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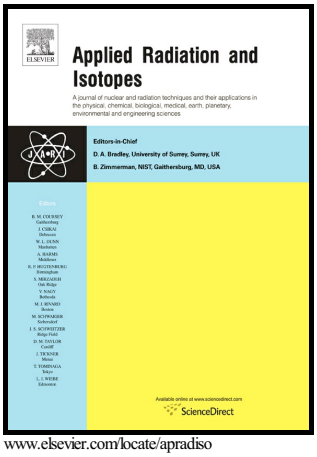

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Simulation of a complete X-ray digital radiographic system for industrial applications

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Abstract

Simulating X-ray images is of great importance in industry and medicine. Using such simulation permits us to optimize parameters which affect image's quality without the limitations of an experimental procedure. This study revolves around a novel methodology to simulate a complete industrial X-ray digital radiographic system composed of an X-ray tube and a computed radiography (CR) image plate using Monte Carlo N Particle eXtended (MCNPX) code. In the process of our research, an industrial X-ray tube with maximum voltage of 300 kV and current of 5 mA was simulated. A 3-layer uniform plate including a polymer overcoat layer, a phosphor layer and a polycarbonate backing layer was also defined and simulated as the CR imaging plate. To model the image formation in the image plate, at first the absorbed dose was calculated in each pixel inside the phosphor layer of CR imaging plate using the mesh tally in MCNPX code and then was converted to gray value using a mathematical relationship determined in a separate procedure. To validate the simulation results, an experimental setup was designed and the images of two step wedges created out of aluminum and steel were captured by the experiments and compared with the simulations. The results show that the simulated images are in good agreement with the experimental ones demonstrating the ability of the proposed methodology for simulating an industrial X-ray imaging system.

Keywords: X-ray tube, Computed radiography, Imaging plate, Industrial radiography, MCNP simulation.

1. Introduction