

FLEXIBLE, “SINGLE-SHOT” IMAGE RECONSTRUCTION SYSTEM FOR FASTER EIXPCT (EDGE ILLUMINATION X-RAY PHASE-CONTRAST TOMOGRAPHY)

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Technology Description

Joint reconstruction (“JR”) is a patented image reconstruction technique for “single shot” edge illumination x-ray phase-contrast tomography (EIXPCT). This system uses standard x-ray detection hardware and enables faster image acquisition times, lowering radiation exposure, without restrictive assumptions on the object or scanning geometry.

EIXPCT is a promising new imaging system that exploits x-ray refraction for unprecedented contrast of soft tissues and other objects which cannot be detected by standard absorption-based radiography. Conventional image reconstruction for EIXPCT includes a phase retrieval step that requires two or more images at each tomographic view angle, thereby increasing data acquisition times and elevating radiation exposure. JR solves this problem by generating an image from a “single shot” data set (i.e., a single image per tomographic view). This technique uses a novel iterative gradient-based algorithm to combine the phase retrieval and image reconstruction steps into one step. Furthermore, the JR approach improves on previous “single-shot” methods because it can be used with standard x-ray detection hardware and does not make restrictive assumptions about the object being scanned or the scanning geometry. This flexible technique could open the possibility of using EIXPCT in vivo for imaging lungs, joints or other soft tissues.

Stage of Research

The inventors validated JR with computer-simulations and experimental EIXPCT data sets. They plan to continue this research by constructing a full-scale small-animal CT system based on EIXPCT.

Publications - Chen, Y., Guan, H., Hagen, C. K., Olivo, A., & Anastasio, M. A. (2017). [Single-shot edge illumination x-ray phase-contrast tomography enabled by joint image reconstruction](#). *Optics letters*, 42(3), 619-622.

Applications

- **Medical and in vivo imaging** – image reconstruction for X-ray phase contrast tomography
- **Material testing and security scanning**

Key Advantages

- **Faster image acquisition** – “single-shot” edge illumination only requires a single image for each view angle, lowering both imaging time and radiation exposure
- **No restrictive assumptions on image reconstruction:**
 - could adapt to real-world imaging scenarios where object is comprised of more than one material
 - can be applied to both cone beam and parallel beam geometries

- compatible with current, readily-available x-ray detection hardware
- flexible for exploring innovative data acquisition protocols
- **Advantages of EIPXCT:**
 - higher contrast than conventional X-ray
 - could open possibility of imaging soft tissues, such as lungs and joints

Patents - [Single-shot method for edge illumination X-ray phase-contrast tomography](#) (U.S. Patent No. 10,598,612)