

Scatter Estimation Using Measured Energies in CT, PET, SPECT or Other Imaging Modalities (P-1375)

Key facts

- Real-time scatter estimation, enabled by machine learning
- Successful demonstrations in X-ray computed tomography and positron emission tomography
- Improved accuracy promised by using energy measurements

Abstract

In imaging modalities that use ionizing radiation, such as X-ray computed tomography (CT) or positron emission tomography (PET), photon scattering decreases image contrast and impedes image quantification. Therefore, scatter correction is essential, but accurate scatter estimation is often prohibitively time-consuming. Machine-learning can be employed for real-time, highly accurate scatter estimation (Deep Scatter Estimation, DSE), but so far, accuracy is limited by the use of measured photons in only a single energy bin.

The Technology

This invention is based on the assumption that large-angle, low-energy scatter (which is often discarded as much as possible) contains useful information about low-angle, high-energy scatter (which shall be estimated and removed from the measured data) that can be leveraged by machine learning. The invention uses energy measurements to discern measured photons by energy bin. Multiple raw-data images can be formed from raw data acquired in multiple energy bins, and used for machine-learning approaches such as convolutional neural networks (compare Figure 1).

Development Stage

Deep scatter estimation has been successfully demonstrated in clinical X-ray CT [1] and clinical PET imaging [2]. Employing additional energy measurements is currently under investigation at the DKFZ.

Applications and Commercial Opportunity

The invention can be used in any industrial or medical imaging modality which uses ionizing radiation

and suffers from scattered photons, and which can differentiate measured photons by their energy (e.g., positron emission tomography, single photon emission computed tomography, energy-selective X-ray computed tomography).

Inventor

The inventors are Dr. Yannick Berker and Prof. Marc Kachelrieß of the Division of X-Ray Imaging and Computed Tomography at the DKFZ.

Intellectual Property

The priority patent application "A method for generating an image of an object from measurement data" EP 18186298.8 was filed July 30th, 2018, but has not been published yet.

References

[1] Maier, Kachelrieß et al. *Med Phys* 2018.

<https://doi.org/10.1002/mp.13274>

[2] Berker, Kachelrieß et al. *IEEE NSS/MIC* 2018.

<https://goo.gl/eCSeJC>

Further Information

No other public information is currently available.

DKFZ Contact:

For further information, including a CDA, please contact:

Dr. Frieder Kern
Deutsches Krebsforschungszentrum
Technology Transfer Office T010
Email: F.Kern@dkfz.de
Tel.: +49-(0)6221-42-2952

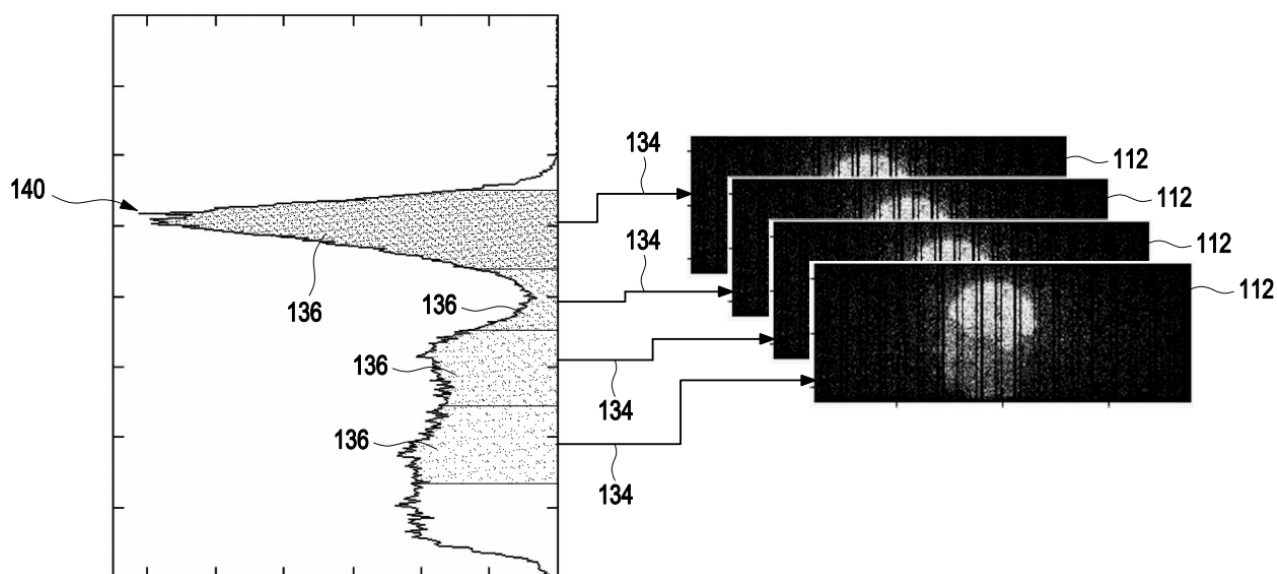


Figure 1. Left: in positron emission tomography, the spectrum of measured photon energies comprises a full-energy peak (140) contaminated with high-energy scatter, as well as contributions from lower-energy, scattered photons. Currently, lower-energy photons are discarded, and Deep Scatter Estimation uses photon measurements from only the full-energy peak to form a single raw-data image for machine learning. This invention involves using multiple energy bins (136), including the ones below the full-energy peak, for additional information about scatter contributions within the full-energy peak. Right: the information from multiple energy bins can be used to form an ensemble of raw-data images for machine-learning, e.g., for training a convolutional neural network (CNN) and, subsequently, inputting into the trained CNN.