Temporal Scaling (TS) of Diffusion in the Isolated Rat Hippocampus

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Introduction

Last year we reported on new work applying a fundamentally new method, temporal scaling (TS) (1), to the isolated rat hippocampus. The method, inspired by the theory of Brownian motion in fractal and disordered media, characterizes TS of diffusion related quantities, and subsequently may yield novel information on tissue microstructure in normal and diseased tissues. Here we describe more on this work and its fruition leading to a recent publication (2).

Experimental

MRI was performed on isolated fixed rat hippocampi imaged on a 600MHz narrow bore Bruker instrument maintained in PBS at 37 ± 0.2 °C. Data were acquired in a *q*-space acquisition format. Image resolution was 78x78x500 microns. Subsequently TS analysis was applied (1) to yield a variety of maps reflecting different diffusion characteristics.

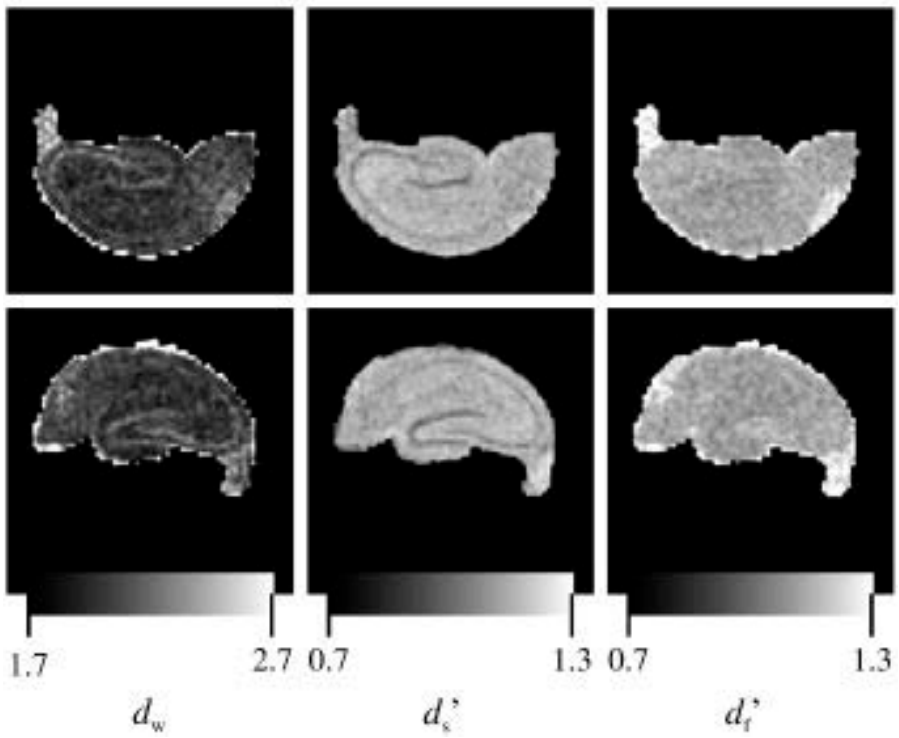

Figure 1. Maps of the walk dimension (d_w, left column), projected spectral dimension (d'_s, middle column), and projected fractal dimension (d'_f, right column) for two different excised rat hippocampi (the two rows).

Results and Discussion

The TS approach generates several parameter maps that relate different to tissue microstructure yielding a variety of maps. **Figure 1** shows some examples for the walk dimension, projected spectral dimension and projected fractal dimension. These images offer different contrast that may be informative on tissue microstructure.

Conclusions

The TS method generates image data with a fundamentally different contrast to the standard diffusion encoding methods. These may thus reflect different aspects of tissue microstructure that may be indicators for disease and/or response to therapy. This work has been published this year (2). Future work will look for contrast changes with disease, or perturbation studies on live tissues.

Acknowledgements

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References

(1) Ozarslan, E. *et al.* J. Magn. Reson., 183 (2):315–323 (2006).
(2) Ozarslan E, *et al*. NeuroImage, 60(2):1380–1393 (2012).