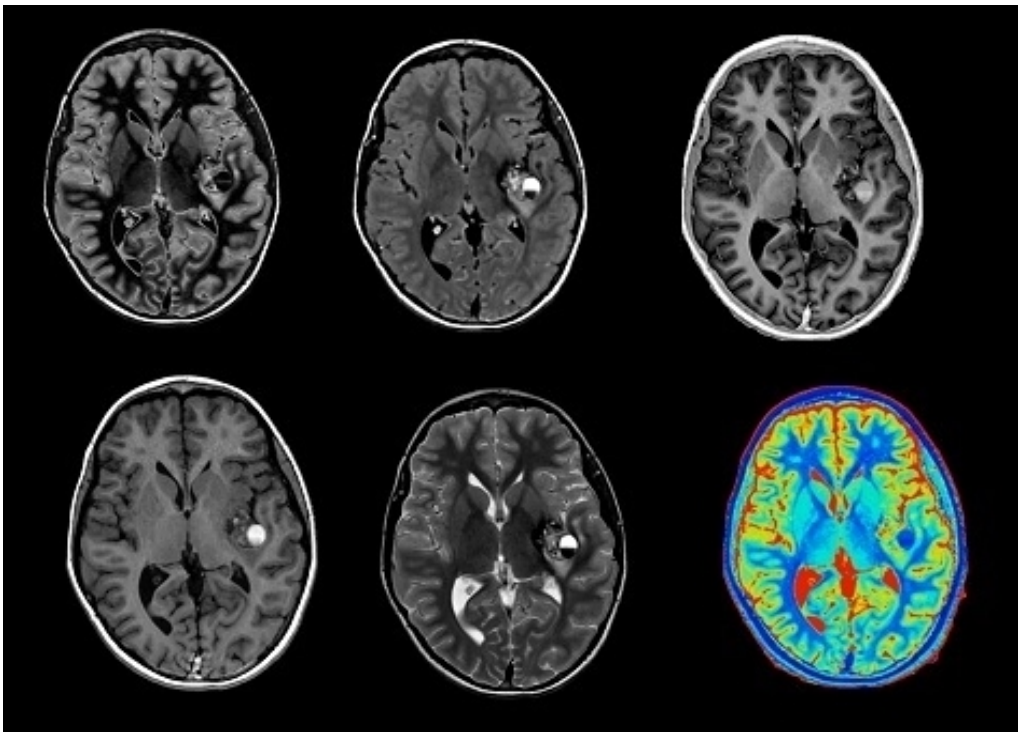


3T MR Research Program

Center for MR Research

University of Illinois at Chicago

TECH 2000 3T MRI RESEARCH FACILITY

SUMMER 2018 ISSUE

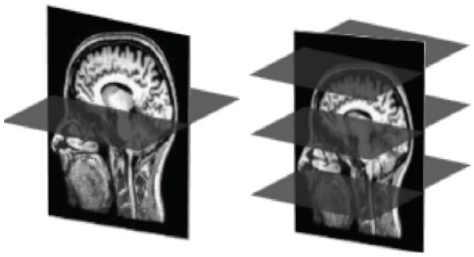
3T Research News

By Mike Flannery

The 3T MR Research Program has officially updated the 3T MR750 scanner to the DV26.0 software. We would like to thank all the research user groups for their patience as we made this transition. We now have the capabilities to acquire images with some of GE's most advanced imaging technology with enhancements to workflow, accelerated image reconstruction, applications and image post processing. The most significant step forward is obtaining the ability to conduct multiband DWI and fMRI in line with the Human Connectome Project (HCP) protocols.

HyperBand

HyperBand is an acceleration technique that excites and acquires multiple slices to reduce the scan times for both DWI and DTI imaging and allows for increased slice coverage at a lower TR for fMRI of the brain. Previous acceleration techniques speed up acquisition times by reducing the number of data points sampled. HyperBand simultaneously excites and acquires multiple slices to reduce the scan time while also minimizing SNR loss when compared to under sampling acceleration techniques. When combined with parallel imaging (ARC), HyperBand can achieve a scan time reduction of up to 4.



HyperBand key points:

- Increase the number of diffusion directions or increase the number of slices or use a higher temporal resolution without increasing scan time.
- Simultaneously excites and acquires multiple slices without compromising quantitative diffusion metrics (e.g. ADC and FA).
- Scan time reduction with less SNR penalty

HyperSense

HyperSense is a scan time reduction technique for 3D sequences that allows further increases in acceleration beyond parallel imaging alone by utilizing a pseudo-random k-space data sampling followed by an iterative reconstruction to decrease data acquisition time. Hypersense is compatible with all CUBE sequences, DIR, MRCP, PROMO and 3D TOF sequences.

The above MRA image of the brain was acquired with a HyperSense factor of 1.5. The scan time reduction was 7:41 to 4:07 by utilizing HyperSense

Research Highlight

Dr. Xiaohong Joe Zhou, PhD, DABR

Dr. Xiaohong Joe Zhou Inducted into Medical and Biological Engineering Elite

The American Institute for Medical and Biological Engineering (AIMBE) has announced the induction of Xiaohong Joe Zhou, Ph.D., Professor of Radiology, Neurosurgery, and Bioengineering; Director, Center for Magnetic Resonance Research - 3T Program, Department of Radiology, College of Medicine, University of Illinois at Chicago to its College of Fellows. Dr. Zhou was nominated, reviewed, and elected by peers and members of the College of Fellows for outstanding contributions to technical development of magnetic resonance imaging and exploring its applications in cancer.

Election to the AIMBE College of Fellows is among the highest professional distinctions accorded to a medical and biological engineer. The College of Fellows is comprised of the top two percent of medical and biological engineers. College membership honors those who have made outstanding contributions to "engineering and medicine research, practice, or education" and to "the pioneering of new and developing fields of technology, making major advancements in traditional fields of medical and biological engineering, or developing/implementing innovative approaches to bioengineering education."

A formal induction ceremony was held during the AIMBE Annual Meeting at the National Academy of Sciences in Washington, DC on April 9, 2018. Dr. Zhou was inducted along with 156 colleagues who make up the AIMBE College of Fellows Class of 2018.

Research spotlight

Girish Srinivasan, PhD

Dr. Girish Srinivasan is currently the Co-Founder and Chief Technology Officer of PhenoMx, Inc. He is involved in phenotyping imaging for precision medicine and innovating solutions for the creation of the digital physical exam that would allow for measuring the vital organs and tissues of the entire body non-invasively.

Dr. Srinivasan obtained his PhD at UIC in 2016. Working under the guidance of Dr. Joe Zhou at the Center for MR Research, Dr. Srinivasan designed and implemented a new fast motion robust MRI data acquisition technique and applied it for obtaining high resolution diffusion images of the brain. He also created a Diffusion Imaging Visualization Environment (DIVE)for processing MR diffusion images.

The following abstract has been presented by Dr. Srinivasan and his research team and was selected as the Monthly Highlight by journal "Magnetic Resonance in Medicine"

http://blog.ismrm.org/2018/05/18/qa-with-girish-srinivasan-and-joe-zhou/

Steer-PROP: a GRASE-PROPELLER sequence with interecho steering gradient pulses.

Purpose

This study demonstrates a novel PROPELLER (periodically rotated overlapping parallel lines with enhanced reconstruction) pulse sequence, termed Steer-PROP, based on gradient and spin echo (GRASE), to reduce the imaging times and address phase errors inherent to GRASE. The study also illustrates the feasibility of using Steer-PROP as an alternative to single-shot echo planar imaging (SS-EPI) to produce distortion-free diffusion images in all imaging planes.

Methods

Steer-PROP uses a series of blip gradient pulses to produce N (N = 3-5) adjacent k-space blades in each repetition time, where N is the number of gradient echoes in a GRASE sequence. This sampling strategy enables a phase correction algorithm to systematically address the GRASE phase errors as well as the motion-induced phase inconsistency. Steer-PROP was evaluated on phantoms and healthy human subjects at both 1.5T and 3.0T for T_2 - and diffusion-weighted imaging.

Results

Steer-PROP produced similar image quality as conventional PROPELLER based on fast spin echo (FSE), while taking only a fraction (e.g., 1/3) of the scan time. The robustness against motion in Steer-PROP was comparable to that of FSE-based PROPELLER. Using Steer-PROP, high quality and distortion-free diffusion images were obtained from human subjects in all imaging planes, demonstrating a considerable advantage over SS-EPI.

Conclusion

The proposed Steer-PROP sequence can substantially reduce the scan times compared with FSE-based PROPELLER while achieving adequate image quality. The novel k-space sampling strategy in Steer-PROP not only enables an integrated phase correction method that addresses various sources of phase errors, but also minimizes the echo spacing compared with alternative sampling strategies. Steer-PROP can also be a viable alternative to SS-EPI to decrease image distortion in all imaging planes. Magn Reson Med 79:2533-2541, 2018.