# RF Shimming With a Conventional 3T Body Coil

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## Concept

RF shimming is seen as a potential technology for reducing high field image shading. Using Katcher's nomenclature [1] we distinguish between static and dynamic RF shimming; whereby static refers to applying amplitude scaled and phase shifted versions of essentially the same RF signal to multiple transmit elements, and dynamic refers to applying arbitrary RF signals to multiple transmit elements. This work is concerned with static RF shimming, which can advantageously be implemented independently from the imaging sequence.

In a quadrature birdcage coil, there is very little coupling between the in-phase and quadrature feed points. Hence it can be considered to have two independent transmit elements, and so can be used with no modification for RF shimming [2]. Here we investigate the performance of static RF shimming using a conventional RF body coil at 3T.

## Methods

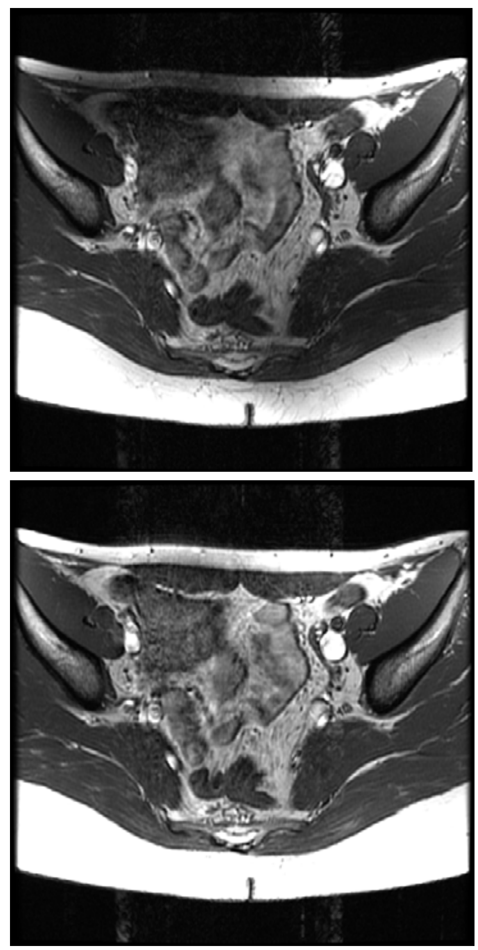
Using a GE Signa HDx 3.0T system, the low power RF exciter signal is split into two, and each signal then independently attenuated and phase shifted under computer control, using a system similar to that described by Vogel et al. [3]. These two signals are then fed through separate power amplifiers, a transmit/receive switch, and then to the in-phase and quadrature ports of the body coil. The quadrature (circular polarized) reception is retained.

The attenuation and phase shift values are calculated such that the combined complex transmit B1 fields from the in-phase and quadrature channels are as uniform in magnitude as possible, using Matlab's constrained optimization routines.

The transmit B1 maps are estimated using the double angle technique [4]; whereby a low-resolution single-shot asymmetric EPI sequence [5], with spectral-spatial excitation, is used to acquire the individual images. The transmit B1 phase is set equal to that of the acquired images.

Communication between the pulse sequence, the Matlab optimization process, and the DAC process controlling the attenuators and phase shifters, is automated such that very little operator intervention is required.

The B1 mapping requires two 6 second acquisitions, and so is relatively non-intrusive with respect to the overall work flow.



## Results

There is a large variation in high field shading between volunteers. Some volunteers exhibit barely perceptibly shading, while with others it is quite severe. The images at the right are from a "severe-shading" volunteer. These were acquired with a spin-echo sequence and an eight channel cardiac receive array.

The top image shows an image with the body coil driven in standard circular polarized mode, with an in-phase and quadrature amplitude scaling of (1.0,1.0), and a phase delta of 90 deg.

The bottom image shows the improvement due to static RF shimming, using the optimized amplitude scaling of (1.0, 0.58), and a phase delta of 35 deg.

## Discussion

Initial static RF shimming results in the pelvic region using a standard body coil are very encouraging. However a more extensive evaluation is required to better identify the applicability to other body regions.

Being able to use a standard body coil for RF shimming is attractive because of the good power efficiency and low channel coupling of the birdcage design.

## References

[1] Katcher et al., ISMRM Proc., 2256 (2005)
[2] Weyers et al., ISMRM Proc., 2023 (2006)
[3] Vogel et al., ISMRM Proc., 3551 (2006)
[4] Stollberger et al., SMRM Proc., WIP 106 (1988)
[5] Feinberg et al., MRM **13**, 162-169 (1990)