PERSONAL DOSE COMPUTATION WITH THE AID OF STAFF MONITORING SYSTEMS BASED ON 3D DEPTH CAMERAS

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For more than 50 years, passive dosimeters have been used to assess the dose to workers occupationally exposed to ionizing radiation. Such dosimeters are designed to measure the operational quantity $H_p(10)$ as an estimate of the effective dose, E, which is a quantitative expression of the “radiation detriment” that cannot be measured directly. With these dosimeters, the results are mostly known only after some time, and wearing a dosimeter is often seen as a burden by some workers. Furthermore, the uncertainties associated with the present dosimeters (within a factor of 1.5 or 2 from the real value) are not negligible.

In line with the current move to more real-time personal dose monitoring, we are working towards an innovative approach based on computational methods to determine occupational exposures. The aim of this research is to calculate doses to workers instead of measuring them. For this, the spatial radiation field, including energy and angular distribution, needs to be known. The real movement of the persons in a given workplace can be monitored in real-time using Time-of-Flight cameras and flexible computational phantoms representing the workers anatomy can be positioned using the tracking information. Finally, all this input data should be transferred to a tool, using Monte Carlo techniques to calculate the doses to the workers.

As a first step, a tool used to track a person in 3D coordinates using Microsoft® Kinect™ was developed. The tool, which is utilizing the skeleton tracking algorithm embedded in the Kinect SDK from Microsoft, is capable of correctly tracking the worker movement in real-time. A series of validation experiments were performed to test the tracking tool and the dose calculation method. An anthropomorphic phantom was positioned on a moveable table in the horizontal irradiator of the Laboratory for Nuclear Calibration (LNK) at SCK•CEN. The phantom was moved to different distances from a Cs-137 source. The position of the phantom was monitored with the Kinect™ and the coordinates recorded. The dose to the phantom was calculated using different methods: 1. Using the reference values from the calibration facility (LNK), 2. Using VISIPLAN-3D: An analytical dose assessment tool developed at SCK•CEN, 3. Using MCNPX Monte-Carlo simulations, and 4. Using InstaDose® dosimeters based on direct ion storage technology. A comparison was made between each method and results showed good agreement between the reference, the measured and the calculated dose. This experiment was repeated with different degrees of complexity of movement of the phantom. This first test proved the validity of the methodology used.