**INTRODUCTION**

What is the problem?

* Parkinson’s disease is irreversible, and early diagnosis is important.
* The tissue’s MRI property T2\* time constant is an effective biomarker for Parkinson’s disease early diagnosis.

MRI signal decay exponentially against time with the time constant T2\*, which is tissue and magnetic field inhomogeneity dependent. One of the early signs of Parkinson’s disease is iron overloaded at the substantia nigra region, the overloaded iron will distort the magnetic field and cause a change in T2\* at that region, therefore can be used as an effective biomarker for Parkinson’s disease diagnosis.

* So, it is very valuable to get the quantitative T2\* image of the brain, and a traditional way is to acquire images at different times and use the signal’s exponential decay in each voxel to get the T2\*.
* However, the motion of the brain makes acquiring MRI images very difficult, and a large amount of data can’t be used because of motion artefacts.
* And it is even more difficult to get a T2\* image of the brain because multiple images are required to obtain one T2\* image.

What are previous solutions?

* Taking several images and averaging them to reduce motion artefacts, but it will make the acquisition time long.
* Using a larger voxel size, so the movement will not have a huge impact, but it worse the resolution, and not able to see small tissue structures in the brain.

Why is this interesting?

* Desirable to find a method robust to motion in the brain, not sacrifice resolution or scan time, and able to accurately measure T2\*.

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 its in vivo motion robustness.

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 an aligned effective T2\* SNR.
* **Advantage: observed**

**METHODS**

Key concepts

* In MRI the signal acquired depends on the resonance H proton’s response to the radiofrequency excitation, different excitation strategies (also known as pulse sequence) can be used to acquire different information.
* Introducing k-space aliasing SPGR (ka-SPGR)
* Pulse diagram of ka-SPGR [Figure]
* Ka-SPGR is based on the analytical solution for RF spoiled GRE sequence [reference]
* Explaining the equation a bit.

Explain what we expect or predict.

* Fitting the F-state give T2\* value

Describe exactly what will be studied or focused on in the paper from a theoretical or conceptual perspective.

What are the details of the implementation? Use clearly labelled figures with captions where appropriate

Give reasons for these details/parameter choices

Make it so anyone familiar with your field can implement the method

Use a table summarizing parameters used for the experiments for different result sets. How experiments are carried out.

* Knowing the F-states of the signal under this pulse sequence can be used to fit exponential decay and obtain T2\* 🡪 analytical solution
* Find out how different TR and period selections may affect the T2\* calculation.

(Different periods and different TR allow us to acquire different points on the exponential fit, and also there is noise, so there will be optimal TR and period for T2\* calculation)

* Model performance of spins with different T2\* under different N-Periodic RF spoiling SSFP pulse, different TR, different period.
* See the accuracy of the T2\* fit.
* Find the TR and Period can generate smallest bias within MRI machine limit, 6ms TR.

**RESULTS**

The result of the experiments.

• Show comparative results: Use clearly labeled figures with captions!

• Describe what is seen in your results

• Was it as expected? Why or why not?

**DISCUSSION**

Limitation of the results

Future work