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P2.66: First application of sparse-view image reconstruction with total-variation minimization for SiPM-based photon-counting CT

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Photon-counting computed tomography (PC-CT) is a type of next-generation X-ray CT system for medical applications. It enables quantitative evaluation, such as concentration estimation, which is not possible with conventional CT systems. This is because the number and energy information of the individual incident X-rays can be obtained by reading them out in pulse form. By utilizing this property to estimate the concentration of contrast agents injected into the body, it is expected to expand the possibilities of novel diagnostics, such as drug delivery systems. Therefore, we established the SiPM-based PC-CT system combined with the YGAG scintillators [1, 2, 3] and evaluated its performance in several cases [4, 5]. However, to estimate the concentration of contrast agents flowing inside small animals more accurately, the temporal resolution of CT imaging needs to be improved [5]. In such a situation, the sparse-view CT technique, which involves reconstructing CT images from the smaller number of projections than that of conventional way [6], is an attractive method that enables CT imaging with shorter duration without degrading image quality. In this presentation, we report the initial results of an image quality evaluation of sparse-view CT images obtained with our established SiPM-based PC-CT system. We used static phantoms equivalent to an iodine contrast agent as the subject (Fig. 1). The six energy thresholds were set to 11, 33, 55, 65, 75, and 90 keV; and the tube voltage and tube current were set to 120 kV and 0.1 mA, respectively. We then obtained the projection data and applied the image reconstruction method based on total variation minimization to the sparsely view-sample sinogram data with the number of projections reduced to 1/5 of the original (Fig. 2). As part of the results, from the sparsely sampled data, we successfully reconstructed the CT images equivalent to ones from the sinogram data of the original. Furthermore, we obtained the correct CT values in the region of 5 mg/mL of iodine within the standard deviation. In addition, the standard deviation with sparse-view CT is 34.0% smaller than the conventional one in the 11–33 keV energy band (Fig. 3). This means that the total imaging time could be reduced to 1/5 while improving image quality by 34.0%, i.e.; the X-ray dose could also be reduced to 1/5. Finally, we also performed sparse-view CT imaging on mice injected intravenously with iodine contrast agents. We briefly report the results of the quantitative evaluation.

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