

Magn. Reson. Discuss., referee comment RC3
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Comment on mr-2021-34

Alexej Jerschow (Referee)

Referee comment on "Magnetostatic reciprocity for MR magnet design" by Pedro Freire Silva et al., Magn. Reson. Discuss., <https://doi.org/10.5194/mr-2021-34-RC3>, 2021

The work described is very cool. I think one can say that Fig. 2 summarizes the main idea and procedure suggested. By using the principle of magnetostatic reciprocity, one can have magnets self-assemble into a configuration that will maximize the field in a specified region. Naturally, this approach could be used for generating magnet designs that produce very homogeneous fields, or even a specific magnetic field distribution. The experimental and computational demonstrations will also be of high value in a range of magnet design applications.

I agree with the other comments, however, that the presentation is significantly non-optimal. Many terms are not explained well, and there are several inaccuracies, that make it very difficult for the reader to follow. I therefore think that this manuscript will be significantly improved if all terms are carefully introduced and defined, and if the logical flow is improved.

For example:

(1) "This simplifies Eq. 1 to:" But Eq. 2 does not look like a simplification, only if you know exactly what you are looking for. Perhaps rather this should be called a transformation?

(3) "Whereas this approach matches exactly the ideal coupling between two equal magnets,"
it is not clear what coupling between magnets means here

(4) "Assuming $B_{\text{target}} = -BrA$ in Eq. 1, one can see how maximum compliance with the target field is given by the minimum magnetostatic energy condition." Target field is not

defined, and it is not clear where the minimum magnetostatic energy conditions comes from or what it refers to.

(5) Section heading "High-n applications" should probably be reworded to simply say something like "Arrangement of n magnets" (does it matter what kinds of magnets?)

(6) "which takes small results in neodymium magnets as $\mu_k = 1.03$ and $\mu_r = 1.12$ " what does small results mean?

(7) "Similarly, one can deduce a reciprocity between two regions in space and the magnets/fields contained therein." it is not clear whether this sentence indeed says what the authors wish to say.

(8) Convoluted sentence: "One can nonetheless estimate the relative inefficiency of a design in optimally placing magnetic energy in the anchor volume in which a sample will be placed. "

(9) "intensity-optimal magnet, which should be thought of as the ultimate goal of the MR magnet designer, as the field's homogeneity can then be targeted through a wealth of solutions." What is an intensity-optimal magnet and how do you balance this goal against the goal of homogeneity?

(10) "On the other hand, field inhomogeneity does not constitute a fundamental problem for NMR, as it only reduces the net measured signal, and not the local contributions. This effect comes naturally from local dephasing, which has successfully been targeted with "shimming" RF pulses (Topgaard et al. (2004)), which can periodically or continually compensate for any "

(11) "local deviation in phase." What type of phase is referred to?

Again, pretty cool work, but improvement in presentation will make it much more useful for a broad audience.