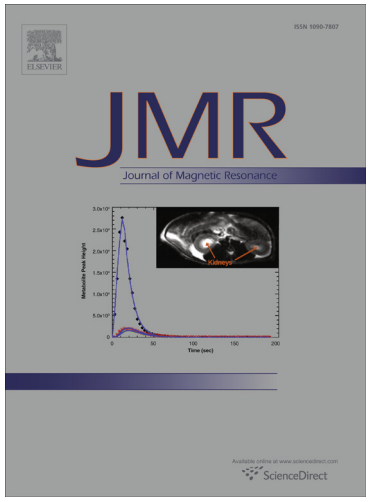

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Shimming Halbach magnets utilizing genetic algorithms to profit from material imperfections

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Abstract

In recent years, permanent magnet-based NMR spectrometers have resurfaced as low-cost portable alternatives to superconducting instruments. While the development of these devices as well as clever shimming methods have yielded impressive advancements, scaling the size of these magnets to miniature lengths remains a problem to be addressed. Here we present the results of a study of a discrete shimming scheme for NMR Mandhalas constructed from a set of individual magnet blocks. While our calculations predict a modest reduction in field deviation by a factor of 9.3 in the case of the shimmed ideal Mandhala, a factor of 28 is obtained in the case of the shimmed imperfect Mandhala. This indicates that imperfections of magnet blocks can lead to improved field homogeneity. We also present a new algorithm to improve the homogeneity of a permanent magnet assembly. Strategies for future magnet construction can improve the agreement between simulation and practical implementation by using data from real magnets in these assemblies as the input to such an algorithm to optimize the homogeneity of a given design.

Keywords: portable NMR, NMR Mandhala, Halbach magnet, shimming

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