Biography

In March 1990. Hiroyuki Kudo received his doctoral degree in electrical and communication engineering from the Tohoku University, Japan. Since then, he has worked at the Tohoku University for 2 years, and then at the University of Tsukuba for 28 years. Currently, he is a Professor at Faculty of Engineering, Information and Systems, the University of Tsukuba, Japan. His scientific interests include medical image analysis, image reconstruction for medical tomography devices such as Computed Tomography (CT) and Positron Emission Tomography (PET), and computer-aided-diagnosis. In particular, he spent a long time of his research career to develop advanced image reconstruction methods in tomography. Most of his research results have been published in top journals in this research field such as Physics in Medicine and Biology and IEEE Transactions on Medical Imaging. Furthermore, his papers have been cited 4,000 times in Google Scholar and 2,000 times in Web of Science, in total. In the past, he has served as a scientific or program committee member for the International Meeting on Fully 3-D Image Reconstruction in Radiology and Nuclear Medicine (Fully 3-D Meeting), the International Meeting on Image Formation in X-Ray Computed Tomography (CT Meeting), and the IEEE Medical Imaging Conference. He was a co-chair of the Eighth Fully 3-D meeting in 2005. He has also been serving as an Editor in Chief of the Journal Medical Imaging Technology (MIT), and worked as a Guest Editor for IEEE Transactions on Medical Imaging. He received best paper awards more than 10 times from several international and domestic journals by his papers on advanced tomographic image reconstruction methodologies. He received the IEICE (The Institute of Electronics, Information, and Communication Engineers, Japan) Fellow award for his contributions on "cross-sectional image reconstruction methods in medical computed tomography". In 2018, he obtained Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology for his contributions on "research on design method and image reconstruction method for new CT", which is one of highest awards on science and technology in Japan.

Title of my talk

Image Reconstruction for Sparse-View CT and Interior CT

Abstract

Since 2000, it has been widely recognized that radiation dose in CT examinations increases cancer risk. To overcome this drawback, new designs of CT scanners such as sparse-view CT and interior CT have been actively investigated in CT community. The sparse-view CT refers to CT in which the number of projection data is reduced to decrease patient dose as well as to accelerate data acquisition. The interior CT refers to CT in which x-rays are radiated only to a small region of interest (ROI) to decrease patient dose. A key in these scanners is how to reconstruct images with sufficient quality from the limited projection data. This talk mainly consists of two parts. The first part is concerned with image reconstruction for the sparse-view CT using Compressed Sensing (CS) and Deep Learning (DL). CS is a promising technique appeared around 2005, which is able to reconstruct high-quality images even from the limited number of projection data. Furthermore, since 2018, DL has also been investigated for the sparse-view CT image reconstruction. The explanation will be constructed as follows. First, we explain basic knowledge on this subject, which includes the principle of sparse-view CT, as well as the principle of CS and DL image reconstruction. Second, we introduce our recent research activities on this topic, as well as showing application examples to medical x-ray CT, x-ray phase CT, and electron tomography. The second part is concerned with image reconstruction for interior CT. For a long time up to 2007, it had been believed that exact image reconstruction in the interior CT is impossible, because the Radon transform operator corresponding to the interior CT possesses a complicated null space. Since 2007, however, several exact solution methods have been discovered in the CT community. To guarantee the solution uniqueness, some of them use very small prior knowledge on the object, and others use very small additional measurement of projection data. We introduce these research activities including ours toward the exact interior tomography. We also show application examples to medical x-ray CT and x-ray phase CT.