# Evaluating further benefits of $B_1^+$ homogenity when more transmit chnnels are used

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## INTRODUCTION

Parallel transmission (pTx) system [2-5], capable of applying different RF amplitudes and phases in independent transmit (Tx) channels, can be used to mitigate Tx ($B_1^+$) nonuniformity and to achieve more homogeneous RF excitation at high magnetic field. Human MR system equipped with a multi Tx hardware typically have a much smaller number of Tx channels than Receive (Rx) channels (8 Tx channels is probably the most common case). Previous studies have documented that more transmit channels allow higher flexibility in control of $B_1^+$ field (6-7). The purpose of this study was to evaluate whether more of Tx channels could improve the Tx field performance.

## MATERIALS AND METHOD

All measurements were performed on a 7T MR scanner (Siemens Erlangen, Germany) using a custom build 16 channel Tx/Rx head array coil. $B_1^+$ maps of oil (gadolinium) and water phantoms were obtained for individual coil elements using a saturated turbo flash sequence with the following acquisition parameters TR/TE: 1000/1.9 ms, rectangular shape saturation pulse of 700 µs duration for fast individual coil element acquisition. RF-shimmed [1] $B_1^+$ maps were calculated for different number of transmit channels varying the number of coil elements driven by each channel. The magnitude least squares method was used to calculate RF shimmed [1] $B_1^+$ maps.

## RESULTS

Figure, 1.a) represents sixteen normalized FA-maps acquired for the 16 channel transmit array using an 8 channel parallel transmit system alternatively on the even or odd channels with proper termination of the unused channels. Figure 1.b) shows quantitative RF shimmed maps varying the number of transmit channel (represented as row) using different combinations of coil elements (represented as column). The mean magnitude distances from the flat target profile are given in Figure 1.c). For only 2 coil elements driven by 2 channels (2/2) strong inhomogeneities remain. However, if more coils are driven adequately by 2 channels (2/4, 2/8, 2/16) higher homogeneity is reached. For more transmit channels (e.g. Tx channel 4 and 8) the $B_1^+$ homogeneity further increases. The results in a water phantom (Figure 2) show that simulated RF-shimmed $B_1^+$ profiles are more inhomogeneous with a similar trend toward higher homogeneity with more channels and coil elements. However, the resulting homogeneity is significantly lower than for the oil phantom and does not improve very much between 4 and 16 TX channels

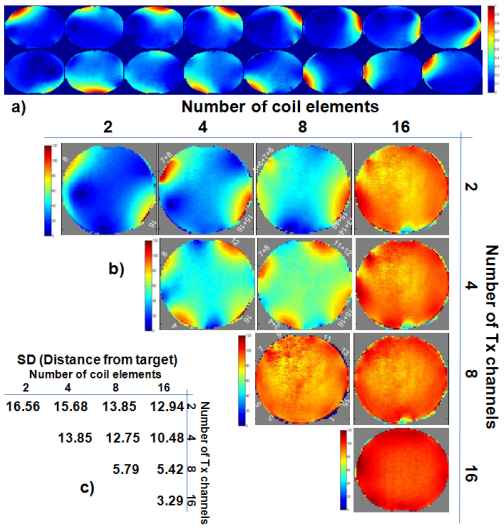


**Fig 1: a)** shows 16 individual transmit channels $B_1^+$ maps of oil phantom. **b)** Quantitative comparison of number of transmit channels by mean of number of coil elements. **c)** distance from target of quantitative evaluation respectively

## DISCUSSION

Higher B1 homogeneity has been achieved using more transmit channels. Increasing the number of transmit channels improves the flexibility in controlling the local phase and amplitude of the B1 field. However, increasing the number of transmit channels may not result in further significant homogeneity improvement. Therefore, higher $B_1^+$ homogeneity may only be achieved by transmit-SENSE, e.g. using spokes trajectories. The impact of the number of channels is subject to future studies.

## CONCLUSION

B1 field inhomogeneity at 7T can be minimized to a certain level by varying the phase and amplitude of individual channels of the 16 channel transmit array. However, even with a larger number of channels, complex B1+ distributions cannot be corrected by means of RF-shimming only. Transmit-SENSE with spoke trajectories may be more efficient in correcting inhomogeneities even with a lower number of channels. This will be subject of future studies.

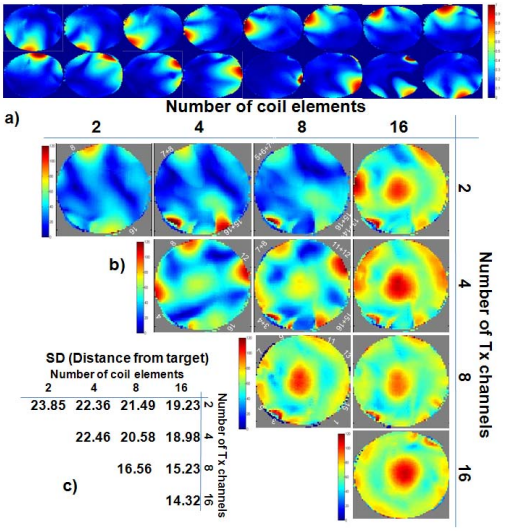


**Fig 2: a)** is 16 individual transmit $B_1^+$ profiles of water phantom. **b)** Quantitative comparison of number of transmit channels by mean number of coil elements. **c)** distance from target of quantitative evaluation respectively

## ACKNOWLEDGEMENT

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## REFERENCE

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