From multi-coil kspace to single-coil kspace

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Abstract

The way to combine multi-coil kspace data acquired from parallel MRI to a single kpsace data for neural network training.

1 Method

Define a k-space data as K and this Fourier transformation $\mathcal{F}^{-1}(K)$ as $X = a + jb$. When we have N multi-coil data, we can obtain multiple $\{K_i\}$ and thereby $\{X_i\}$.

Define $|X|$ as the magnitude of the complex data X, i.e. the MRI image we visualize. To obtain the single coil magnitude image $|Y|$, we compute

$$\begin{aligned} |Y| &= (|X_1|^2 + |X_2|^2 + ... + |X_N|^2)^{\frac{1}{2}} \\ &= ((a_1^2 + b_1^2) + (a_1^2 + b_1^2) + ... + (a_N^2 + b_N^2))^{\frac{1}{2}} \\ &= ((a_1^2 + a_2^2 + ... + a_N^2) + (b_1^2 + b_2^2 + ... + b_N^2))^{\frac{1}{2}} \\ &= (A^2 + B^2)^{\frac{1}{2}} \end{aligned} \tag{1}$$

where $A = \sqrt{(a_1^2 + a_2^2 + ... + a_N^2)}$ and $B = \sqrt{(b_1^2 + b_2^2 + ... + b_N^2)}$.

Thus, we can treat

$$Y = A + jB \tag{2}$$

as the single coil image data obtained from multi-coil data without losing information. And we can compute the corresponding kspace data as $\mathcal{F}(Y)$. Note that the sign the real and imaginary parts can not be retrieved. See the visual result below.

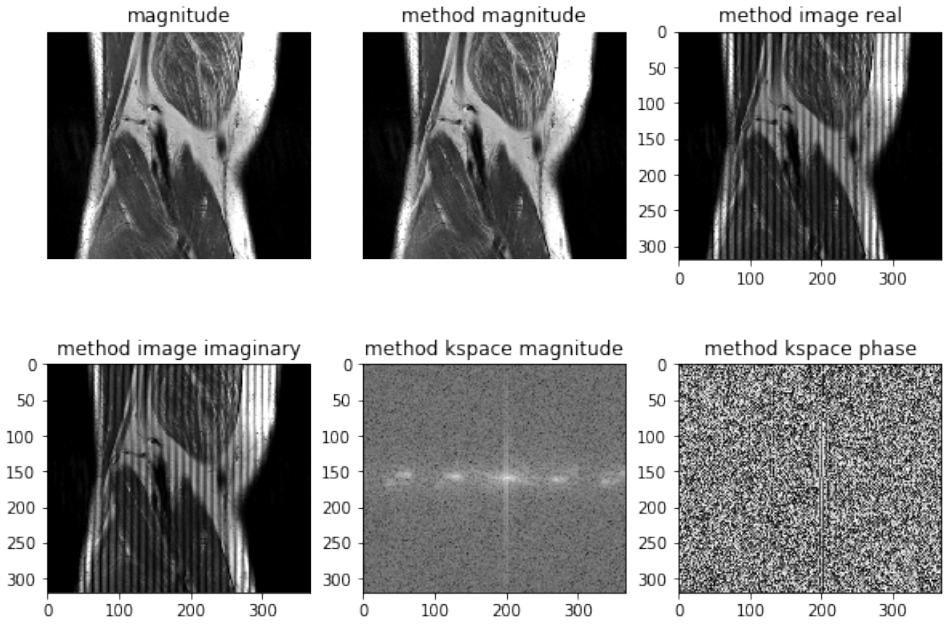

Figure 1: **magnitude**: The standard method to generate an image from multi-coil kspace data. **method magnitude**: The proposed method to compute magnitude of Y. **method image real**: The real part of Y. **method image imaginary**: The imaginary part of Y. **method kspace magnitude**: The magnitude of $\mathcal{F}(Y)$. **method kspace phase**: The phase of $\mathcal{F}(Y)$.