Time Efficient Flip Angle Measurement at 7T

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Introduction

With the non-significant risk classification of 7T, high field MR imaging is poised to advance clinical radiology. However, despite the greater signal-to-noise ratio (SNR) and spectral resolution afforded by 7T compared to lower field strengths, challenges such as dielectric effects, inhomogeneous excitation, specific absorption rate (SAR) restrictions, and susceptibility artifacts must be addressed. Unlike the 1.5T and 3T, 7T systems do not have a body coil, so excitations are performed by smaller volume or surface coils, yielding highly variable excitation. Over the years, various methods have been used to measure B1 [1-3]. In this abstract, we utilized a fast double angle B1 mapping sequence [4] to obtain the flip angle allowing calculation of B1, which is necessary in quantitative MR measurements as simple as T1 and T2.

Methods

Three healthy volunteers were studied on a 7T scanner (GE Healthcare, Milwaukee, WI). A double angle sequence with B1 insensitive magnetization reset pulse, 2D Fourier readout, and multi-slice capability was used to acquire the images with two volume T/R head coils. Data analysis was performed using custom built software in Matlab (Mathworks, Natick, MA). A series of 8 low resolution (256x32 with FOV 24cm, TE/TR MinFull/1s) images were acquired throughout the brain in 1:08 mins. The magnetization reset pulse enabled relatively short TR to be used.

Results

In vivo B1 maps demonstrated a large variation, as large as 3 fold differences in some regions, in effective flip angle experienced by tissue in slice and across slices. The following figure exhibits the differences between excitation offered by coils with different designs.

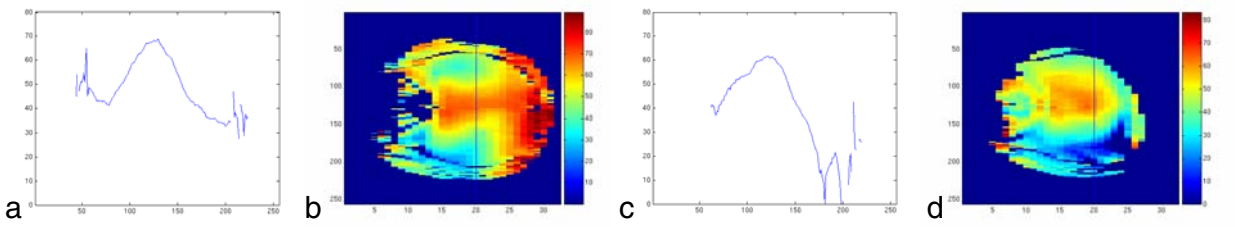

Figure. Maps of flip angles (b,d) acquired in 2 different volume coils. (a,c) demonstrates variation in the actual flip angle observed by tissue through a section of the brain.

Conclusion

We have demonstrated a time efficient way to measure B1 and the flip angle, allowing further quantitative analysis at 7T. This permits the manual adjustment of transmit gain during the scan to yield the desired flip angle in the region of interest. At the same time, the experiment showed the need of performing B1 measurements at higher fields such as the 7T in order to accurately assess tissue properties.

Reference

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