

FIRST EXPERIMENTAL RESULT WITH FLUORESCENT X-RAY CT BASED ON SHEET-BEAM GEOMETRY

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Introduction

Fluorescent X-ray CT (FXCT) enables us to reveal the cross-sectional distribution of very low concentration of specific elements, e.g., I, Gd, or Au, in biomedical samples at a high spatial resolution of hundreds of μm . We have developed the first generation of FXCT imaging system to collect fluorescent photons emitted from iodine using a thin incident beam [1-4]. Since the current system employs a data-acquisition scheme of the first generation type of CT, it requires huge time to obtain a whole set of projections. In order to overcome the problem, we propose a novel imaging geometry using a sheet incident beam [5].

Experiments

In order to prove the concept of this imaging protocol, we constructed a preliminary imaging system for simulating the proposed imaging geometry using a single HPGe SSD at the BLNE-5A bending-magnet beamline (6.5GeV), KEK in Japan. A white-x-ray beam from a source was monochromatized using a monochromator Si (220) at 37 keV. The photon flux rate in front of the object was approximately 9.3×10^7 photons/mm²/s for a beam current of 40 mA. The monochromatized beam was shaped to a sheet beam of 2.0 cm wide x 1.0 mm thick using an x-ray slit. An HPGe detector operating in photon-counting mode to detect emitted fluorescent photons. To confirm the efficacy, we performed an imaging experiment using a physical phantom and a normal mouse brain at ex-vivo state. First, the sample was scanned translationally along the beam direction, and after the translational scan the sample was rotated. Although the data-collection scheme is sequential, the data set finally obtained corresponds with that acquired using the linear array of detectors.

Results and discussion

Fig.1 shows the reconstructed image of the phantom and mouse brain. In the Fig.1 (a), three circles corresponding to the regions including the iodine solution are successfully delineated. In the Fig.1 (b), the cortex and thalamus can be identified anatomically, and the iodine content of the brain is estimated to be about 20

$\mu\text{g/ml}$. From the results, we can conclude that the proposed scheme can also offer quantitative biomedical information related to cerebral perfusion at a high spatial resolution. If the detector elements are two-dimensionally arrayed, we can obtain a 3D CT image by piling up the 2D tomographic images. In addition, if the CCD camera is placed downstream of the object, we can simultaneously obtain a transmission image that can provide auxiliary data for attenuation correction and morphological information. The proposed FXCT can therefore simultaneously obtain both morphological and functional information, while PET/CT requires separate measurements to obtain the two kinds of images.

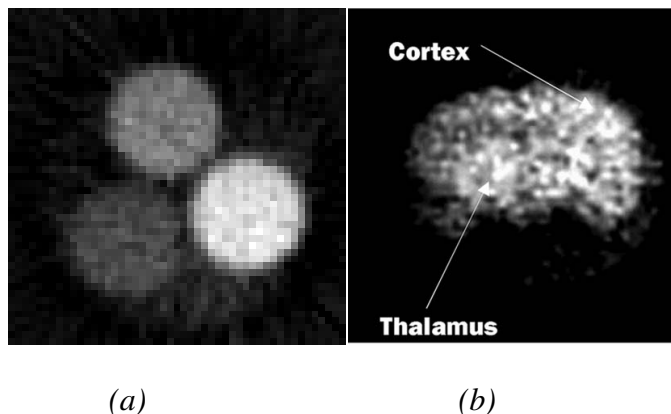


Fig.1: The reconstructed image (a) phantom and (b) mouse brain.

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