Prior Image Constrained Compressed Sensing (PICCS)

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WARF: P08127US

Inventors: Guang-Hong Chen

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a method for reconstructing a high quality image from undersampled image data.

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 most common method for reconstructing CT images from 2-D data is the filtered backprojection technique. However, in a typical filtered backprojection image reconstruction, anywhere from 400 to 1000 views are required to suppress image artifacts in a 2-D CT image. Furthermore, 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 at a 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.

In magnetic resonance imaging (MRI), a substance is subjected to a uniform magnetic field and the resulting magnetic moment causes a signal to be emitted, which may be received and processed to form an image. The region to be imaged is scanned in a sequence of measurements known as views, and the number of views determines the quality of the image and the length of the scan. If an insufficient number of views are acquired, streak artifacts are produced. However, reducing scan time is important to increase patient throughput, increase patient comfort and reduce motion artifacts. One strategy that has been developed to shorten scan time is parallel imaging, which uses undersampled spatial data to measure Fourier coefficients.

Although the data acquisition methods are different for CT and MRI, the challenge in image reconstruction is common: a method is needed to reconstruct a high quality image from an undersampled data set.

The Invention

UW-Madison researchers have developed a method for reconstructing a high quality image from undersampled image data that is applicable to a number of imaging modalities including CT, MRI and positron emission tomography (PET).

A seed image is acquired by using a prescan, reconstructing a high signal-to-noise (SNR) ratio image from data acquired through any modality, or from a fully sampled data set. This prior seed image is used to iteratively reconstruct a final output image from an undersampled data set taken of the same anatomical structure as the seed image. The high SNR seed image guides a mathematical manipulation of the data set, resulting in a high quality image constrained by the original high SNR image. The method typically requires only two to five iterations to achieve clinically useful images, resulting in a convergence speed much faster than any known iterative image reconstruction methods.

Applications

- High quality image reconstruction with CT, MRI or PET

Key Benefits

- Reduces streaking and artifacts caused by undersampled data, even in the presence of motion
- Allows image reconstruction of CT images acquired with less views and/or lower X-ray doses
- Reduces scan time in MRI imaging by requiring fewer data samples for image reconstruction

Additional Information

For More Information About the Inventors

- Guang-Hong Chen

Related Technologies

- 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 cardiac CT image data, see WARF reference number P08250US.

Related Intellectual Property

- View Continuation Patent in PDF format.

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