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

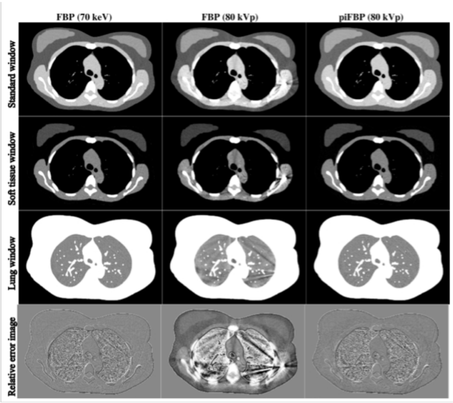
Inventors at Duke have developed a method to eliminate beam hardening artifacts and to improve CT quantitative imaging ability. This is intended to be applied in post-processing of commercially available CT scanners. Specifically, this is an algorithm-based method that incorporates diverse base materials, 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.

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



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Meet the Inventors

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Publication(s)

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External Link(s)

• From the lab of Dr. Ehsan Samei