MRI Simulator Notes

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Tasks

- I computed the parameter requirements for the simulation

Parameter requirements

Summary

- The ems are arranged in a grid, with the number of grid points in each dimension being $2r_{\mathrm{grid}} + 1$, with r_{grid} an integer.
- The ems are placed at $x = [-x_{\mathrm{lim}} : \Delta x : x_{\mathrm{lim}}]$, where $\Delta x = x_{\mathrm{lim}}/r_{\mathrm{grid}}$ and similarly for y.
- The number of samples of k-space taken in the phase-encoding direction (y) is $2r_{\mathrm{pe}} + 1$ and the number of samples taken in the frequency-encoding direction (x) is $2r_{\mathrm{fe}} + 1$, with r_{pe} and r_{fe} integers.
- We require the field-of-view to satisfy $FOV_x \geq 2x_{\mathrm{lim}}$ and $FOV_y \geq 2y_{\mathrm{lim}}$.
- We require a pixel dimension of $\Delta x \times \Delta y$.

- For the field-of-view requirements, we use

$$FOV_x = \frac{1}{\Delta k_x},$$

where Δk_x is the spacing between k-space samples in the x direction, and similarly for y.

- For the pixel size requirements, we use

$$\delta_x \approx \frac{1}{2k_{x,max}},$$

where δ_x is the spatial resolution in x and $k_{x,max}$ is the maximum sample of k-space in the x direction, and similarly for y.

For the FOV requirements, I find

$$\frac{r_{\mathrm{fe}}}{k_{x,max}} \geq 2x_{\mathrm{lim}}\,, \qquad \frac{r_{\mathrm{pe}}}{k_{y,max}} \geq 2y_{\mathrm{lim}}\,.$$

For the pixel size requirements, I find

$$\frac{x_{\mathrm{lim}}}{r_{\mathrm{grid}}} = \frac{1}{2k_{x,max}}\,, \qquad \frac{y_{\mathrm{lim}}}{r_{\mathrm{grid}}} = \frac{1}{2k_{y,max}}\,.$$

Comments