

A method to eliminate beam hardening artifacts and to improve CT quantitative imaging ability

Unmet Need

For many commercially available CT scanners, the photons emitted from the X-ray source spread within a wide and continuous distribution of energy spectrum. As the poly-energetic X-ray beam passes through matter like tissue, bone, and implants, beam-hardening artifacts are generated. The various artifacts, such as cupping and streaks, affect the voxel values in the reconstructed image, and make the quantitative evaluation of attenuation properties challenging. Ever since the first clinical CT scanner in 1967, numerous efforts have been made to address this challenge via poly-energetic reconstruction. However, the current methods are limited based on tissue or other material type, require complicated adoption, or have limited quantitative performance based on the resulting image reconstruction. There is a need for improved methods that can accurately reconstruct artifact-free images with poly-energetic spectrum that can be applied to CT scanners.

Technology

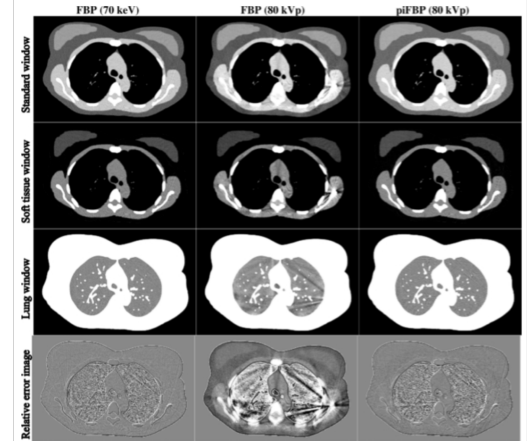
Inventors at Duke have developed a method to eliminate beam hardening artifacts and to improve CT quantitative imaging ability. This is intended to be applied in post-processing of commercially available CT scanners. Specifically, this is an algorithm-based method that incorporates diverse base materials, including lung, fat, breast, soft tissue, iodine, and metal implants into the reconstruction process. The technology has been demonstrated to efficiently generate artifact-free iodine maps and effectively eliminate beam hardening artifacts caused by bone and metal implants for quantitative analyses. A phantom experiment on a clinical CT scanner offered absolute relative errors of less than 0.4% across material inserts.

Other Applications

This method could also be applied to other X-ray imaging modalities in fields beyond medical imaging, such as security, military, and industry applications.

Duke

LICENSING & VENTURES



Duke File (IDF)

T-004343

Inventor(s)

- Lin, Yuan
- Samei, Ehsan

Links

- [From the lab of Dr. Ehsan Samei](#)

College

Trinity College of Arts & Sciences

For more information please contact

Chang Villacreses, David
9196683401
david.chang@duke.edu

Advantages

- Can incorporate the knowledge of various base materials (e.g., fat, breast, soft tissue, bone, iodine, and metal implants) and the spectrum information into the reconstruction process
- Not influenced by patient motion artifacts
- Fast reconstruction process
- Ready for clinical applications on current single spectrum CT scanners

Publications

- [An efficient polyenergetic SART \(pSART\) reconstruction algorithm for quantitative myocardial CT perfusion \(Medical Physics, 2014\)](#)
- [A fast poly-energetic iterative FBP algorithm \(Phys Med Biol, 2014\)](#)
- [Development and validation of a segmentation-free polyenergetic algorithm for dynamic perfusion computed tomography \(J Med Imaging, 2016\)](#)
- [Issued US Patent 10,121,267](#)

Patents

Patent Number: 10,121,267

Title: SPECTRAL ESTIMATION AND POLY-ENERGETIC RECONSTRUCTION METHODS AND X-RAY SYSTEMS

Country: United States of America