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Three-dimensional visualization of a beta-emitting nuclide by combining a directional Geiger-Mueller counter and Structure from Motion

At the Fukushima Daiichi Nuclear Power Station (FDNPS) where the accident occurred due to large tsunami caused by the Great East Japan Earthquake of 11 March 2011, it is important to understand and visualize the distribution of radioactive substances in order to reduce exposure dose of workers and to establish decontamination plans.

We focused on the importance of visualizing beta-emitting nuclides in addition to gamma-emitting ones to reduce the exposure dose of workers at the FDNPS, and proposed a method for three-dimensional (3-D) visualizing the position of beta-emitting ones. It is also important in discussing the effective dose of the crystalline lens of the eye.

We prepared a directional detector to beta rays by equipping the Geiger-Mueller (G-M) counter with a resin collimator. By combining the counter with Structure from Motion (SfM) technology using a digital camera, the self-position and posture information of the measurement system on the movement trajectory can be estimated one by one. Since the counter has directivity, it is possible to estimate the position of the beta-emitting nuclide on the 3-D model reconstructed with SfM from each position on the movement trajectory. In the demonstration test, the ^{90}Sr - source position was visualized in three dimensions. In the presentation, detailed visualization techniques will be reported.

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