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Imaging Electrical Current Density Using Nuclear Magnetic Resonance

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Abstract: In this study, images of nonuniform and uniform electric current density in conductor phantoms, which contain magnetic resonance active nuclei, are produced using Magnetic Resonance Imaging (MRI). A standard spin echo pulse sequence is used, with the addition of a bipolar current pulse. The flux density parallel to the main magnetic field, generated by the current pulse, is encoded in the phase of the complex MR image. The spatial distribution of magnetic flux density is extracted from the phase image. Current density is calculated using the magnetic flux density. This fairly recent technique is known as Magnetic Resonance Current Density Imaging (MRCDI). In this paper, images of magnetic flux density, generated by uniform and nonuniform current flow, and the current density image of a uniform current flow are given. Current density levels as low as 1μ A/mm² are measured. Effects of current density on k-space data are also discussed.

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