A Portable 0.2 T Whole-body Magnetic Resonance Imaging System

[1]Linxin Chen, [1]Zaimin Zhu, [2]Huabing Liu, [2]Huaxue Liu, [2]Youwei Hou, [2]Mengyao Li, [2]Shuo Li, [3]Wenhui Yang, [3]Chengwei Lu, [1]Fangrong Zong*

[1]School of Artificial Intelligence, Beijing University of Posts and Telecommunications, Beijing, China

[2]Beijing Limecho Technology Co., Ltd, Beijing, China

[3]Institute of Electrical Engineering of the Chinese Academy of Sciences, Beijing, China

Introduction: Magnetic resonance imaging (MRI) is vital for neurological diagnosis [1], however, the high cost, large footprint, and infrastructure requirements of high-field systems constrain its availability in resource-limited settings [2]. To address this, we developed a compact, low-power 0.2 T portable whole-body MRI system suitable for point-of-care applications.

Methods: The system incorporates an open dual-column NdFeB permanent magnet (0.2 T, ± 5%) with passive and first-order active shimming, achieving a homogeneity of 47 ppm in a 200 mm DSV and stability within ≤ 10 ppm/h. Active thermal regulation maintains 28 ± 0.1 °C (Fig. 1.c). The gradient subsystem uses dual-planar compensated coils, delivering a maximum gradient strength of 46 mT/m and a slew rate of 40 T/m/s (Fig. 1.a). The RF system adopts a single-channel transmit-receive configuration based on a solenoid coil structure (Fig. 1.b). The system supports SE, FSE, and GRE sequences. Electromagnetic interference (EMI) is mitigated using copper mesh shielding. The system is powered by a lithium iron phosphate battery, is mobile within 500 m, and includes a manual patient table for flexible deployment.

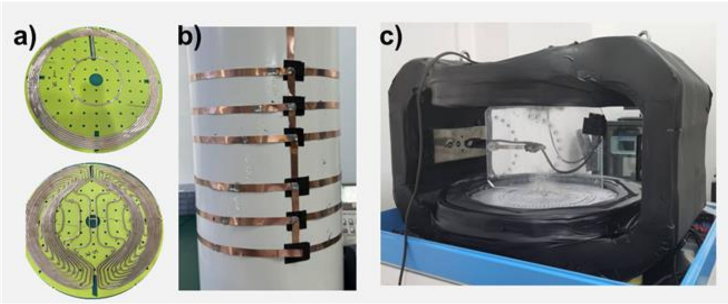

Fig. 1.a) Gradient coil; b) RF coil; c) Permanent magnet structure.

Results: A 3D GRE sequence (TR = 52 ms, TE = 13 ms) was used to acquire a brain image with a voxel size of 2.5 × 2.5 × 2.5 mm^3 (Fig. 2.a). A 2D SE sequence (TR = 0.5 s, TE = 30 ms) was used to image the hand and ankle, with a voxel size of 2 × 2 mm^2 (Fig. 2.b and Fig. 2.c). The images demonstrated good tissue contrast and structural clarity, validating imaging performance without RF shielding.

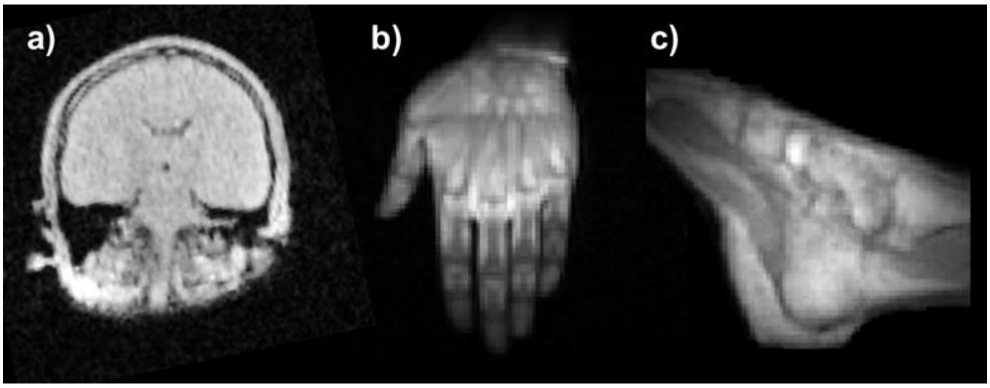

Fig. 2.a) 3D brain image using GRE; b) 2D hand image using SE; c) 2D Ankle image using SE.

Conclusion: We developed a portable 0.2 T whole-body MRI system for imaging in resource-limited settings. Preliminary evaluations demonstrated stable operation and feasible image acquisition. Future work will focus on EMI suppression and AI enhancement to support broader deployment.

References: [1] Ali et al., Artif. Intell. Rev. (2025). [2] Altaf et al., Front. Neuroimaging (2025).

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