University of Stuttgart
Institute of Smart Sensors

Master thesis
3D printing of NMR shim pieces using linear programming

Recently, miniaturized nuclear magnetic resonance (NMR) spectrometers that utilize permanent magnets as the source of the static B_0-field are gaining increasing attention for applications in a large number of fields, including. medicine, chemistry, and industrial quality control. This is because permanent magnets are robust, compact, portable, and produce magnetic fields without consuming electrical power. One requirement of all NMR applications is a high homogeneity of the static B_0- field. The required homogeneity is achieved in a process called shimming, which iteratively improves the magnetic field homogeneity.

You will first optimize and build a simple H-shaped magnet. This magnet consists of two permanent magnetic blocks, two pole pieces, and a yoke made of iron. Using a commercial Gaussmeter or NMR measurements, you will then characterize the resulting magnetic field and analytically model the field using spherical harmonics. To correct the inhomogeneities in the magnetic field, you will then use small cylindrical pieces (≈2Ø mm x 2 mm) of 3D-printed ferromagnetic material. You will carry out this field optimization iteratively by using integer linear programming (ILP) to find the optimum distribution of the cylindrical printed pieces onto each pole piece's surface.

Requirements

- ✓ Basic knowledge of COMSOL
- ✓ Basic knowledge of FEM
- ✓ Good knowledge in Matlab is mandatory

Duration: 6 months

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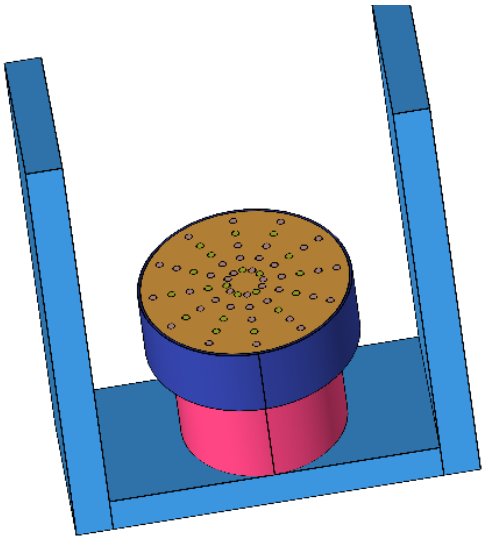

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