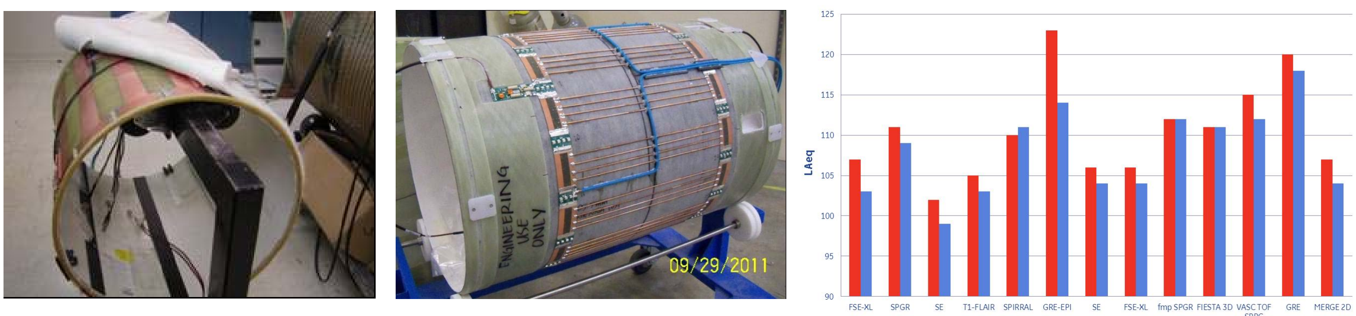
Low Acoustic RF Coil Design

Saikat Saha[1] and Washington De Lima[2]
[1]GE, Waukesha, WI, United States, [2]GE, Florence, SC, United States

Introduction: During high field MR scans, patients become uncomfortable due to the high acoustic noise and vibration produced inside the patient bore. This noise can be as high as ~125dBA depending on the field strength of the scanner and PSD being used. The main source of noise inside the scanner is due to the gradient coil (when pulsed) vibrating in a static magnetic field generated by the magnet. This noise is transmitted through the RF body coil to the patient ears. Another major source of noise is vibration of the RF body coil itself. RF body coil vibrates due to the eddy current generated by the gradient coil pulsing on the copper sections of the RF coil. Some of the previous work, which addresses the issue of acoustic noise and vibration have been documented in [1-2]. The design described here addresses the issue of acoustic noise by significantly reducing the vibration which in turn reduces the noise by upto 9 dBA in a conventional Birdcage RF coil without compromising the RF performance.

Method & Result: Couple of 1.5T whole body RF coils is studied here for the purpose of acoustic performance comparison. The common architecture for both the coils are: 16 rung High Pass Birdcage design, 70 cm patient bore diameter, 2-port driven and mounted similarly inside the gradient coil. The first coil (shown in Figure 1a) which is the standard coil has antenna rungs made of 5-6 cm wide 1 oz. copper foil/sheet while the second coil (shown in Figure 1b) which is the low acoustic design, is made of 4 copper conductors placed parallel to each other forming an antenna rung. The standard coil has rungs with acoustic cut-outs and slits at strategic locations to minimize the eddy current from gradient coil pulsing. The rung width is same in both the coils. Such a rung configuration reduces the copper area (where the eddy current is generated and flows in the rung) by more than 90% but still helps in retaining the same RF performance. Since this coil comprises of rung made of several parallel conductors separated or insulated from each other, it can also be attributed as Litz coil design. The cross-section of individual conductor and the number of conductors per rung can be optimized depending on the type of coil design/configuration. In order to compare the acoustic performance of both coils, they were subjected to same PSDs with the microphone located at the ear position of a patient. The acoustic noise expressed in A-weighted average noise level (LAeq) with respect to various PSDs is plotted in Figure 1c. The red colored bars are from standard coil and blue colored bars are from Litz coil. From this figure it is seen that the acoustic noise has been reduced by 3-9 dBA in the Litz coil. RF tests were also performed on both the coils which show: Unloaded Q of standard coil is 285 while that of Litz coil is 275, B1 uniformity is within 1% and SNR is within 2% of each other.

Thus, we have shown a whole body RF coil design (Litz coil) with which we not only improve the acoustic performance of the MR scanner by 3-9 dBA but also keep similar image quality. Furthermore, this type of technology can be easily implemented in TEM, micro-strip RF coil designs also.



(a) (b) (c)

Figure 1a: Standard RF coil with copper foil rung; **Figure 1b:** Litz rung RF coil; **Figure 1c:** Plot showing acoustic levels (LAeq) measured in dBA inside the patient bore for different clinical PSDs

1) (ISMRM 2009) **Low E-Field and Low Acoustic Birdcage Coil Design**; S. Saha, GE Healthcare, Florence, SC, USA
2) (ISMRM 2002) **A Whole Body RF Coil Design to Reduce Acoustic Noise**; D.J. Weyers[1], S. Li[2], and D.E. Dean[1]; [1]GE Medical Systems, Waukesha, WI, USA; [2]IGC Medical Advances, Milwaukee, WI, USA