Docket #: S17-454

Improved synthetic image contrast generation using Deep Learning

Synthetic MRI enables reconstruction of multiple contrasts from a single (multi-echo) scan which significantly improves scanning efficiency. However, the existing voxel-wise model-fitting method is not optimal and results in inaccurate parameter estimation and undesired artifacts. Here a deep learning method is proposed to improve the contrast synthesis from multi-delay multi-echo MR imaging. With synthetic MRI contrast (such as T2-FLAIR) from in-vivo datasets as an example, the proposed method outperforms existing model-fitting based method to overcome artifacts and improve synthesis accuracy. The invention is an essential component for delivering reliable and accurate synthetic MRI, further accelerating scanning and improving quantitative parameter mapping.

Applications

- 1. Generation of any arbitary contrast-weighted MRI images from raw MRI signals such as multi-delay multi-echo MRI sequences 2. Geneartion of MRI images with quantitative parameter mapping from raw MRI signals 3. Improve of the image quality of the synthetic MRI, for example to reduce flow artifacts, reduce partial-volume effects, improve resolution.

Advantages

- Existing method for generation the synthetic contrast is to conduct model fitting on a voxel-by-voxel basis. From the fitted parameter of the voxel, one can generate the synthetic contrast of MRI. Compared with the model-fitting contrast synthesis, the proposed data-driven deep learning solution demonstrates superior performance with improved accuracy (quantitatively compared with acquired T2-FLAIR images) and reduced artifacts (from

qualitative visual assessments). Model fitting method try to achieve a closest fitting of parameters but may lead to artifacts and errors in the synthesized images from the parameter since there is a nonlinear nonlocal transform. These artifacts and errors, for example incomplete suppression and pseudo-edge enhancement, are significantly reduced by using the data-driven deep learning method for contrast synthesis. In addition, model-fitting from multi-echo MRI cannot synthesize Gradient Echo MRI with T2* contrast, while the proposed method can.

Patents

- Published Application: 20210027436

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