A 10-Element Medial and Lateral Accessible Breast Coil Array Optimized for Parallel Imaging

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Synopsis: In this paper, we present a 10-element, 8-channel Rx breast coil optimized for both bilateral and unilateral SENSE imaging. The coil is also medial and lateral accessible for tissue biopsy. Furthermore, the coil provides good coverage of axillary tissue and higher signal-to-noise ratio (SNR) than 4-channel breast coils.

Introduction: In cancer diagnosis, MRI breast coils are increasingly used in the determination of specificity using dynamic contrast imaging. Tissue biopsy is the gold standard for tissue characterization and MR is increasingly used in interventional procedures for cancer treatment. Newly developed clinical protocols use parallel imaging [1,2] for high resolution and rapid, dynamic breast imaging [3,4] for improving spatial and temporal resolution. To meet these many requirements, the breast imaging coil should have high SNR, be SENSE compatible, and preferably provide both lateral and medial access for tissue biopsy. Bilateral and unilateral SENSE imaging capability in the left-right (L/R) direction is required for the design of breast-SENSE coil. SENSE imaging in the superior-inferior (S/I) direction is also desirable for 2-dimensional encoding. To meet these goals, we have designed and built a 10-element breast-SENSE coil for 8-channel MRI systems.

Methods and Materials: The SENSE-capable breast coil consists left and right sections covering each breast. Fig. 1 shows the five element geometry of one section. For unilateral imaging, five elements of one section are selected while the other five elements are turned off by using active decoupling circuitry. In bilateral imaging mode, the two medial coil elements are turned off and the remaining eight elements are used. Coupling between coil elements is minimized using both geometric overlap and preamplifier decoupling. Phantom and volunteer images were acquired using a GE 1.5T Signa 8-channel scanner with ASSET capability. Conventional bilateral and unilateral images acquired from a 4-channel breast coil are compared with those from the breast-SENSE coil. ASSET imaging with reduction factor of 2 was also performed on healthy volunteers for both bilateral and unilateral modes. The phase encoding was in the left-right direction. The SENSE compatibility was studied by simulating the g-factor maps in the R-L and S-I directions.

Results and Discussions: We observed 25% gain in SNR in bilateral mode, and 17% increase in unilateral mode over the 4-ch coil. In unilateral mode, the contribution from the fifth element results in a 10% higher SNR over the bilateral mode coil. In the SENSE application, both simulation and volunteer imaging yielded good coverage in the L/R direction (Fig.2a, 2b and Fig. 3). SENSE imaging in the S-I direction was made possible by the two loop coils in the S/I direction. However, we found if two more saddle coils are placed over the loop coils, the SENSE compatibility will be greatly enhanced (simulation of Fig.2c).

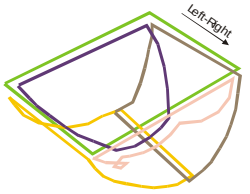

Fig.1 Element Geometry at one breast

a. Bilateral L/R R=2
g_{avg}=1.03 g_{max}=1.06

b.Unilateral L/R R=2
g_{avg}=1.19 g_{max}=1.60

c.Bilateral S/I R=2
g_{avg}=1.30 g_{max}=4.85

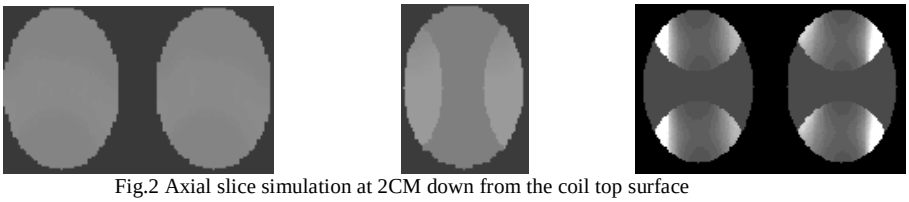

Fig.2 Axial slice simulation at 2CM down from the coil top surface

Full With ASSET Full With ASSET

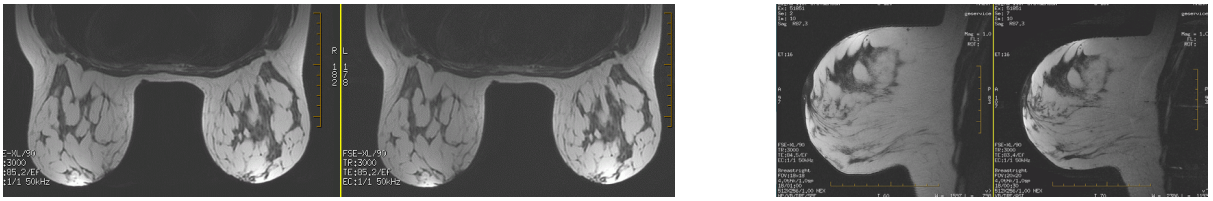

Fig.3. Bilateral Axial and Unilateral Sagittal Images with and without Asset (Asset L/R, R=2)

Conclusions: The 10-element medial and lateral accessible breast coil shows better SNR than the 4-channel breast coil. The coil also demonstrates good SENSE imaging capability in the left-right direction. Installing additional saddle coils will significantly increase SENSE imaging performance of the coil in the superior-inferior direction and increase the speed of dynamic contrast acquisitions.

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