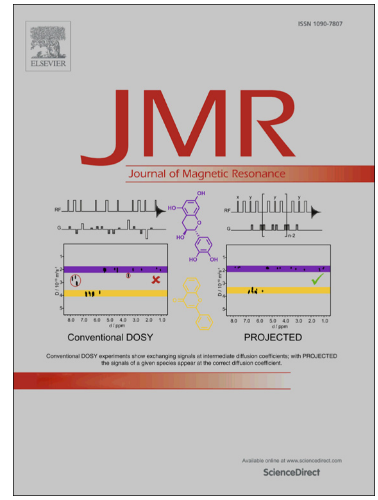

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PII: S1090-7807(17)30087-3

DOI: http://dx.doi.org/10.1016/j.jmr.2017.03.015

Reference: YJMRE 6075

To appear in: *Journal of Magnetic Resonance*

Received Date: 14 September 2016

Revised Date: 23 March 2017

Accepted Date: 25 March 2017

Please cite this article as: Y. Wang, F. Liu, X. Zhou, S. Crozier, Design of transverse head gradient coils using a layer-sharing scheme, *Journal of Magnetic Resonance* (2017), doi: http://dx.doi.org/10.1016/j.jmr.2017.03.015

Design of transverse head gradient coils using a layer-sharing scheme

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Abstract

In this paper, a new design for transverse asymmetric head gradient coils is proposed for magnetic resonance imaging (MRI). Unlike the conventional coil designs where the x and y coils are placed onto separate radial layers, the new design has windings for both the x and y coils in each transverse coil layer. The coil performance using the new design was compared with the conventional coils with the same dimensions and constraints. The results showed that the new design can improve coil performance in terms of a lower inductance, lower resistance and a higher figure of merit.

Keywords: *gradient coil; head coil; MRI; magnetic field*

1. Introduction

In Magnetic Resonance Imaging (MRI) system, gradient coils are used to generate linear gradient magnetic fields that are superimposed on a strong uniform magnetic field [1]. The performance of the gradient coils can significantly affect the imaging quality and enable new sequences and, consequently, gradient coil designs continue to evolve.

Some recent developments in gradient coil design include multi-layer coils which were proposed to spread the coil tracks out onto more coil layers [2]. For a given coil efficiency, this method can produce a smaller resistance compared with an actively-shielded two-layer coil, resulting in a potentially improved thermal performance. Three-dimensional (3D) gradient coils have been proposed that connect the primary coil layer and the shielding coil layer, allowing the current flow directly from the primary coil to the shielding coil [3-7]. Under the same constraints as a layered coil, a 3D coil is able to increase the wire spacing and reduce the coil inductance and local heating problems [4, 8, 9]. However, both the multi-layer and 3D designs can be challenging to fabricate.

In this work, a novel gradient coil configuration was proposed with the focus on improving the electromagnetic performance of the transverse coils. This new design employs a layer-sharing scheme, with some sections of the x primary layer distributed to the y coil and *vice versa*. Compared to existing gradient coil configurations/designs, the key advantage of the proposed method lies in its higher efficiency in delivering the required magnetic field inside the imaging region (DSV), without requiring any extra construction complexity. This advantage can be used to improve other coil