Development of AC and DC drive coils for a small volume magnetic particle imaging system

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ABSTRACT
Recent development in a new imaging modality called Magnetic Particle Imaging (MPI) technique has attracted much interests from researchers where it is expected to provide a higher spatial and temporal resolutions of images. The MPI technique works by utilizing an AC field to modulate the magnetic response from magnetic nanoparticles and a gradient DC field to localize the magnetic nanoparticles, where the characteristics of AC and DC fields affect the performance of MPI technique. The purpose of this study is to develop compact DC and AC drive coils as a preliminary step towards implementation in a small volume MPI system. The AC drive coil is designed based on a Helmholtz-coil configuration and resonated at a frequency to lower its circuit impedance. The gradient DC field is realized by combination of permanent magnets and a DC coil to shift a Flux Free Line (FFL) vertically. A 3rd-order Butterworth low-pass filter is implemented in the DC drive coil circuit to protect its DC current source from high-frequency field induction. The AC drive coil is able to be resonated at the designed frequency of 8 kHz and fairly good horizontal and vertical gradient DC fields are obtained. The DC drive coil is able to shift the FFL vertically at 0.33 mm/A and further improvement can be expected in the coil design for future implementation in the small volume MPI system.

KEYWORDS
Coil; Resonance; Low pass filter; Magnetic particle imaging

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