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# Dual-Energy Pinhole-Type Fluorescent X-Ray Computed Tomography for Scatter Correction

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## 1 Introduction

We have so far proposed a pinhole-based FXCT (p-FXCT) system with a 2-D detector and volumetric beam [1]. This system enables faster data acquisition by completely eliminating the need for translational scans, and the first 3-D FXCT image of a physical phantom was obtained using this system. However, the energy resolution of the 2-D detector was not sufficiently high to enable discrimination between the fluorescent and stray scattered x-rays according to their energies. Even if the detector was perpendicular to the incident beam so that photons scattered via Compton, Thomson, and multiple scattering could be prevented from impinging upon the detector, contamination was inevitable. Since all of the detected x-ray photons were used in the reconstruction and were treated as if they were fluorescent x-ray photons, the background noise was enhanced, and the image quality deteriorated. We propose a pinhole-based fluorescent x-ray computed tomography (p-FXCT) system with a 2-D detector and volumetric beam that can suppress the quality deterioration caused by scatter components [2]. In the corresponding p-FXCT technique, projections are acquired at individual incident energies just above and below the K-edge of the imaged trace element; then, reconstruction is performed based on the two sets of projections using a maximum likelihood expectation maximization algorithm (ML-EM algorithm) that incorporates the scatter components.

## 2 Experiment

Figure 1 shows a schematic diagram of the proposed imaging geometry. An incident monochromatic volumetric beam, with photon fluxes parallel to one another are linearly polarized within a horizontal plane, impinging and covering the object. Imaging agents, such as iodine, are thus excited and isotropically emit x-ray fluorescent photons on de-excitation [3,4]. A thin W plate with a pinhole is placed between the object and the CCD camera, such that the plate surface and the detective surface are parallel to the beam propagation. Only fluorescent photons passing through the pinhole are detected by the 2D detector without energy resolution. The projections are acquired just above and below the K-edge energy (33.4 and 33.0 keV). The procedure is repeated while rotating the object over 180 degrees.

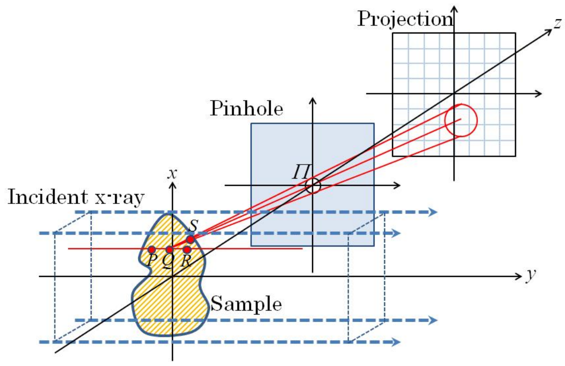
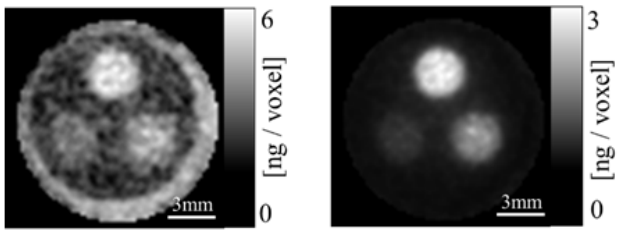



Fig. 1 Schematic diagram of the p-FXCT geometry




(a) (b)

Fig. 2 (a) Simple subtraction, and (b) the proposed method.

## 3 Result

We imaged a 10-mm-diameter acrylic cylinder having three 3-mm-diameter channels which were filled with I solution of three kinds of concentration (0.1, 0.2, and 0.3 I mg/ml). Figure 2(a) and (b) are the reconstructed cross-sections of the phantom obtained using simple subtraction, *i.e.*, subtraction of the reconstructed image below the K-edge from one above the K-edge, and the proposed method based on the ML-EM algorithm, respectively. The back ground noise was removed and the contrast was improved using the proposed method.

## References

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