A 64-CHANNEL CARDIAC RECEIVE-ONLY PHASED ARRAY COIL FOR CARDIAC IMAGING AT 3T

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Target Audience: RF Engineers

Purpose: In MRI, phased array coils [1] can be used to improve the spatial or temporal resolution due to the combination of up to 128 receive channels [2]. By incrementing the number of channels, the diameter of coil elements has to be reduced for the same imaging region. This reduction in size yields SNR improvement close to the coil element but concurrently reduces the SNR in the center of the body in bulkier persons due to the limited sensitivity of small coil elements. In a previous study we investigated the arrangement of coil elements in a two-parted 64-channel phased-array cardiac coil (40-channel chest part, 24-channel back part) for optimized SNR and g-factor values in the heart [3]. In this study we verify the imaging performance of the implemented 64-channel receive-only phased array prototype coil in comparison to the simulation results.

Methods: Experiments were performed on a 3T MAGNETOM Skyra and 3T MAGNETOM Prisma (Siemens AG, Erlangen, Germany). Signals of pairs of receive elements were combined to a single output cable. Low-noise converters including preamplifiers were used to convert the received signals to intermediate frequencies. Analysis of the coil performance in a thorax phantom was done in SNR Units [4] and optimally combined complex data [1]. Therefore, gradient echo images were acquired (FA/FOV/Res/Slice/TR/TE= 25°/450mmx450mm/256x256/5mm/3.6ms/1.43ms) as well as noise-only images. Noise correlation matrices were utilized to calculate SNR maps on a per-pixel basis. 1/g-factor maps were used to compare the imaging performance during accelerated imaging. In vivo measurements were performed using a 2D TrueFISP cine imaging pulse sequence in short-axis-view and in four-chamber-view using accelerated imaging (tGRAPPA [5]; R = 3, 5, 7, and 8). All results were compared to a 38-channel coil setup (Body 18 Tim coil / 20 channels of the patient-table-integrated Spine 32 Tim coil).

Fig.1 New 64-channel cardiac coil. The chest part can be closely matched to the thorax with a hinge for improved accelerated imaging.

Results: The channels of the 64-channel cardiac coil (Fig.1) showed noise correlation between 0.1% and 54.6% with an average of 5.5%. In phantom measurements, the center SNR with the new 64-channel cardiac coil was 10% less in SNR units or 6% less using optimally combined complex data compared to the commercial coil setup in a transversal plane. Inverse g-factor comparison between the 64-channel cardiac array and the 38-channel commercial setup revealed a 2% higher mean noise amplification at R=3, 14% less at R=5, 50% less at R=7, and 50% less at R=8 with the 64-channel array. In vivo image quality was superior with the 64-channel cardiac phased array coil at R=5 and R=7 (Fig.2).

Discussion: The 64-channel cardiac phased array prototype benefits from image reconstruction using optimally combined complex data due to the higher channel count. Nevertheless, center SNR is slightly less compared to the commercial coil due to smaller coil elements. Improved 1/g-factors were observed with the 64-channel cardiac phased array due to a strong adaptation of the coil to the human thorax and the higher number of receive elements. As expected, high signal occurs close to the coil elements. For homogeneous signal intensity in the image special care has to be taken about the normalization prior to imaging.

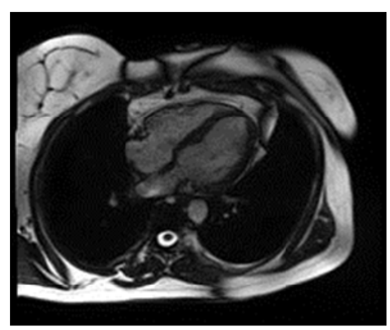

Fig.2 Four chamber view at tPAT=7

Conclusion: The results with the 64-channel phased array prototype coil in 2D imaging are promising for further investigation in 3D imaging, like coronary angiography. There the high count of receive channels potentially yields considerably improved image quality compared to routinely used commercial coil setup.

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