A Dedicated 8-Channel Flexible Array Coil for Ocular fMRI

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Introduction

In ocular imaging, the development of dedicated MRI coils is useful to increase SNR in the eyes area in order to detect small injuries in the eyeball [1], in some cases, monitoring the visual cortex is needed to determinate the damage in the visual pathway (Figure 1) and/or verify the success of a surgery. In this work, the development of an 8-channel flexible array coil for ocular fMRI is addressed.

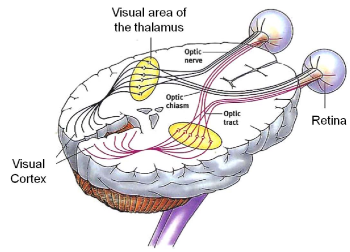

Figure 1. Visual pathway.

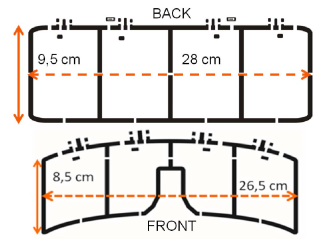

Figure 2 Geometry of the array.

Methods

The coil is comprised of two pieces with four channels each. The size of the coil elements was chosen to be 8.5cm x 6.5cm in the front half and 9.5cm x 7cm in the back half, see Figure 2. Each neighboring element is decoupled using a shared conductor with a decoupling capacitor. Non-neighboring elements are decoupled by adding a low-input impedance preamplifier [2] to each element. Each element in the array was tuned to 63.63MHz and matched to 50Ω in the presence of a head phantom with 5g/l NaCl and 1.25g/l NiSO4, which is 16cm in diameter. The elements were also actively decoupled by a tuned trap circuit including a PIN diode during transmission.

SNR-maps were calculated from a series of identical phantom images and compared with images acquired with a conventional head coil (Siemens Healthcare, Germany) according to Ohliger et al [3]. *In vivo* images were acquired and compared with the conventional head coil. All measurements were executed on a 1.5T whole body scanner.

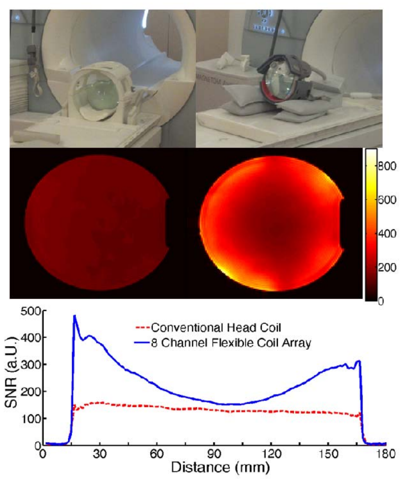

Figure 3 Top: Different Setups. **Top-left:** Conventional Head coil. **Top-right:** 8-channel flexible coil array. **Middle:** Calculated SNR-maps. **Middle-left:** Conventional Head coil. **Middle-right:** 8-channel flexible coil array. **Bottom:** Corresponding SNR-profiles.

Results

The isolation achieved between single elements was better than -20dB. In Figure 3, a comparison of the calculated SNR-maps of acquired images using a gradient-echo-sequence (parameters: TR/TE: 300/6.1ms, FOV: 180x180mm^2, Matrix: 256x256, slice-thickness: 2mm) of the 8-channel flexible array and the conventional setup at the same scale is shown. The 8-channel flexible array shows a 200% SNR improvement at the surface and 25% at the center of the phantom compared with the conventional head-coil. In Figure 4 *in vivo* image acquired with the 8-channel flexible array coil is compared with the conventional setup.

Discussion/Conclusion

Figure 3 shows a very high SNR improvement in the area of interest with the 8-channel flexible array. *In vivo* images acquired with the 8-channel flexible array have shown better image quality throughout the whole visual pathway in comparison with the images acquired with the conventional head-coil. Thus, we can conclude that the 8-channel flexible array is well suited to be used for ocular fMRI as well as for other applications related to the visual pathway. In addition, the parallel imaging capabilities of the array allow the acceleration of the experiments avoiding possible motion artifacts and even with better image quality.

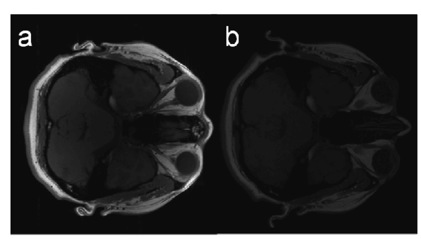

Figure 4. *in vivo* images acquired with a SE sequence (parameters: TR/TE: 400/15ms, matrix: 256x256, FOV: 18x18cm^2, slice thickness: 3mm). **Left:** 8-channel flexible array. **Right:** head coil array.

References

1. Lopez MA et al. Proceedings ESMRMB 2012, Lisboa, Portugal.
2. Roemer PB et al. Magn Reson Med. 1990, 16:192-255
3. Ohliger MA et al. Magn Reson Med. 2004, 52:628:639.