Denoising Magnetic Resonance Imaging Data

NOise reduction with DIstribution Corrected (NORDIC) technique for improving MRI imaging.

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Noise Variation Reduction in Magnetic Resonance Imaging

An algorithm that increases signal-to-noise (SNR) ratio in imaging data uses spatial-temporal properties of noise without applying assumptions on the underlying image signal. The technique, which improves already obtained image data and does not require modifying any existing sequences, can be applied to fMRI, diffusion (dMRI), arterial spin labeling (ASL), and quantitative parameter mapping. The algorithm uses sparsely overlapping blocks and a distance-weighted approach to combine these blocks, which reduces computational complexity and improves noise removal. The algorithm has a multi-scale dimension for selecting patches, and using varying patches and a weighted combination of patches improves noise removal. This parameter-free, locally low-rank noise variation reduction algorithm improves quantification of imaging data, leading to the use of higher resolution, by at least two-fold.

Improves SNR and Removes Noise

Clinical magnetic resonance imaging (MRI) acquisitions are inherently limited by SNR. Low SNR limits signal fidelity, reduces spatial resolution and can degrade the ability to make quantitative measurements. In addition, image constraint is normally applied with iterative algorithms where the constraint has to be tailored for each application. This technique removes noise and improves the apparent SNR, allowing for better determination of quantitative parameters, higher resolution. The parameter-free method deterministically selects a threshold, as opposed to heuristic or iterative methods for noise removal. While it does use complex valued signals for low SNR applications, these can trivially be extracted from the MRI system and used for applications such as SWI. For higher SNR data, the algorithm can be applied to magnitude MRI data, since the noise distribution is sufficiently close to Gaussian.

BENEFITS AND FEATURES:

- Parameter-free, locally low-rank soft-thresholding approach for SNR enrichment
- Reduction of noise variation; improved noise removal
- Improved determination of quantitative parameters
- Higher resolution; improved SNR without loss of spatial resolution
- Non-iterative (sparsely overlapping blocks, distance weighted approach)
- Reduces computational complexity
- No modifications of existing pulses sequences needed
- Particularly advantageous with non-uniform noise, such as that occurring in parallel imaging and multiband/simultaneous multi-slice (e.g., image acceleration techniques)
- Software implemented on an MR scanner for image reconstruction

APPLICATIONS:

Technology ID
20170236

Category
Engineering & Physical Sciences/MRI & Spectroscopy
Life Sciences/Diagnostics & Imaging
Life Sciences/Human Health
Life Sciences/MRI & Spectroscopy
Software & IT/Algorithms
Agriculture & Veterinary/Veterinary Medicine

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- Clinical applications; multiple imaging modalities
- Magnetic resonance imaging
- Medical diagnostic equipment
- Parallel imaging and multiband imaging/simultaneous multi-slice
- High resolution diffusion imaging
- High b-value imaging (diffusion)
- Arterial spin labeling
- Cardiac or anatomical imaging

Phase of Development - Software developed and tested. MATLAB code is available here for download for non-commercial entities.

Researchers

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References

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