

# Inductive Coupled Local TX Coil Design

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**Introduction:** A Transmit/Receive coil provides several advantages compared to receive only coils:

- 1) Only the tissue of interest is excited, thus fold over artifacts can be eliminated which is also very helpful for parallel imaging technique.
- 2) A local TX/RX coil only deposits RF power to the limited ROI, the RF power deposition to the patient is much less compared to the receive only coil, reducing the total SAR to the patient significantly.
- 3) By using local TX/RX coils, the requirement to RF power is significantly reduced which is very important for ultra-high-resolution imaging and some spectroscopy sequences.

On the other hand the local TX/RX option is not always available due to cost considerations. In this paper we present a novel method to implement a local TX/RX function with an inductive coupled TX local coil.

**Method:** Usually a whole body resonator as a Transmit (TX) body coil is always available on the MR scanner. The idea of inductive coupled local TX coil is to place an additional small birdcage resonator into the TX body coil. This small coupled resonator should have high Q-value to couple as much as possible with the TX body coil so that the RF power deposition is concentrated in the inner sides of the small coupled resonator. The length of the coupled resonator should be slightly longer than the desired application FOV to ensure good homogeneity within the FOV. With this coupled resonator, the local transmitting can be realized. In the example, an 8-rung birdcage resonator of 20.5 cm length and 20 cm diameter is used.

In order to achieve homogeneous B1 distribution, the high order modes of the coupled resonator should be shifted away from the operation frequency as far as possible. The whole body TX coil should be a circular polarized coil to avoid excitation of the opposite polarization field.

In side of the small birdcage resonator, a receiver only coil can be placed to achieve best possible SNR. In the example shown in this paper the receiver layer is consists of 18 loop elements for optimal parallel imaging performance. The 18 loop elements are arranged in 3 segments in the head-feet direction and 6 in the azimuthal direction (see also Fig.1). 8 PIN diodes are used in the coupled resonator to switch off the coupled resonator when the 18 channel receiver array is active.

**Results:** The B1 profile within the coupled resonator is dominated by the resonator mode of the small birdcage resonator. Even when we shift the coupled resonator to the side of the patient bore to simulate an inhomogeneous TX body coil profile, the B1 homogeneity inside of the coupled resonator is mostly preserved.

The reference amplitude for 180 degree flip angle with 1ms rectangular pulse length reduced from 200V without coupled resonator to about 70V with the coupled resonator.

We used a conventional RX only coil to compare both the SNR of the TX resonator as well as the receive profile in the head-feet direction. The receiver coil has the same coverage as the 18 channel receiver array inside of

the coupled resonator. Figure 2 shows the SNR and image profile comparison between this local TX/RX coil and a standard 12-element RX only coil with a gradient echo type sequence. We see a sharp signal intensity drop outside the FOV of interest. With Spin-Echo type sequences, the desired roll-off is even more pronounced due to the nonlinear dependence on the excitation field B1. Volunteer images (Fig.3) show also clear advantages in suppressing the fold over artifacts from the tissues outside of the FOV

**Conclusion:** We demonstrated a novel inductive coupled local TX coil concept which requires no local coil RF transmit connection. No additional TX/RX switches and no local coil transmit cables are required. This simplifies system design and reduces cost.

**References:**

- [1] US patent 4680549 (1985)

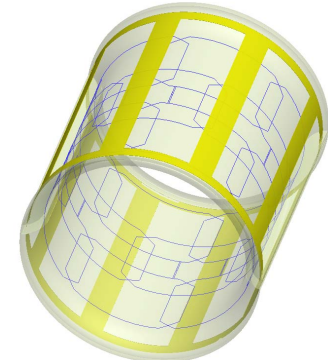


Fig1: outline of the 8-leg TX/RX coil with 3 x 6 element receiver array

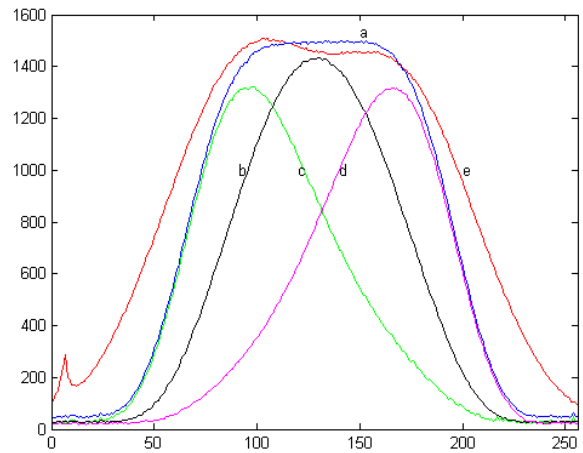


Fig.2: SNR of TX/RX knee coil (a) and coil profile of the 3 segments (b, c, d) compared with conventional 12 element knee coil (e)

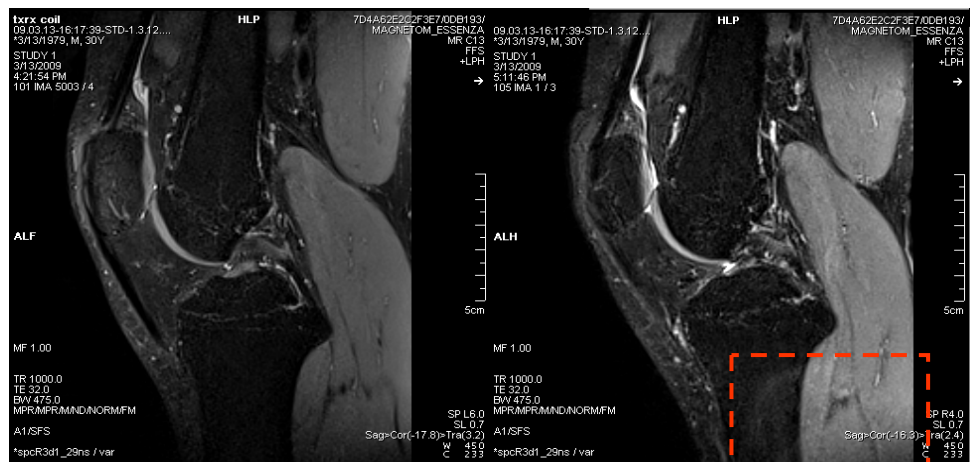


Fig. 3: Sagittal image comparison between local TX coil (left) and conventional 12 element receive only knee coil (right), acquired on 16 Channel Siemens ESSENZA System