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Abstract 47725

Active optical decoupling circuit for radio frequency endoluminal coil

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Purpose/Introduction

Nowadays, coaxial cables used to transmit MR signal to RF data cabinet are progressively replaced by optical fiber to limit transmission losses [1]. Electro-optic conversion can also be done directly into the coil. It is also a mean to overcome heating effects arising with metallic coaxial cables in the case of endoluminal coils [2]. A receiver coil should also be decoupled during the emission of Radio Frequency (RF) pulses. In this work, an active optical decoupling circuit for endoluminal coil is presented and compared to a reference coil with regular decoupling using bias signal through coaxial cable.

Subjects and Methods

The schematic presentation of the experience is shown in Fig.1; the equivalent circuit for galvanic decoupled reference coil and optical decoupled coil are presented in Fig. 2a and 2b, respectively. Decoupling of the galvanic coil is insured by a PIN diode driven by a current provided by the MR data cabinet. For the optical decoupled coil, DC bias current provided by the MR system is converted in optical signal by direct modulation of laser diode. This optical signal controls two photodiodes providing sufficient current for a direct operating of the PIN diode. Coils were inserted successively in a cylindrical tank filled with a saline water solution at 5 g.L^{-1} and two different acquisitions were realized:

Images obtained with endoluminal coil as receivers using a gradient echo sequence are presented in Fig. 3.

Fig.4 shows images for a fast spin echo sequence using the 'Body' coil as a transceiver. Here, endoluminal coils are unselected so they are supposed to be constantly decoupled.

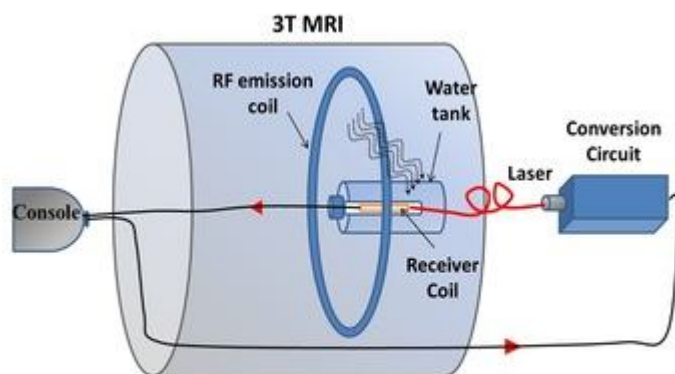


Fig.1: Schematic presentation of the experience performed on a 3.0T GE Discovery MR750 system.

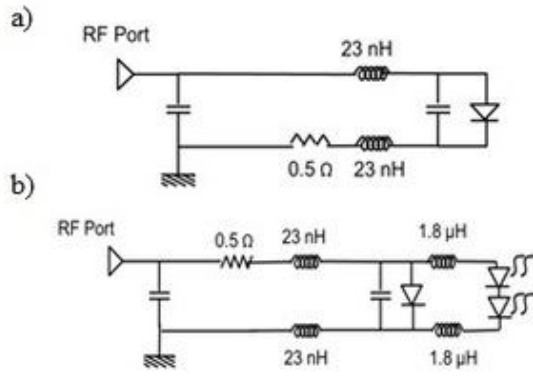


Fig.2: Equivalent circuit of endoluminal coils constituted of rectangular single loop coil (5.1 mm width ; 47 mm length) a) of the reference coil and b) the optical decoupled coil. Two 1.8 μH inductors separate photodiodes from the rest of the coil.

Results

SNR profiles presented in Fig. 3 show that the SNR at 2 mm distance from the tube for the reference coil is about 301, while it is about 262 for optically decoupled probe. Fig. 4a) and 4c) show image uniformity with a standard decoupling and coupling effect on image with a non-decoupled coil, respectively. Fig. 4b) shows that optical decoupling is still not perfect.

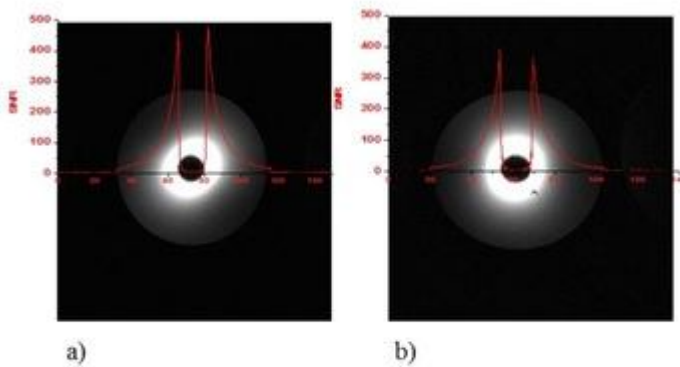


Fig.3: Images obtained with endoluminal coil using a gradient echo sequence with a) galvanic decoupling and b) optical decoupling. Red curve represent the SNR profiles along an horizontal line centered with the coil.

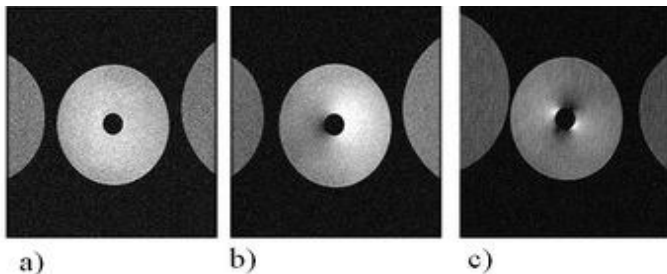


Fig. 4: Images obtained with 'Body' coil using a fast spin echo sequence with a) the reference coil, b) the optical decoupled coil and c) coupled coil inserted in the water tank.

Discussion/Conclusion

The proof of concept of this decoupling circuit was demonstrated. However, the circuit need to be improved in order to compete with usual decoupling circuit. In particular, special care should be taken in the optical conversion and transmission of the bias signal that could explain performance differences.

References

[1] J. Yuan et al., *IEEE Transactions on Medical Imaging*, 2008; Vol.27, pp. 1432-1438.

[2] C. Armenean et al., *Magnetic Resonance in Medicine* 2004; Vol.52, pp.1200–1206.

