

Supporting Information

In musculoskeletal MRI, like most of clinical MRI, receiver arrays with many channels are commonly used to provide high SNR and acceleration for parallel imaging. However, more computation is required in the reconstruction to process the large number of coil elements, which can make iterative reconstructions slow. Array compression methods (1-3) seek to reduce the computational load by reducing the multi-channel data prior to the reconstruction. Following coil compression, a smaller set of “virtual channels” are used in the reconstruction. The transformation to virtual channels, denoted A , is applied at each k -space location k to a vector $v(k)$ containing measurements from all channels. A can be determined by solving

$$\begin{aligned} & \text{minimize} \sum_k \| (A^H A - I)v(k) \|_2 \\ & \text{subject to } AA^H = I \end{aligned}$$

The solution can be computed algebraically using a singular value decomposition.

In 3D MSI or multi-echo imaging, it is assumed that the coil sensitivities are independent of the spectral bin or echo. Thus, a coil compression scheme should apply the same linear transformation along the coil dimension in each bin while utilizing complementary information in all bins to determine an appropriate transformation. Under this assumption, the summation can be modified to be over all bins. We take the approach of (1), applying a set of aligned A -matrices in $x - k_y - k_z$ hybrid space, each at a slice along the readout direction.

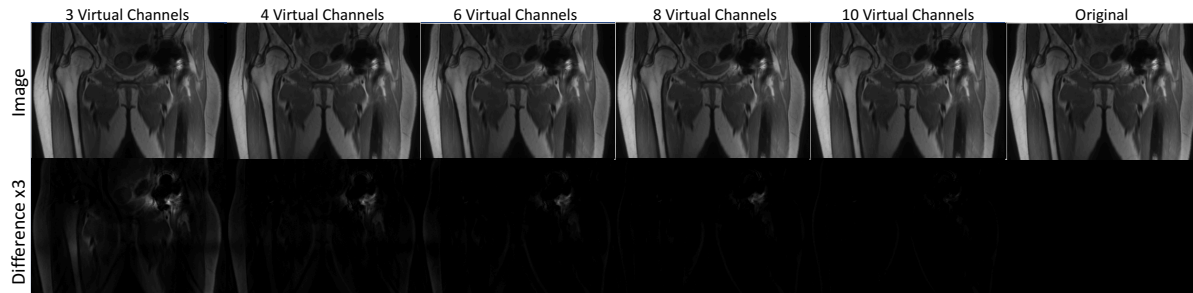
Data acquired from one patient acquired with 2×2 acceleration and a 32 channel coil was reconstructed with coil compression to 3, 4, 6, 8, and 10 virtual channels and an autocalibrating parallel imaging (acPI) method. acPI reconstructions without coil compression were used to evaluate reconstruction errors and determine how many virtual channels should be used in coil compression. Error images shown in Figure 1 that very high compression ratios can be achieved with comparable artifact near metal. 10 virtual channels were used in our reconstructions.

References

- [1] Zhang T, Pauly JM, Vasanawala SS, Lustig M. Coil compression for accelerated imaging with cartesian sampling. *Magn Reson Med* 2013; 69:571–582.
- [2] Buehrer M, Pruessmann KP, Boesiger P, Kozerke S. Array compression for MRI with large

coil arrays. *Magn Reson Med* 2007; 57:1131–1139.

[3] Huang F, Vijayakumar S, Li Y, Hertel S, Duensing GR. A software channel compression technique for faster reconstruction with many channels. *Magn Reson Imaging* 2008; 26:133–141.



Supporting Figure S1: Joint coil compression of bins allows the number of channels to be reduced from 32 to a small number of virtual channels prior to reconstruction without introducing reconstruction errors. This results in an approximately proportional reduction in reconstruction time.