A 16 Channel Phased Array Coil Optimized for Diagnostic Breast Imaging

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Introduction

Over the last years MR imaging for the diagnosis of breast diseases has become an important technique in addition to the traditional screening methods like mammography or ultrasound due to its high sensitivity. However, the quality of the method strongly depends on the hardware used, especially the RF coil. An optimized RF coil for breast diagnosis has to meet several requirements: it has to match a great variety of breast sizes, it needs to support axilla imaging, high acceleration factors with low g factors in parallel imaging are needed and finally a high SNR is expected. In this abstract we present a high sensitivity 16 channel breast phased array coil for high acceleration imaging, with an adjustable coil size and switchable axilla elements. The coil (fig. 1) is presented for 1.5T and 3T each.

Methods

Figure 2 shows the coil element layout. The coil elements are arranged around two cylinders. Each cylinder is surrounded by 6 array elements. Perpendicular to these elements, two large loop coil elements enable quadrature reception and homogenize the sensitivity profile of the array. Two additional elements are especially designed for high sensitivity in the axilla regions. They can be switched off during acquisition (when not needed) to reduce wrapping artifacts of the arms. To achieve optimized filling factors for different breast cup sizes the outer array elements as well as the axilla elements are fixed on an adjustable slider. This offers the possibility to change the coil cylinder size from approx. 2 x 2000 ccm to 2 x 1400 ccm in minimum position. All coil elements are impedance matched at 63.6 MHz and 123.2 MHz respectively and connected to low noise preamplifiers. Noise correlation as well as parallel imaging properties were evaluated. The SNR performance of the coil was compared to the 4 channel Breast Matrix coil (Siemens Healthcare, Erlangen) with a volume of 2 x 1550 ccm.

Results and Discussion

The noise correlation for all elements is better than 20% in maximum and better than 35% in minimum slider position, verifying the sufficient decoupling of all coil elements for the whole range of slider positions. In the axilla region an average raise in SNR of 40% could be observed by switching on the dedicated axilla elements [1]. Figure 3 shows g-factor [2] maps acquired with the 3T coil, calculated from a phantom data set with parallel imaging factors R=5 to 8 in LR direction[3]. Up to a factor of R=7 the coil shows very low g-factors. The SNR of the 16 channel coil is 10% higher than that of the Breast Matrix in a center ROI on a phantom, this gain is increasing towards the outer regions (fig. 4). For this measurement the slider was adjusted to minimum position.

Figure 5 shows an image of a healthy volunteer acquired with a T2-weighted TSE sequence with an acceleration factor of R=4 at 1.5T. The in-plane resolution is 0.8 mm

Conclusion

The new developed 16 channel breast coils for 1.5T and 3T have adjustable coil sizes thus offering optimized filling factors over a wide range of breast sizes. The dedicated axilla elements provide a high image quality in the axilla region, preventing the need for additional coils. Parallel imaging with acceleration factors of up to R=7 in one direction is possible with a low parallel imaging artifact amplitude. Compared to the Siemens Breast Matrix coil a gain of 10% in the center of the phantoms could be observed, proving the excellent SNR performance of the coil.

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References

[1] Geppert et al., Proc. ESMRMB 25 (2008): #557
[2] Pruessmann et al., MRM 42: 952 (1999)
[3] Wichmann et al., Proc. ESMRMB 25 (2008): #551

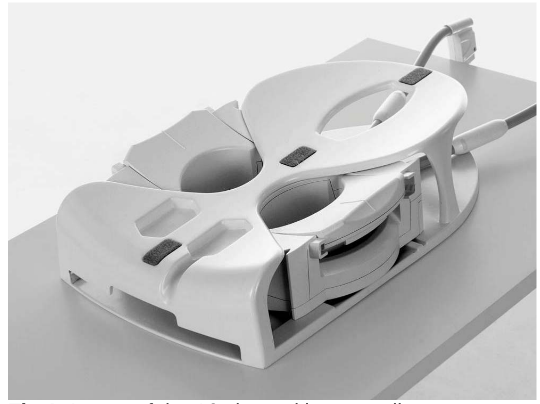

Fig.1: Image of the 16 channel breast coil

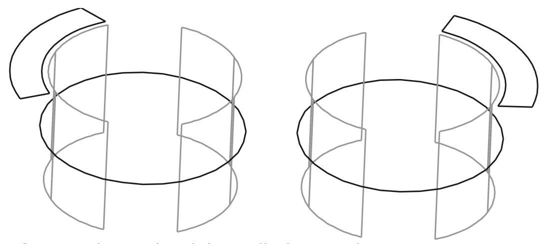

Fig.2: Schematic of the coil element layout.

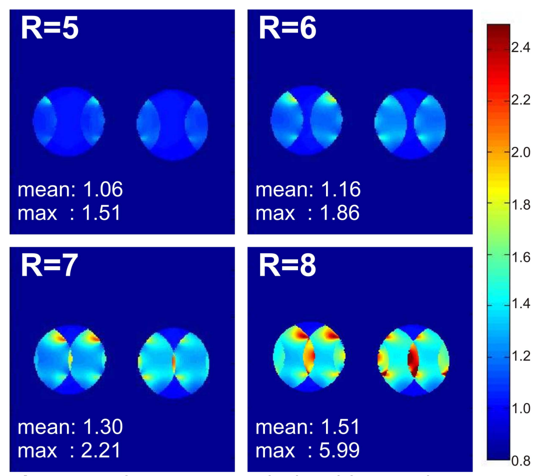

Fig.3: 3T g-factor maps, calculated from a phantom data set with acceleration factors of R=5-8

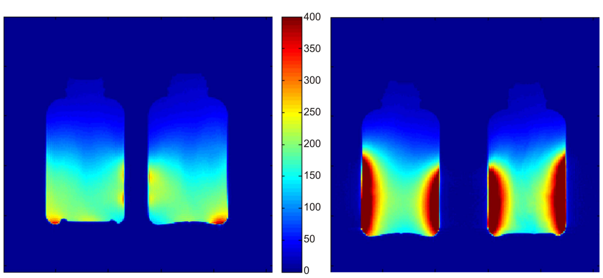

Fig.4: SNR comparison of the 4 channel Breast Matrix (left) and the new developed 16 channel coil (right) at 1.5T.

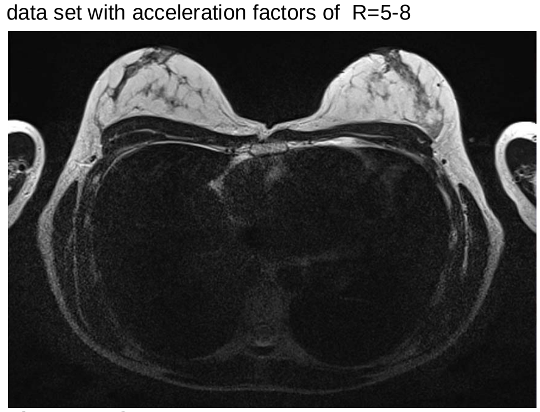

Fig.5: TSE@1.5T, TE 89ms, TR 6200ms, R=4