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An Improved Passive Shimming Strategy for the Unsaturated Magnetization Problem in the Low-field Superconducting MRI Magnet

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The imaging quality of the Low-field magnetic resonance imaging (MRI) equipment is usually inferior to that of the high-field MRI equipment, however, the low-field MRI equipment has the advantages of lightweight, low cost, flexibility, etc., and is enough to meet most of the medical standards. With the progress of image reconstruction technology, the competitive disadvantage of the low-field MRI could be compensated owing to its improving image quality, which is bound to trigger a new boom for studying the low-field MRI. Passive shimming has been widely applied to correct the bare magnetic field of a fresh MRI magnet to the desired value. In the low-field MRI magnets, ferromagnetic materials used by passive shimming are usually in an unsaturated magnetization state, which is susceptible to the background magnetic field. Therefore, the passive shimming for the low-field MRI magnets becomes more complex and extremely challenging when it comes to the unsaturated magnetization problems. In this paper, an improved strategy for passive shimming in the low-field MRI magnets was proposed to improve the calculation accuracy of the magnetic field generated by the ferromagnetic materials, and some practical shimming measures were taken to improve the magnetic field homogeneity. The related passive shimming tests had been carried on a 0.5 T superconducting MRI magnet, which showed that the shimming efficiency was significantly improved, and the magnetic field homogeneity over some target volumes reached expectations.

Keywords: Low-field MRI, Passive shimming, Unsaturated magnetization, Superconducting magnet.

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