DIFFUSION WEIGHTED MRI: HOW TO DETECT AND HANDLE MEASUREMENT ERRORS DUE TO SUBJECT MOTION DURING CLINICAL IMAGE ACQUISITION

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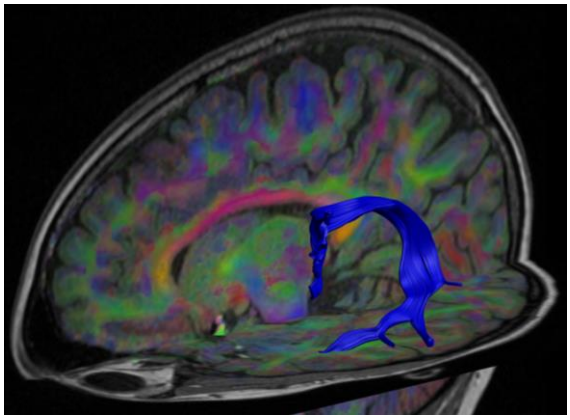

Fig. 1 *Tracing a white matter tract in a brain.*

Diffusion MRI can be used to model human brain white matter trajectories with non-invasive measurements (**Fig. 1**). This is achieved using specialized diffusion sensitive gradients fields in MRI acquisition that can detect the microscopic motion of water molecules [1]. However, errors non-related to this motion typically impede an unequivocal characterization of the diffusion process. For example, hardware issues and subject motion during the acquisition can induce an artificial signal increase or decrease which are typically seen as dark lines due to acquisition technique (**Fig. 2**, left). [2,3]

An image registration step that generally precedes diffusion model estimations is to correct for the misalignments of images due to subject motion in a long acquisition. However, it cannot correct for intensity errors. Consequently, in the presence of rotation these intensity errors will be distributed over multiple slices.

We have developed a tool for the automatic detection of these artefactual slices and a way to minimize their impact on the model estimation. The detection is based on the modified Z-score [4] of the intensity variances between different acquisition slices. We also show how these values are applied in weighted least squares diffusion tensor estimation is shown in **Fig. 2** middle and right.

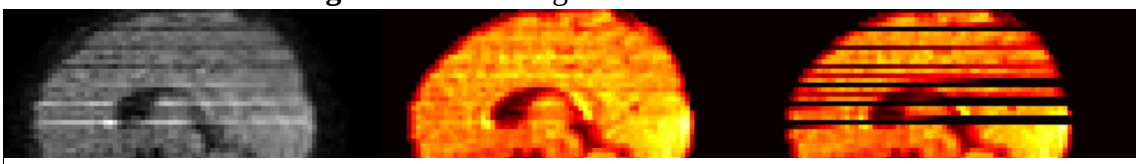

Fig. 2 Left: a diffusion MRI image with artefactual slices, middle: standard weights of a WLLS estimation, and right: artefacts are detected and their weights in the estimation are lowered accordingly i.e. the estimated model is not affected by the artefacts.

[1]Basser,et al. *J.Magn.Reson.***103**,247–54(1994) [2]Le Bihan,et al. *J. Magn. Reson. Imaging*. **24**, 478–88(2006) [3] Jones & Cercignani *NMR Biomed.***23,**803–20 (2010) [4] Iglewicz & Hoaglin ASQC Quality Press 36, (1993)