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First application of super-resolution imaging technique using a Compton camera

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In medical imaging, precise and reliable images are very important. However, the quality of images is sometimes limited because of low-event statistics owing to the lack of sensitivity of detectors in radiology. However, long exposure to radiation and a long inspection duration become a burden for the patients. In this paper, we propose a method for generating/predicting high quality images of gamma-ray sources from low statistic data by using machine learning, particularly, sparse coding and dictionary learning. As a first application, we generated/predicted a high-quality image of 137-Cs, which emits 662-keV gamma rays from low-event statistics measured using a Compton camera. We simulated various geometries of the gamma-ray source (137-Cs; 662 keV) with the Compton camera by Geant4. Then, a complete set of low-resolution and high-resolution dictionaries were prepared. We acquired the images reconstructed from actually measured data as test samples. The convergence of gamma-ray image was found to be similar for the real and predicted images, which was also supported by an improvement of the structural similarity. We also discussed future plans to use this technique for visualizing radium chloride (223-Ra) in the patient's body, which makes the in-vivo imaging of alpha-particle internal therapy possible for the first time.

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Author: SATO, Shogo (Waseda university)

Co-authors: KATAOKA, Jun (Waseda University); Prof. KOTOKU, Jun'ichi (Graduate School of Medical Care and Technology, Teikyo University); Mr OYAMA, Asuka (Graduate School of Medical Care and Technology, Teikyo University); Mr TAGAWA, Leo (Waseda university); FUJIEDA, Kazuya (Waseda University); Mr NISHI, Fumiya (Waseda University Research Institute for Science and Engineering)

Presenter: SATO, Shogo (Waseda university)

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