February 2022

MEP Project

Shimming B1 field with actively-coupled dielectric blocks

Supervisor

Paulina Šiurytė
p.siuryte@tudelft.nl

Principal Investigator

Sebastian Weingärtner
s.weingartner@tudelft.nl

Website

https://www.mars-lab.eu/

Description

MRI hardware has advanced greatly, now enabling high and ultra-high field imaging, with field strengths up to 10T. However, at higher field strengths, the lengths of transmitted RF pulse wavelengths approach the dimensions of the human body. This results in wave interference and transmit magnetic field (B_1^+) imperfections become more prominent. This leads to signal drop-out in the images and cannot be easily accounted for in conventional scanners.
In this project, we develop a new approach to correct for these field inhomogeneities. We design actively switchable matrix of special materials to locally manipulate the B1+ field. We utilize materials with very high relative permittivity, and couple them in various ways to get the desired result.

Steps & Goals

- Familiarize with MRI basics and why homogeneous fields are important, test the current device prototype
- Run EM simulations and design a next generation device
- 3D print and assemble the device
- Acquire experimental data to verify simulations
- Incorporate remote switching

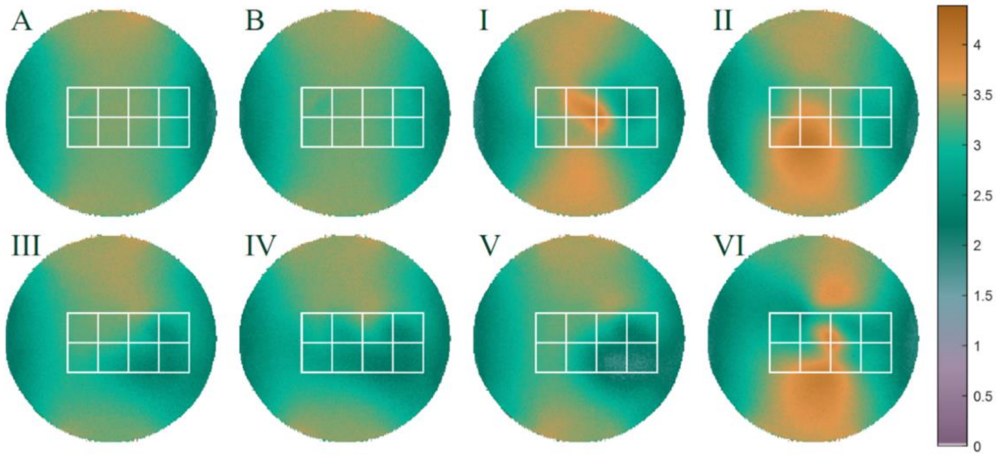

Figure 1. Examples of 2x4 dielectric pocket coupling effects on the relative $|B_1^+|$ maps. A shows a map with no dielectrics while B shows an unwired case.

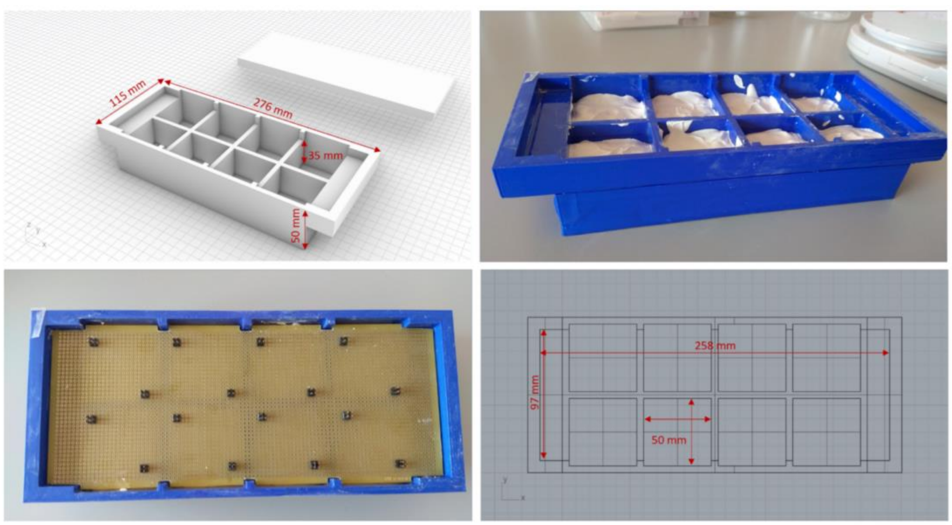

Figure 2. Prototype for the active dielectric shimming device. A 3D printed cask with eight small dielectric pockets is coupled to a non-magnetic PCB. Two poles are connected for each pocket allowing for a variety of electrical coupling between the pockets. Each pocket is filled with a barium titanate slurry to achieve high dielectric constants.