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Radial TRASE: A 2D Slice-Selective RF Encoding MRI System

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Transmit Array Spatial Encoding (TRASE) is an MRI encoding technique utilizing a transmit (Tx) array of radiofrequency (RF) phase gradient coils to achieve spatial encoding, rather than conventional switching gradients of the main magnetic field (B0). TRASE is particularly well suited to low-field, low-cost, and portable MRI systems utilizing lightweight permanent magnets, such as a Halbach array; however, interactions between the TRASE Tx array elements have caused significant challenges for 2D imaging. Here, we present a low-cost and slice-selective radial encoding scheme (Radial TRASE) for 2D TRASE imaging, which utilizes a simplified Tx array compared to prior 2D Cartesian TRASE sampling. The constructed system consists of two RF phase gradient coils capable of 1D encoding any transverse axis. By incremental mechanical rotation over a 90° range, the encoding axis can be changed, allowing a complete radial k-space acquisition. As a first demonstration, a wrist-sized coil pair was experimentally verified on a 2.0 MHz Halbach magnet, incorporating a static B0 slice-selection gradient. Although a high level of isolation is achievable geometrically (better than -20 dB), for a more robust implementation, we also demonstrate the capability of our active parallel transmit system (pTx) cancellation method. Through pTx compensation pulses, residual coupled currents remaining from geometric decoupling can be eliminated, with effective isolations of -50 dB being reached for the two-coil array. Radial TRASE encoded images of a line-pair phantom were acquired, achieving a resolution better than 3.33 mm/lp with minimal coupling related encoding artifacts, indicating the advantage of the simplified Tx array. Mechanical rotation of the Tx array was performed during the TR period, which caused no imaging delays. By both eliminating the requirement for a switched B0 gradient subsystem and further simplifying the RF implementation, this MRI configuration is particularly promising for applications resonating at the lowest end of the NMR spectrum of technical complexity.

Keyword-1

TRASE MRI

Keyword-2

Low-cost, Low-field MRI

Keyword-3

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