CONCEPT OF A RABBIT-SIZED FFL-SCANNER

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INTRODUCTION: In the past years, different Magnetic Particle Imaging (MPI) scanners for small animals using a field free line (FFL) have been presented [1-3]. In this work, a novel concept of a pre-clinical FFL MPI scanner which can accommodate rabbits is presented.

METHODS: An inverse boundary element method has been used to design the wire path of the drive coils and the selection coils [4]. The transmit filter design, based on air-core coils, was optimized for minimal dissipation and eddy current losses [5].

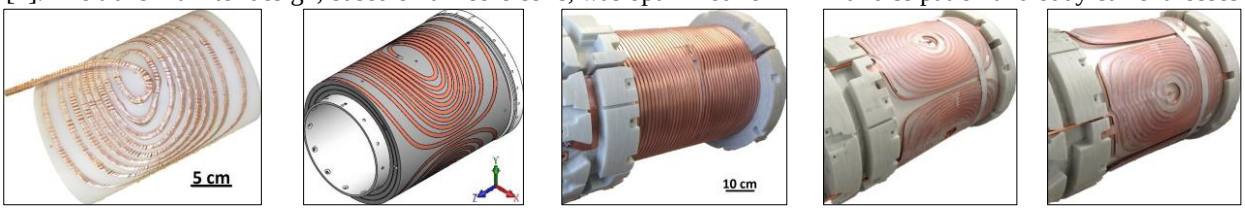

Figure 1: *Detailed views of the different winding paths used in the scanner. From left (inner coil) to right (outermost coil): x-drive coil, y-drive coil, first layer of the selection coil, first layer of the quadrupole at 0° and the first layer of the quadrupole at 45°. The three last images are courtesies of Futura Composites BV, Netherlands.*

RESULTS: A cylindrical volume with a diameter of 18 cm is available for sample/subject placement in the scanner. With a gradient strength perpendicular to the FFL of 0.8 T/m and drive field amplitudes of 15 mT peak, the drive coils dissipate a power of 2.2 kW and the selection coils 32.6 kW. The concept and connection diagrams of the coils and filters are shown in Figs. 1 to 3. Quality factors of more than 500 and a damping of undesired frequencies of more than 100 dB has been obtained for some of the filter coils. The quadrupole coils will be used at 100 Hz, acquiring up to 100 images per second. Simulated images using a system-matrix approach, the different coils' properties and expected reference images are shown in Fig. 4.

a)

b)

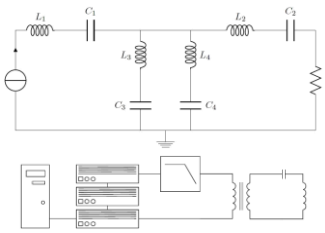

Figure 2: a) *Design of the drive field transmission filter* **b)** *Quadrupole Tx-path with signal generator, amplifiers, low pass filter, impedance matching and power factor correction [6]*

Figure 3: *3D model of a 1st stage filter coil in the transmission path. The used litz wire contains 10000 strands with 63 µm diameter.*

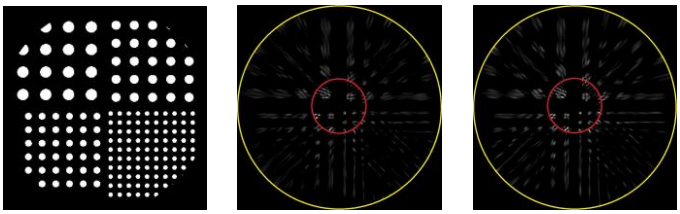

Figure 4: *On the left side, the phantom used for the simulation is shown. The other two figures depict the simulated reconstructions. Both are performed in a 18 cm diameter circle (in yellow). The picture in the center shows the results of an FFL scanner using ideal fields [7], with the area in red representing the surface with the fully sampled information. The right picture shows results of the presented concept.*

CONCLUSION: A concept of a rabbit-sized FFL scanner has been presented. We hope to acquire images in the near future and improve the concept in order to cover an even larger field of view in an equivalent time.

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