INTRODUCTION

Parkinson’s disease (PD) is a chronic neurodegenerative disease that affects the motor region of the brain and causes uncontrollable movement, it is the second most common neurodegenerative disorder [Intro1] and approximately 9.4 million people suffer from PD worldwide [Intro2]. The disease’s pathophysiology is irreversible and currently has no cure. Having effective biomarkers for PD will allow early detection and accurate progress tracking of the disease, which provide strong support for PD treatment and new solution development. One of the early signs of PD is iron overloaded at the substantia nigra region [Intro4], and this raising tissue iron level leads to an effective Magnetic Resonance Imaging (MRI) PD biomarker, T2\* time constant [Intro3].

MRI signal decay exponentially against time with the time constant T2\*, which is tissue and magnetic field inhomogeneity dependent. The overloaded iron will distort the magnetic field and cause a more rapid decay of the MRI signal, which means a T2\* value fall at that region. Therefore, an abnormally small T2\* value can be used as an effective biomarker for Parkinson’s disease diagnosis [Intro5] [Intro6]. The traditional way of generating quantitative T2\* images is to acquire MR images at different times and fit the signal’s exponential decay in each voxel to get the T2\*, this technique is known as T2\* mapping based on Multi-Echo Gradient Echo (GRE) sequence [Intro7].

However, the motion of the brain makes acquiring MRI images very difficult, and a large amount of data can’t be used because of the low-quality acquired images caused by motion artefacts [Intro8]. Additionally, it is even more difficult to get an accurate T2\* image of the brain because multiple images are required to obtain one T2\* image, which makes the T2\* largely affected by patient motion.

A simple way to reduce the effect of motion will be acquiring more MR images and averaging them to reduce motion artefacts, but it will make the acquisition time long. Using a larger voxel size can also reduce the impact of movement on the resulting images. However, it is important to visualise the tiny millimetre size substantia nigra region using a high-resolution imaging technique, as using low-resolution imaging will lose important tissue information for the diagnosis of the disease [Intro8]. A more complex but accurate way is performing motion correction on the acquired images, the drawback will be the huge number of complicated calculations and takes long processing time for the data [Intro9]. Based on all these limitations of previous methods, it is desirable to find a new quantitative T2\* imaging method, which is robust to motion in the brain, not sacrificing resolution or scan time and does not require complicated image correction.

What's the new solution? And when/why is it better than the old ones?

* A new T2\* imaging technique is suggested, which can reduce the effect of motion while maintaining short acquisition time and good resolution, the technique is called k-space-aliased SPGR.
* The images acquired using the new technique are not simply related by decay time, they each contain information coming from different times of the T2\* decay. By extracting useful information from each image, the T2\* decay signal can be reconstructed and T2\* can then be calculated the same way as the traditional technique.
* Theoretically, even if the movement of the brain creates artefacts in some acquisition, it will not have a huge impact on the reconstructed T2\* decay signal, as the signal is obtained by averaging across multiple acquisitions.
* However, there was no quantitative analysis of the new technique’s T2\* accuracy, and no suggested optimal MRI scan parameters for the new technique. It is important to evaluate the new method’s T2\* accuracy and optimal parameters before analyzing the in vivo motion robustness of the new method.

Give a basic preview of the rest of the paper

* Analysis of the T2\* accuracy of the new method uses model simulation and finds the optimal scan parameters to be used in the MRI scan.
* Analysis MRI data acquired from a phantom uses the new method with optimal parameters and gold-standard method, which shows the new method is able to acquire acceptably accurate T2\*.
* Evaluation of the effective T2\* SNR compared with the current gold-standard method, shows a aligned effective T2\* SNR.
* **Advantage: observed**

References:

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