High Spatial and Temporal Resolution Dynamic Contrast-Enhanced Magnetic Resonance Imaging

Tech ID: 24928 / UC Case 2013-144-0

SUMMARY

UCLA researchers in the Department of Radiology have developed a novel acquisition and reconstruction method for dynamic high-resolution 3D contrast-enhanced magnetic resonance angiography (CE-MRA).

BACKGROUND

High-resolution 3D contrast-enhanced magnetic resonance angiography (CE-MRA) has emerged as a widely accepted and powerful technique for diagnostic assessment of almost all vascular territories. The non-invasive nature and lack of ionizing radiation combined with the safety of gadolinium-based contrast agents make CE-MRA an appealing alternative to digital subtraction angiography (DSA) and computed tomography angiography (CTA). Furthermore, dynamic (time-resolved) CE-MRA provides simplified scanning logistics and improved evaluation of the hemodynamic consequences of complex vascular anatomy and pathologies while avoiding some of the limitations of traditional single-phase CE-MRA, such as incorrect contrast bolus timing and venous contamination. However, due to limitations in image acquisition speed, it is difficult to achieve high temporal and spatial resolution at the same time. As a result, typical dynamic CE-MRA acquisitions have lower spatial resolution than conventional CE-MRA. Therefore, it is desirable to develop a dynamic CE-MRA acquisition and image reconstruction strategy that can provide a true temporal resolution higher than the currently available technology, or which can acquire high spatial resolution CE-MRA in a shorter time window than is currently available.

INNOVATION

Dr. Peng Hu and colleagues in UCLA's Department of Radiology have developed a novel acquisition and reconstruction method for dynamic CE-MRA. The present invention utilizes a magnitude subtraction based compressed sensing algorithm to achieve high acquisition acceleration (10x) and improved reconstruction image quality than previously accessible with other approaches. The invention enables very fast reconstruction, with volumes of images available within 10 to 15 minutes and offers multiple extensions possible in combination with parallel imaging or view-sharing techniques. The present invention provides a promising technique for dynamic CE-MRA imaging of complex vascular anatomy and for improved tissue perfusion quantification.

APPLICATIONS

- The invention can be used as a novel MRA option that replaces current Siemens commercial dynamic CE-MRA implementations (TWIST sequence), while reducing contrast agent doses and improving diagnostic quality.
- The invention can be extended to dynamic contrast-enhanced (DCE) perfusion MRI for oncological and cardiac applications.
- The invention can be applied to non-contrast MRI/MRA applications, such as dynamic arterial-spin labeling MRA, to shorten the acquisition time.
- The applications also encompasses perfusion-MRI and MR-angiography using contrast agents and non-contrast techniques.

ADVANTAGES

- The present invention can avoid temporal foot print issues associated with all three major vendors (Siemens, GE and Philips) to improve image quality.
- The present invention circumvents many of the drawbacks of existing k-space based complex subtraction methods.

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OTHER INFORMATION

KEYWORDS

Compressed sensing, magnetic resonance angiography, dynamic contrast-enhanced MRI, MRA, contrast, non-contrast, DCE-MRI, background suppression, digital subtraction angiography, DSA, computed tomography angiography, CTA, dynamic, time-resolved,, dynamic contrast-enhanced, DCE, acquisition, acceleration, k-space

CATEGORIZED AS

- **Engineering**
  - Engineering
  - Other
- **Imaging**
  - 3D/Immersive
  - Medical
  - Molecular
  - Other
- **Medical**
  - Diagnostics
  - Disease: Cardiovascular and Circulatory System
  - Imaging
  - Research Tools

STATE OF DEVELOPMENT

- The invention algorithm has been implemented based on a MRI pulse sequence provided by Siemens.
- The present invention has been tested retrospectively using fully sampled datasets that were exported from the scanner. The subsampling has been simulated and images were then reconstructed from the subsampled data.
- Plans for evaluating the invention for clinical applications are underway.

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,016,159	05/25/2021	2013-144
United States Of America	Issued Patent	9983285	05/29/2018	2013-144

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- An Improved Phase-Contrast MRI Technique
- An Accelerated Phase-Contrast MRI Technique
- A Novel MR Angiography Technique
- Improved Cardiac Late Gadolinium Enhancement MRI for Patients with Cardiac Devices

- Screening

RELATED CASES

2013-144-0

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