

CoilGen Documentation

Philipp Amrein

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CoilGen

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0.1 Purpose, Introduction

This project is supposed to be a community based tool that facilitates the design of coils within the MRI/NMR environment. Up to now, the code is written in MATLAB, but future migration to python might be advantageous, especially since it does not need proprietary software licenses. The author is very willing to collaborate with anyone who wants to do the translation.

0.2 Installation

The project requires MATLAB and additionally FastHenry2 for calculation of the inductance. The MATLAB version should not be older than 2020A. It also requires the MAPPING toolbox since the functions *polyxpoly* and *inpolygon*. Non-proprietary versions of these functions are also very welcome.

0.3 Code description

The algorithm is written within the main function named "coilgen.m". It can be called with various necessary and optional input parameters.

0.3.1 File structure

- Geometry_Data: *stl* files of surface geometries
- sub_functions: Folder of *MATLAB* functions for the algorithm
- Pre_Optimized_Solutions: *.mat* data containers pre-optimized stream functions
- plotting:
- Results:

0.4 Usage

"Coilgen.m" must be called with the required set of input parameters. All other settings and variables are optional. If not specified the default values set. The definitions of the default values can be seen within the function *parse_inputs.m*.

0.4.1 Necessary input parameters

- *coil_mesh_file*: The name of the *.stl* file for the current carrying surface. It must be in the *Geometry_Data* folder.
- *field_shape*: The functional that specifies the target field i.e. the z component of the magnetic field i.e. B_z . In general, it can be any function of the Cartesian coordinates x, y, z . To generate a linear transverse gradient specify: *field_shape* = 'y'. This variable must be a character array.

Other examples:

- *field_shape*='x' (linear x-Gradient)
- *field_shape*='y' (linear y-Gradient)
- *field_shape*='z' (linear z-Gradient)
- *field_shape*='x.*sin(α) - y.*cos(α)' (linear x-Gradient rotated with angle α around the z-axis)
- *field_shape*='2.*x.*y' (Spherical harmonic S_2 shim field)
- *field_shape*='1' (constant field, B_0 offset)

The x, y, z coordinates refer to the coordinate system which is also used for the coordinates of the surface geometry. **Important:** Use the MATLAB *.** operator for element wise multiplication.

0.4.2 Optional input parameters

All other settings and variables are optional. If not specified the default values set. The definitions of the default values can be seen within the function *parse_inputs.m*.

- *coil_mesh_file*: The name of the *.stl* file

0.5 TO DO