CROSS CORRELATION CALCULATIONS AND NEUTRON SCATTERING ANALYSIS FOR A PORTABLE SOLID STATE NEUTRON DETECTION SYSTEM

Andrea Saltos

Dr. William Miller, Thesis Supervisor

ABSTRACT

In efforts to perform accurate dosimetry, Oakes et al. [Nucl. Intrum. Mehods. (2013)] introduced a new portable solid state neutron rem meter based on an adaptation of the Bonner sphere and the position sensitive long counter. The system utilizes high thermal efficiency neutron detectors to generate a linear combination of measurement signals that are used to estimate the incident neutron spectrum. The inversion problem associated to deduce dose from the counts in individual detector elements was addressed by applying a cross-correlation method which allowed to deduce dose with average errors less than 15%. In this work, an evaluation of the performance of this system was extended to take into account new correlation techniques and neutron scattering contribution. To test the effectiveness of additional correlations, the Distance correlation, Pearson Product-Moment correlation, and their weighted versions were performed between measured spatial detector responses obtained from nine different test spectra, and the spatial response of Library functions generated by MCNPX. Results indicate that there is no advantage of using the Distance Correlation over the Pearson Correlation, and that weighted versions of these correlations do not increase their performance in evaluating dose. Both correlations were proven to work well even at low integrated doses measured for short periods of time. To evaluate the contribution produced by room-return neutrons on the dosimeter response, MCNPX was used to simulate dosimeter responses for five isotropic neutron sources placed inside different sizes of rectangular rooms made out of concrete walls. Results show that the contribution of scattered neutrons to the response of the dosimeter can be significant, so that for most cases the dose is over predicted with errors as large as 500%. A possible method to correct for the contribution of room-return neutrons is also assessed and can be used as a good initial estimate on how to approach the problem.