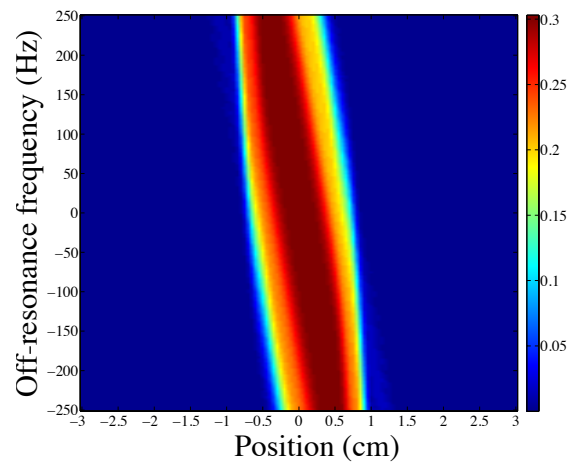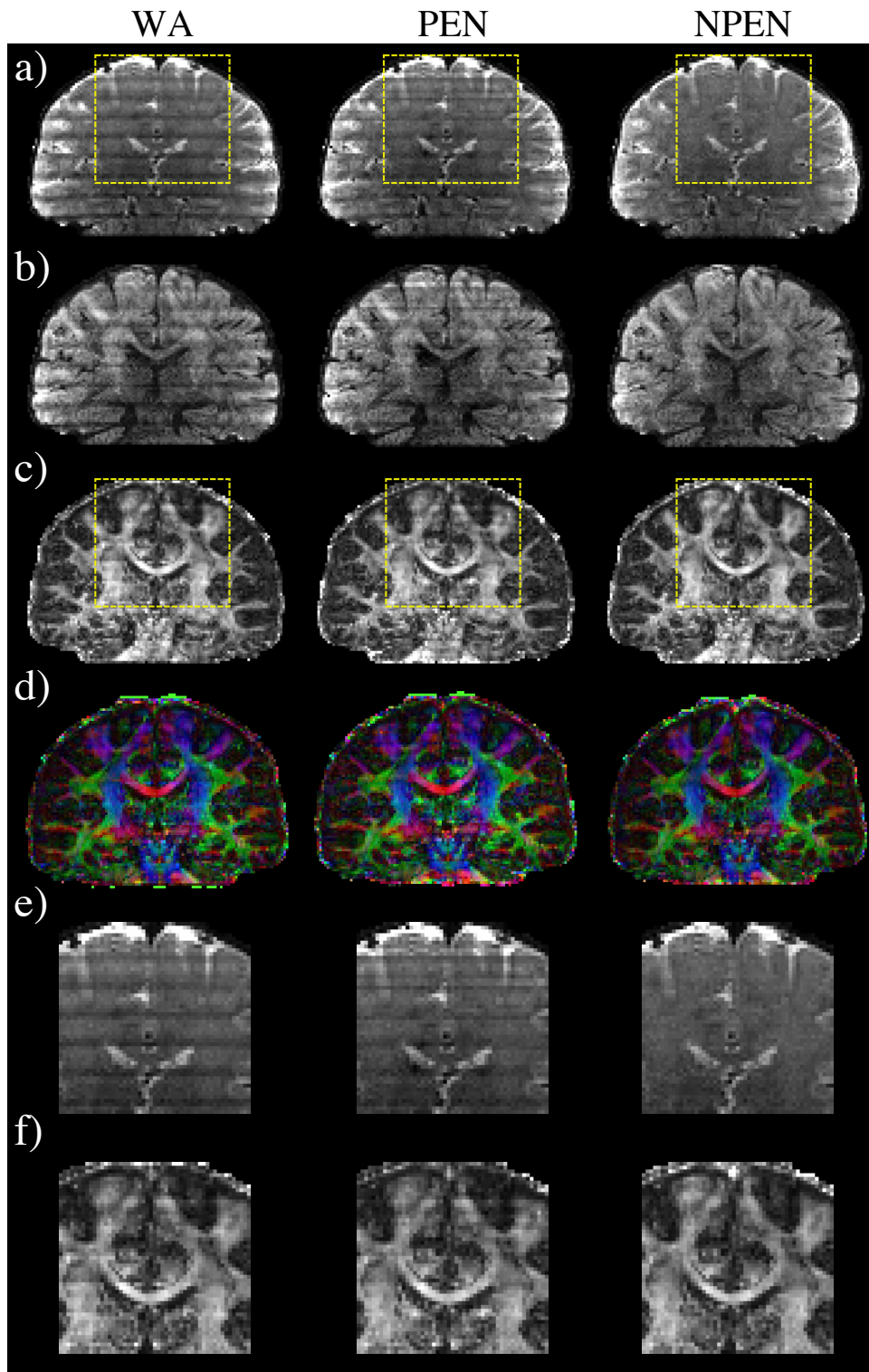Supporting FIG. S1. The waveforms of the excitation pulse (a) and the refocusing pulse (b) used in the simulation and in vivo scans. (c). The simulated signal profile with 1 slab, 2s TR.

Supporting FIG. S2. WM signal profile of one slab simulated at different off-resonance frequencies.

Supporting FIG. S3. A coronal slice of the reconstruction results based on the data acquired from a different subject. (a) b = 0 image. (b) DWI image (b=1000 s/mm^2). (c) FA maps. (d) Color-coded maps of the principal eigenvector (red: right-left, green: anterior-posterior, blue: superior-inferior). (e) and (f) are the zoomed-in regions specified by the yellow rectangles in (a) and (c) respectively.
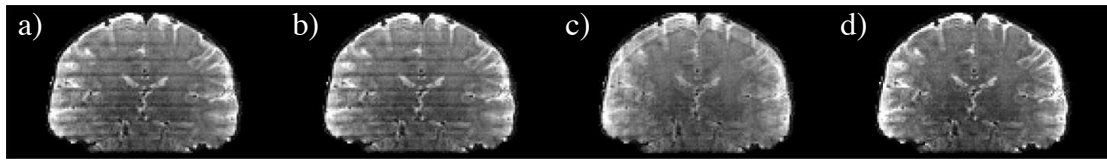
Supporting FIG. S4. Reconstruction results using iteratively regularised Gauss-Newton method: (a) without additional constraints, (b) with in-plane smoothness constraints on slab profile, (c) with frequency constraints on image, (d) with both in-plane smoothness constraints on slab profile and frequency constraints on image. All other reconstruction parameters (e.g. number of iterations, regularisation parameters) are the same in the reconstructions.