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Evaluating the effects of motion on dynamic pTx pulse performance at 7T

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BACKGROUND AND AIM

At ultra-high field, the benefits of increased signal-to-noise ratio come with significant challenges, such as prominent B_1^+ inhomogeneities[1]. Recently, a fast online pTx pulse optimization method (FOCUS) has been introduced to achieve uniform flip angles (FAs) distributions[2,3]. This technique requires the acquisition of B_0 and multi-channel B_1^+ maps, taking in total around 1:15min. Due to the preparation's duration, B_0 and B_1^+ maps are typically acquired once at the beginning of the session and used to optimize all the subsequent pTx pulses. Therefore, subject motion during the session might compromise FA uniformity. In this work, we investigate the impact of motion on the FA distribution of 11 k_T-points pTx pulses optimized with FOCUS[4].

METHODS

Four healthy volunteers were scanned at 7T (MAGNETOM Terra.X, Siemens Healthineers, Forchheim, Germany). A multi-echo GRE and a pre-saturated TurboFLASH sequence were acquired at 15 different head positions to compute B_0 and B_1^+ maps[5,6]. At each position we computed the flip angle map resulting from both a pTx pulse optimized with the maps at this position (i.e. re-optimized pulse), and one optimized on the maps acquired at the first position (i.e. original pulse). The framewise displacement (FD) was used as a measure of the amplitude of the motion between each position and the reference one[7].

RESULTS

The recomputed pulse exhibit a clear improvement in FA distribution compared to the original pulse, although the mean relative error (MRE) stays in the same range. Over all subjects, there is a significant positive correlation between the FD and the original pulse's error. Across all scans, the MRE of the FA map resulting from the re-optimized pulse is 2.58±0.24%

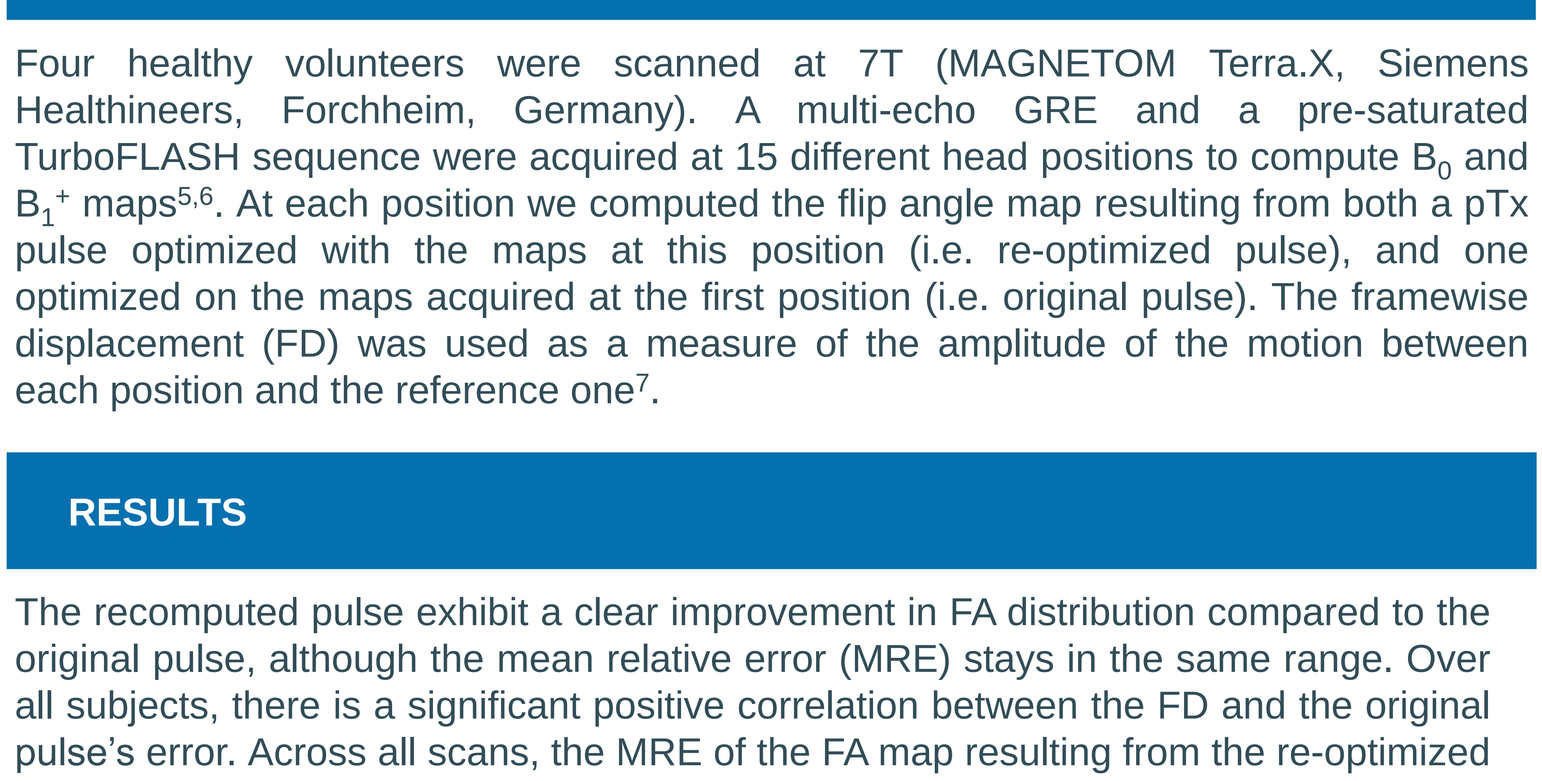

***Figure 1**: Sagittal slice of the flip angle (FA) maps resulting from both the original pulse (i.e. optimized on reference position) and the re-optimized pulse in each subject. The target is a flat 5° FA map. The mean relative error (MRE) is computed against the target.*

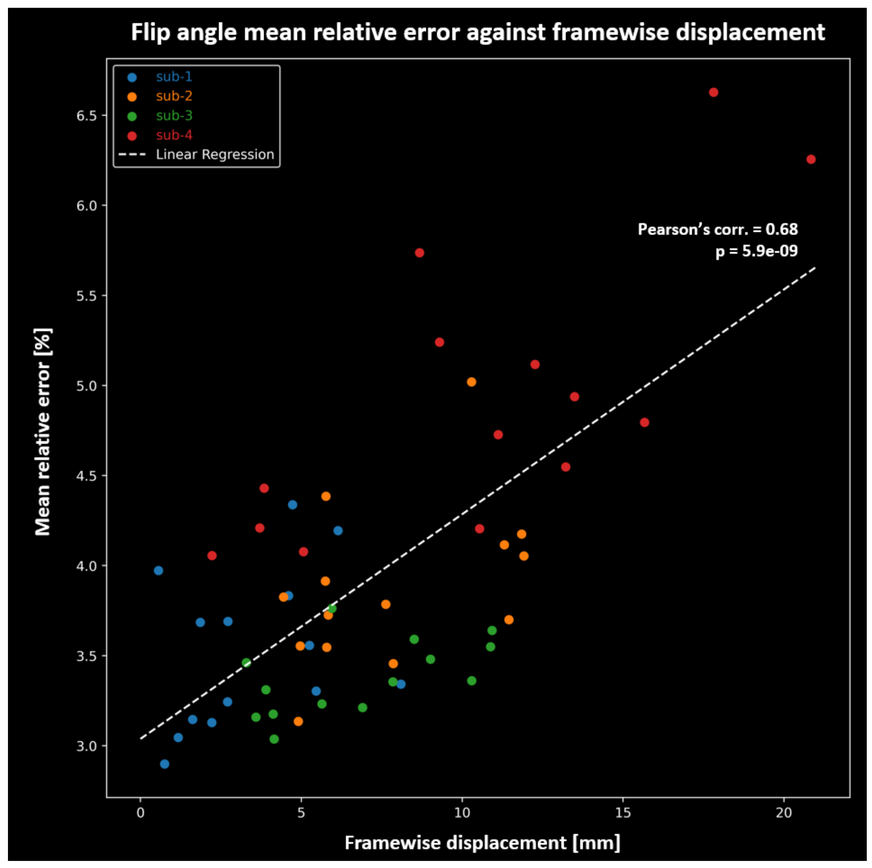

***Figure 2**: Scatterplot of the mean relative error against the framewise displacement for each position of each subject*

CONCLUSION

PTx pulses optimized with the FOCUS method are robust to rigid head motion in the range we measured (FD < 20.8mm). For these motion events, the original pulse yielded a MRE under 6.5%, comparable to the re-optimized pulses with maps acquired at each head position.

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