# Comparison of Sensitivity and SNR between 25mm, 50mm and 75mm Diameter Round Coils for Head Imaging on 7T

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## Introduction

SNR and sensitivity map of the element coils are important factors when a multi-coil is designed. It was reported that there was the minimum size at any given frequency for SNR gain by a coil size reduction (1). It is also well known that electrical characteristics of dielectric materials have more influence on a coil sensitivity as the resonant frequency increases. So SNR and sensitivity map of several coil sizes at 300MHz of 7T proton Larmor frequency with a head-sized object were measured as a basic coil data for a multi-coil design.

## Material and Methods

Single round coils with 25mm, 50mm, and 75mm diameters (copper foil center to center) were tuned as receive only coils for 7T proton imaging (Fig1). The round coils were made of 0.025mm width polyimide sheet with 0.018mm width copper on. The trace width was 5mm. Each coil had one active decoupling circuit in it. 32 element high-pass self-shielded birdcage was used as the transmit coil (2). The round coils were located 10mm under the imaged object and at a distance of 15mm from birdcage coil elements. 18cm diameter spherical phantom filled with 0.014M NiCl-doped water that has dielectric constant of 86 was imaged as a head sized dielectric material. The same size silicon oil phantom with dielectric constant of 2.8 was imaged as a head sized object with small dielectric effect for comparison purpose. A volunteer human head was also imaged. The images were acquired on GE Signa 7T MRI system. The used pulse sequence was FSE; TR=5000ms, TE/Ef=9.6ms, BW=20.8kHz, ETL=8, Thickness=5mm, FOV=20cmx20cm, 256x192, 1NEX. The slice was selected perpendicular to the coil plane at the coil center. The reconstructed images with 256 x 256 resolution were segmented into 32x32 areas, each of those was constructed of 8x8 pixels. The coil sensitivity was calculated as the averaged signals with the above-mentioned segmented areas. SNR was calculated by applying NEMA methods to each of the segmented areas with successively acquired two images for phantom images. As for human head images, SNR was calculated by dividing averaged signals of the segmented areas by the noise that was calculated as a average of the averaged signal with the segmented areas in the noise area colored by blue in Fig.3. Both the sensitivity and SNR were plotted with every line constructed of 32 segmented areas in the direction of bottom to top in the area enclosed by yellow rectangular on Fig.2 and Fig.3. The sensitivity was plotted after the normalization by the maximum value of the segmented areas.

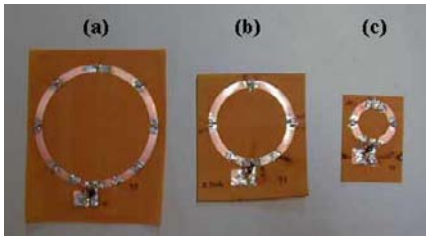


Fig.1 Pictures of built single round coils; 7.5cm (a), 5.0cm (b), 2.5cm (c). All coils were tuned to resonate at 298MHz. The impedances were matched to 50 Ω under human head loading.

## Results and Discussion

Fig.2 shows the results of phantom images. There was found the SNR gain by the coil size reduction at least down to 50mm diameter. This means that the coil is electrically coupled enough with imaged object at least down to 50mm diameter. Notice that sensitivity and SNR were also so influenced by the imaged dielectric object with 50mm and 75mm diameter coils that there were not so much difference between those of 50mm and 75mm diameter, although there were a tendency that smaller coil still had better SNR in the area near the coil plane. The same trend with SNR was found in the volunteer head images (Fig.3).

## Conclusion

Round coils of 50mm and 75mm diameter were electrically coupled enough with a head-sized object that there was found SNR gain by the coil size reduction. The sensitivities and SNRs of 50mm and 75mm diameter coil were also so influenced by the imaged dielectric object on 7T proton frequency that their distributions were similar, although there were a tendency that smaller coil still had better SNR in the area near the coil plane.

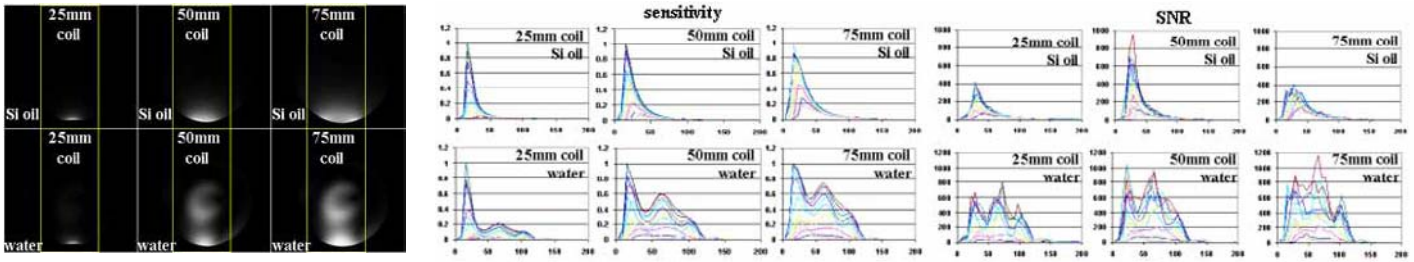


Fig.2 Phantom images (left), calculated sensitivity with the images (middle), and calculated SNR (right).

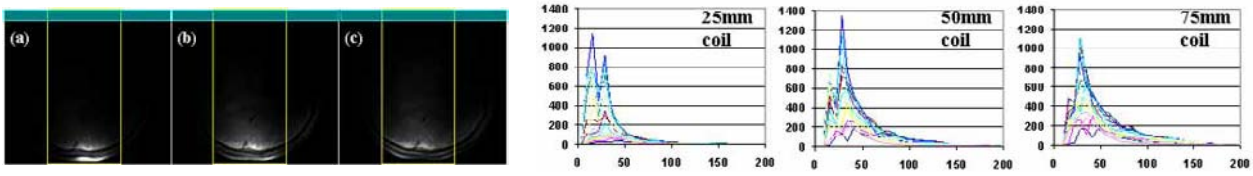


Fig.3 Volunteer head images (left). (a) : with 25mm diameter coil, (b) : with 50mm diameter coil, (c) : with 75mm diameter coil. Right graphs are calculated SNR plot with the volunteer head images.

**Reference** E.B. Boskamp et al. Proceedings of ISMRM 2005, p916 (2) Nabetani et al. Proceedings of ISMRM 2005, p932

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