A novel design for a 1 Tesla magnet for mobile MR

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Introduction:

Mobile MR Systems depend mainly on lightweight magnet constructions delivering a homogeneous magnetic field. Available magnets for mobile systems are either heavy in weight or suffer from weak field strength. Aim of this study was to develop a compact magnet with high field strength, large field of view (FOV) and limited weight. A novel construction based on the Halbach design is presented with 1T field strength, 40mm field of view and 15 kg weight (figure 1a).

Methods and materials:

The magnet was constructed from 160 cube shaped magnet with 20 mm edge length assembled in 5 identical layers. Magnetization direction was chosen as seen in figure 1b, leaving an inner bore of 40 mm * 40 mm. As indicated by the blue and red arrows, the novel modified Halbach design is built of these subgroups, each forming individually a Halbach magnet. The field distribution of the new design was simulated and additionally a field map was measured with a hall probe.
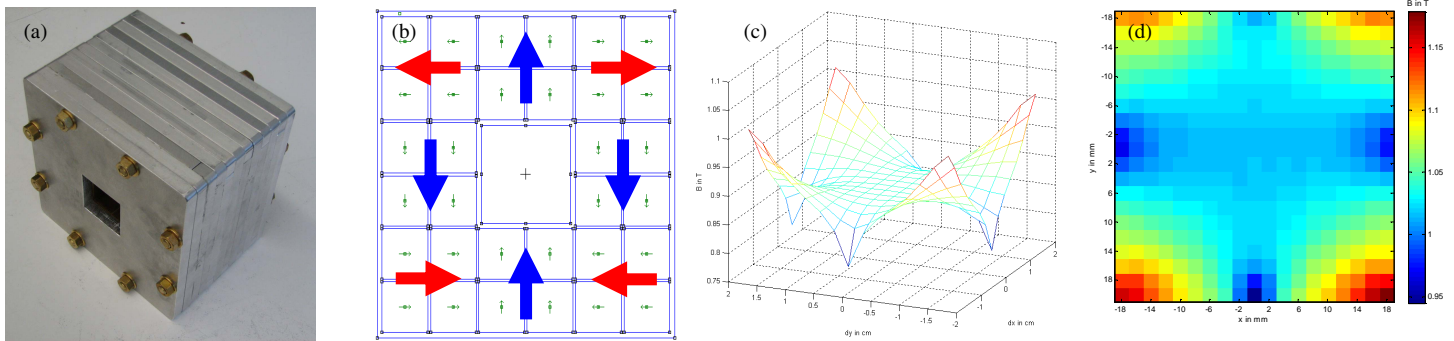

Figure 1: (a) Picture of the assembled magnet, (b) direction of magnetization, (c) simulated field distribution and (d) measured field distribution

Results:

Field strength of the magnet was determined to be 1018 mT in the center of the magnet. The overall weight of the construction was only 15 kg, while delivering a 40 mm bore. The field distribution of the simulation (figure 1c) and hall probe measurements (figure 1d) lead to similar results. The homogeneity in the centre of the simulated magnet is 88e-6 for an area of 5mm x 5mm (40e-3 for 20mm x 20mm).

Conclusion:

A modified Halbach design with 1T field strength, 40 mm bore size and 15 kg weight is presented with a homogeneous field which can be used for mobile MR application due to its compact design.