A Frequency Selective Surface (FSS) Shield for Portable Low-Field MRI

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Introduction: Portable low-field MRI systems suffer by low signal-to-noise ratio. It require effective RF shielding to suppress environmental noise while preserving coil sensitivity. Traditional copper shields offer strong noise attenuation[1] but often reduce B_1 field strength when placed near the coil[2]. To overcome this trade-off, we propose a wire-mesh Frequency Selective Surface (FSS) that does both shielding and sensitivity conservation for solenoid coils.

Methods: Three shielding configurations—no shield, solid copper shield, and FSS shield (Fig. a)—were simulated and fabricated, all impedance-matched to 50 Ω. Bench measurements (B_1 sensitivity, noise suppression) and imaging tests with phantoms and fruit samples were conducted using a 100 mT unshielded MRI system.

Result: As the Fig. b shows that the FSS shield suppressed over 90% of external noise while maintaining higher coil sensitivity than the copper shield. Imaging tests showed ~30% higher SNR than the copper case and nearly 10× improvement over the unshielded configuration (Fig. c).

Conclusion: The proposed FSS shield enables efficient noise suppression in portable, unshielded MRI systems without compromising coil sensitivity. This compact design provides a practical shielding solution for low-field MRI in challenging environments. Evaluation of the proposed wire-mesh Frequency Selective Surface (FSS) shield for noise suppression in low-field MRI.

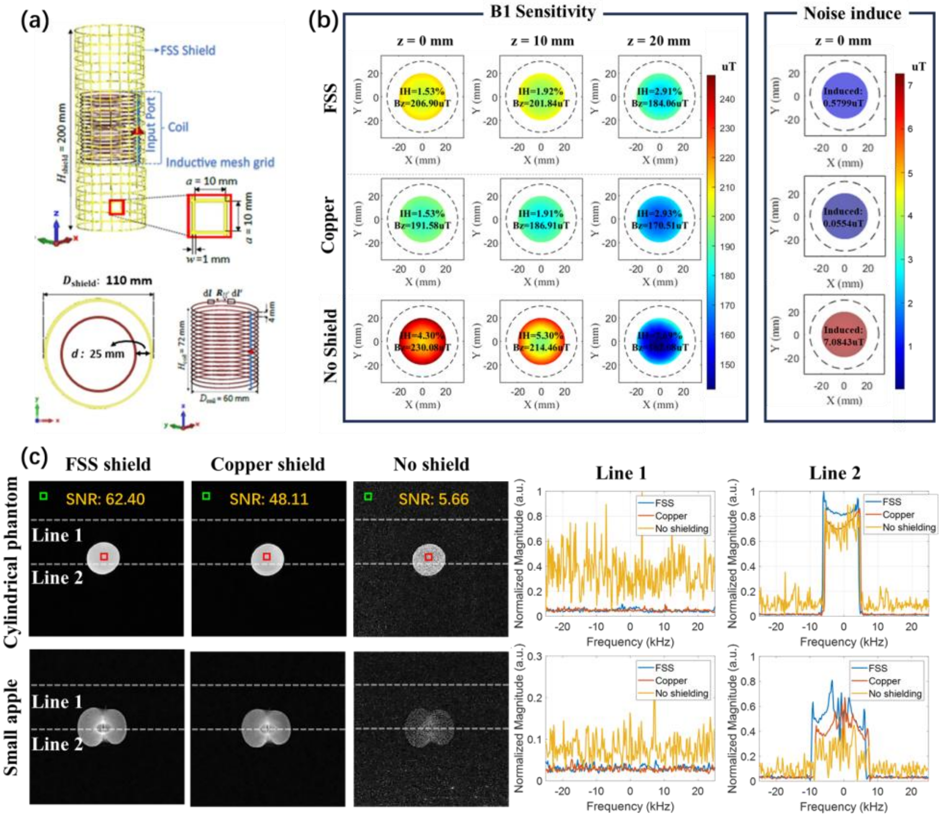

Fig: (a) FSS geometry: a solenoid coil (diameter 60 mm, pitch 4 mm) enclosed in an FSS mesh shield with 10 mm pitch and 1 mm wire width. (b) Simulated B_1 sensitivity maps and induced noise distributions for FSS, copper, and no shielding configurations. At various imaging depths (z = 0, 10, 20 mm). (c) Imaging results for cylindrical phantom and fruit sample (small apple).

References: [1] de Vos B, et al., Journal of Magnetic Resonance, 2024, 362: 107669. [2] Ochi H, et al. Electronics and Communications in Japan, 1994, 77(1): 37-45.