ON THE REQUIREMENTS FOR A COMPLETE RF TRANSMIT COIL AT ULTRAHIGH FIELD FOR HEAD IMAGING

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Dissertation

Submitted to the Faculty of the

Graduate School of Vanderbilt University

in partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

in

Physics

May 2022

Nashville, Tennessee

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Dedication

Acknowledgment

Where to begin? I am immensely thankful to so many in my life for helping me get here physically, emotionally, pyschologically, and spiritually. The entire graduate school experience has been much more than simply an intellectual journey for me. I have grown into someone entirely different than the person I started as in the fall of 2017. This dissertation will only in part cover the expanse of knowledge and achievement intellectually that has been gifted to me by life. On the other hand I feel I could write many other dissertations on the work done on my soul during my time here in Nashville. Then maybe write another dissertation on the how it all ties together in the sum of my personhood. I only want to communicate whats happened for me so the reader knows how much the people I dedicate this dissertation have done for me in my life overall.

First I believe that God has brought me here. I believe the complexity and beauty of the world around us requites a loving and scientific God much like the people I admire in academics. I dedicate this dissertation to my God who is my friend who loves me unconditionally and understands the world through and through along with every soul on the planet. He understands justice and even evil and has chosen to place me here knowing the good would outweigh the pain and that life is worth living amidst it all and I thank God for it now. He understands the entire nature of Electricity and Magnetism and left it here for us to discover, much like he leaves a lot of things here for us to figure out, like justice, war, the problem of evil, politics, etc.

I also want to dedicate this dissertation to my lovely wife. She is the light of my life and an inspiration to not only me but everyone she knows. Her encouragement has brought me through many days of considering quitting graduate school. She has always believed in me and I wouldn't not be where I am now if she wasnt in my life. Particularly in my 3rd year of study she has encouraged me to continue on in my study and press on towards my goals and to also be gracious to myself when I do not meet these goals.

My family

Dr. Adam Anderson... Dr. John Gore

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Chapter 2

DENSE ARRAY DESIGN FOR OPTIMAL TRANSMISSION USING SURFACE LOOPS

2.1 Design Process

With the advantages of parallel transmission (pTx) and push for high channel count, it is natural to consider the upper bound of radiating elements in a dense array. There has yet to be published works demonstrating the viability of greater than 100 degrees of freedom or elements for static RF shimming, in part because this is a convoluted conversation. Many assumptions must be made before answering anything close to the question of "How many radiating elements does it take to RF shim a region of interest like the brain?" RF elements come in many shapes and designs, coupling may remove the advantage of densely packed elements if not properly dealt with, brain volumes no doubt vary across the patient population, power constraints are unique to each scanner, and you want the patient to come out of the scanner without a fried brain! This work attempts to address all of these issues for a particular scanner, specifically the Philips Achieva 7T with Multix capabilities. A surface loop is unanimously used across all forms of MR and was chosen as the base element for the dense array. Surface loops are often used in dense Rx/Tx arrays due to the ease of decoupling neighboring elements by overlapping the loops to cancel their mutual inductance. A combination of decoupling strategies is used in order pack many elements into an array. Self-Decoupled coils work nicely to decouple neighboring loops in one direction, yet coupling Power constraints The upper limit of transmission elements is entirely dependent on the channel count or power available and coupling between neighboring elements.

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Chapter 3

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