

Direction Vector Visualization of Scattered Radiation for fluoroscopy by PHITS/PHITS による透視検査のための散乱線方向ベクトルの可視化

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In fluoroscopy, radiation shielding effectively reduces radiation exposure to medical staff [1]. However, it is still unclear how to understand where the scattered radiation comes from and how to properly use radiation shields. The purpose of this study is to clearly visualize the direction of scattered radiation to assist in the optimal use of radiation shields.

The Monte Carlo code PHITS [2] was used to simulate the behavior of scattered radiation under fluoroscopy. The direction vector was obtained by counting the number of photons passing through the plane of each voxel. The voxel space divides the entire fluoroscopy room at regular intervals. The simulations included the x-ray tube, C-arm, water phantom, and couch of the C-arm fluoroscopy system. Scattered photons from the patient were depicted by 3D arrows. Cross sections of the dose distribution were superimposed on the direction vectors. A surgeon model was also included to observe the direction of the scattered rays when the height of the protective plate was adjusted.

The directional vector of the radiation radiating around the patient could be visualized; changing the angle of the C-arm affected the direction and intensity of the radiation. The protective plate effectively shielded the surgeon's head, especially when placed at a height of 130 cm from the floor, resulting in a 99.1% dose reduction.

References

- [1] ICRP, 2018. Occupational radiological protection in interventional procedures. ICRP Publication 139. Ann. ICRP 47(2).
- [2] T. Sato, Y. Iwamoto, S. Hashimoto et al., "Features of Particle and Heavy Ion Transport code System (PHITS) version 3.02", J. Nucl. Sci. Technol. 55(5-6), (2018), pp. 684-690.

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