data rebinned based on the 'most likely' value of x_t.

We have evaluated this new reconstruction algorithm by performing a Monte Carlo simulation with the depth of interaction measurement resolution described by a Gaussian and comparing reconstructed radial point spread functions. The tomograph ring simulated is the Donner 600 crystal tomograph, a 60 cm diameter ring composed of 600 BGO crystals, each 3 mm wide by 30 mm deep by 10 mm high. The table below compares, as a function of depth of interaction measurement resolution, the radial point spread function (in mm) at 10 cm from the center of the tomograph using the two algorithms. A fwhm of 4.18 mm is obtained if no depth of interaction information is used.

Depth Resolution (mm)	0	5	10	15	20	25	30	35	40
Old Method	2.44	2.67	3.14	3.61	4.40	4.87	5.42	5.66	5.89
New Method	2.44	2.67	3.14	3.53	3.77	3.85	4.08	4.24	4.16