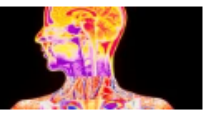
INTERNATIONAL JOURNAL OF IMAGING SYSTEMS AND TECHNOLOGY



RESEARCH ARTICLE

Dual-Resonant RF Coil for Proton and Phosphorus Imaging at 7 Tesla MRI

Ashraf Abuelhaija, Gameel Saleh, Emad Awada, Sanaa Salama, Samer Issa, Osama Nashwan

First published: 10 April 2025 | https://doi.org/10.1002/ima.70081

Funding: The authors received no specific funding for this work.

ABSTRACT

Magnetic resonance spectroscopy (MRS) provides a non-invasive method for examining metabolic alterations associated with diseases. While ^{1}H-based MRS is commonly employed, its effectiveness is often limited by signal interference from water, reducing the accuracy of metabolite differentiation. In contrast, X-nuclei MRS leverages the broader chemical shift dispersion of non-hydrogen nuclei to enhance the ability to distinguish between metabolites. This article presents the design and analysis of a dual-resonant meandered coil for 7 Tesla magnetic resonance imaging (MRI), to simultaneously help in image hydrogen protons (^{1}H) and detect Phosphorus (^{31}P) atomic nuclei at 298 MHz and 120.6 MHz, respectively. Both single-channel and four-channel configurations were designed and analyzed. The single-channel coil integrates an LC network for dual resonance, achieving excellent impedance matching ($S_{11} < -10$ dB) and a homogeneous magnetic field distribution within the region of interest. A transmission-line-based matching network was implemented to optimize performance at both frequencies. The four-channel coil was simulated using CST Microwave Studio and experimentally validated. Simulations demonstrated impedance matching and minimal mutual coupling of −38 dB at 298 MHz and −24 dB at 120.6 MHz. The measured S-parameters confirmed these results, showing high decoupling and robust performance across all channels. The prototype featured integrated LC networks and optimized meander structures, ensuring efficient power transmission and uniform field distribution. This work highlights the effectiveness of the proposed dual-resonant coil designs for MRS applications, offering promising potential for advanced clinical diagnostics.