Medical Imaging

High Temporal Resolution Cardiac CT Imaging with Slowed Gantry Speed

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WARF: P08233US

Inventors: Guang-Hong Chen

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing an improved image reconstruction method that requires fewer data samples and results in images with increased temporal resolution.

Overview

In a computed tomography (CT) system, an X-ray source projects a fan-shaped beam, which passes through the object being imaged and hits an array of radiation detectors. The source and detector array are rotated on a gantry and measure a series of views made at different angular orientations during gantry's revolution. The X-ray dose administered during a CT scan is an issue due to the increased radiation patients can be exposed to, especially when undergoing routine CT scans. A high resolution and artifact-free image requires many views made at different angular orientations during gantry's revolution at high enough X-ray beam intensity. Dose level may be reduced by decreasing the beam strength or reducing the number of views, but either method reduces the signal-to-noise (SNR) ratio of the acquired image.

Cardiac CT is a particularly demanding task. Spatial resolution on the millimeter scale is necessary to visualize the small branches of the coronary arteries. In the past, electron beam CT (EBCT) without contrast media was used to assess coronary calcifications because the lack of moving parts enables very fast scan times. Although EBCT image acquisition provides high temporal resolution, it suffers from low spatial resolution. Recently, improvements have been made with state-of-the-art conventional rotating-gantry CT by increasing rotation speed so that rotation time has decreased from several seconds to about 0.35 seconds. However, even when two X-ray sources are mounted on the CT gantry, the temporal resolution is limited. A method is needed for cardiac CT imaging that provides high temporal and spatial resolution.

The Invention

UW-Madison researchers have developed an application of the PICCS image reconstruction method (see WARF reference number P08127US) for producing a time series of images with a higher temporal resolution than the temporal resolution at which the image data was acquired. In cardiac imaging, this allows use of slow gantry rotation for improved image resolution instead of continuing to increase the speed of gantry rotation, which is mechanically challenging.

For high temporal resolution cardiac imaging, a "cone-beam" arrangement such that the focal spot of the X-ray source and the detector define a cone-shaped beam of X-rays is used. The gantry rotation time is counter-intuitively slowed to about 10 seconds. This rotation time enables a single breath-hold for most cardiac patients, which reduces motion during imaging. During the cone-beam CT data acquisition, the ECG-signal will be recorded as 400 to 600 views of the cone-beam projection are simultaneously acquired during each gantry rotation. The acquired data will be used to reconstruct a "prior" image containing the heart that does not contain dynamic information and possibly contains motion-induced streaks. Next, the acquired projection data are "gated" using the ECG data so that there is one projection per heart beat and images can be reconstructed using data from each gated "window". This allows the PICCS algorithm to accurately reconstruct each cardiac phase. The resulting images have an ultra-high temporal resolution about 20 times better than images obtained using state-of-the-art CT scanners with increased gantry speeds.

Applications

- Image reconstruction with improved temporal resolution with CT, particularly cardiac CT

Key Benefits

- Improves temporal resolution over current state-of-the-art CT imaging techniques
- Allows slow gantry rotation speed for improved resolution without mechanical challenges

Additional Information

For More Information About the Inventors

- Guang-Hong Chen

Related Technologies

- For more information about the general method of PICCS, see WARF reference number P08127US.
- For more information about an application of PICCS with radiation therapy, see WARF reference number P08125US.
- For more information about a method to reconstruct images from time-resolved image data, see WARF reference number P08250US.
- For more information about prior image reconstruction in cardiac cone-beam CT, see WARF reference number P09177US02.

Tech Fields

- Medical Imaging : CT
- Medical Imaging : MRI
- Medical Imaging : Other diagnostic imaging

For current licensing status, please contact Jeanine Burmania at jeanine@warf.org or 608-960-9846