

The SENSE Cardiac Coil for 4-channel Vertical Field MRI Systems

L. Feng¹, V. Chen¹, Y. J. Yang¹

¹USA Instruments, Inc., Aurora, Ohio, United States

Introduction

A new SENSE cardiac coil is designed for 4-channel vertical field systems. It consists of 4 element coils and has the optimized G factor in the anterior to posterior (AP) direction. The traditional body coil usually consists of the volume loop and saddle coils that provide the uniform sensitivity in a large area. It isn't suitable for the cardiac SENSE imaging because it has a very high G factor. The new SENSE cardiac coil combines the volume coil and surface coil structures in order to maintain high SNR in the deep area of the body and also provide the low G factor for the SENSE imaging.

Methods

The new SENSE cardiac consists of 4 element coils: a big loop coil (red line structure in Fig.1), a big saddle coil (blue line), a top saddle coil (black line) and a bottom saddle coil (green line). The one turn big loop is split into two lines at the top. The resonant frequency of the local loop formed by the splitting lines is tuned away from the working frequency. By adjusting the distance between two splitting lines and their positions the big loop coil can perfectly decouple with the top saddle coil. The big loop coil with this unique structure generates a gradient sensitivity profile in the central area in AP direction. The big saddle also has a special structure in order to generate a gradient sensitivity profile in the central area in AP direction. The gap between two top lines of the big saddle coil is much smaller than the distance between two bottom lines. The big saddle also can perfectly decouple with the bottom saddle coil by adjusting the distance between two bottom lines and their positions. Combining these special volume loop and saddle coils with surface saddle coils provides high sensitivity in the deep body area and a low G factor in AP direction. It avoids having very high sensitivity on the surface of the body but low sensitivity in the center of the body.

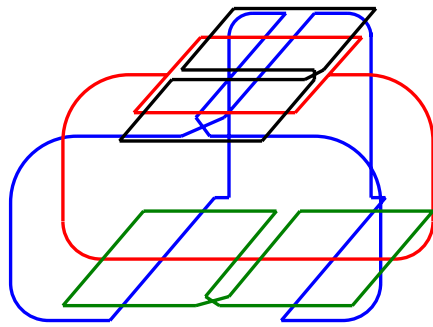


Fig.1 The coil structure

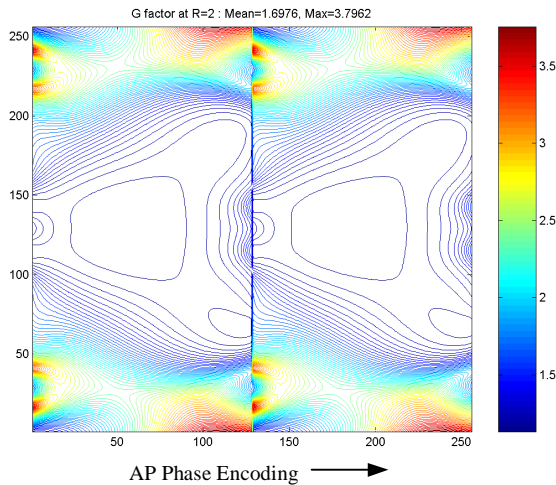


Fig.3 The axial G factor map of the coil

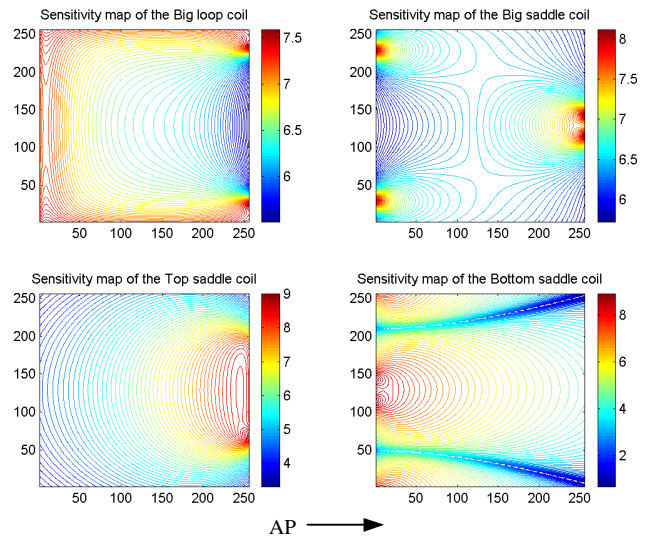


Fig.2 The axial sensitivity map of each element coil

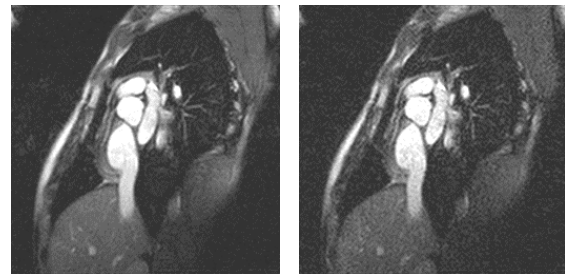


Fig.4 The normal (left) and SENSE (right) cardiac images

Results

Fig.2 shows the axial sensitivity map of each element coil. The map shows the big loop and big saddle coil have a gradient sensitivity profiles in AP direction in the central area of the coil. Fig.3 shows the axial G factor map of the coil for AP phase encoding and R=2. The FOV is 36cm (LR) x 24cm (AP). It shows that the coil has low G factor in the central area of the coil. Fig.4 shows normal and SENSE cardiac images acquired by using the new cardiac coil in Hitachi Altaire MRI system. The SNR of the prototype cardiac coil has been tested and compared with Hitachi medium size body coil. The test result shows the coil has the same SNR as the medium body coil in normal scans even its size is little bit bigger.

Conclusion

By combining the special volume coil structure with the surface coil structure the new cardiac coil can provide high SNR and the low G factor for cardiac SENSE imaging. It makes SENSE cardiac scan feasible in low field vertical systems.

References

- [1] Pruessmann KP, Weiger M, Scheidegger MB, and Boesiger P, Magn Reson Med 42:952-962, 1999.
- [2] Weiger M, Pruessmann KP, Leussler C, Röschmann P, and Boesiger P, Magn Reson Med 45:495-504, 2001
- [3] Griswold MA, Jakob PM, Heidemann RM, Nittka M, Jellus V, Wang JM, Kiefer B and Haase A, Magn Reson Med 47: 1202-1210, 2002