

Fast whole brain T1 mapping at 3 Tesla

F. de Smit¹, H. Hoogduin¹

¹BCN Neuroimaging Center, University Medical Center Groningen, University of Groningen, Groningen, Netherlands

Purpose The purpose of this work is to obtain a fast method for T1 relaxation time measurements at 3 Tesla.

Methods The schematic pulse sequence diagram shown in figure 1 is implemented on a Philips 3T intera scanner. The method is a variation on the methods published by Ordidge et al. [1] and Clare & Jeppard. [2].

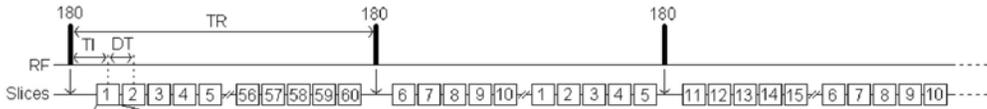
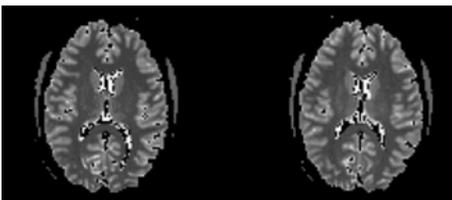


Figure 1: Pulse sequence used for fast T1 mapping.

After a global inversion pulse a single shot EPI sequence with 60 slices is used to sample the inversion recovery curve. The first slice is acquired at $TI = 20$ ms after the inversion pulse. The slice to slice timing $DT = 60$ ms. At the next repetition of the sequence, the order in which the slices are acquired is shifted 5 slices (now starting with slice 6 and finishing with slice 5) to obtain a second sample point on the recovery curve for each slice. The shifting procedure was repeated 12 times resulting in 12 sample points per slice. Other imaging parameters were: $TR = 10$ s, $TE = 26$ ms, matrix = 128×128 , $FOV = 220$ mm (4 subjects) / 256 mm (3 subjects), SENSE-factor = 2.2 and flip angle = 90 degrees. The total acquisition time for 60 slices of 2 mm was 140 s.

T1 parameter-maps were measured in seven subjects after written informed consent was obtained. After temporal reordering of the slices, the data was fitted to $I(t) = I_0(1 - 2\exp(-t/T1) + \exp(-TR/T1))$ to obtain T1-values on a pixel by pixel basis. A separate T1 weighted anatomical scan was used to define regions of interest containing gray matter, white matter and CSF in each subject separately. The anatomical scan was also segmented using the FSL segmentation tool [3]. Both ROIs and segments were used to obtain average T1-values.

Results Figure 2 shows two slices from a T1 parameter-map obtained from one of the subjects. The calculated average T1 values are summarized in table 1 together with values from the literature.



N=7	T1 (ms) ROIs	T1(ms) segments	T1 (ms) [2]	T1 (ms) [4]
GM	1421 ± 106	1318 ± 106	1160	1331
WM	780 ± 25	830 ± 42	860	832
CSF	4043 ± 361	2761 ± 578	3700	-

Figure 2: T1 parameter map

Table 1: Calculated and published T1 values.

Discussion The average T1-values are in close agreement with the values published in the literature. The differences between the ROI and segment based averages can be explained by partial volume effects. In conclusion, a method is implemented at 3 Tesla that provides T1 relaxation times in less than 2,5 minutes.

References [1] R. Ordidge et al., MRM 16:238-245, 1990; [2] S. Clare and P. Jeppard, MRM 45:630-634, 2002; [3] <http://www.fmrib.ox.ac.uk/fsl/>; [4] J. Wansapura et al., JMRI 9:531-538, 1999.