The project of Computational Methods in Physics

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1 Calculate the magnetic field

We can get the magnetic field which is generared by a coil by integrating

$$B_{x0}(x,y,z) = \int_0^{2\pi} \frac{Rzcos\phi}{(x^2+y^2+z^2+R^2-2xRcos\phi-2yRsin\phi)^{3/2}} d\phi \tag{1}$$

$$B_{y0}(x,y,z) = \int_0^{2\pi} \frac{Rzsin\phi}{(x^2+y^2+z^2+R^2-2xRcos\phi-2yRsin\phi)^{3/2}} d\phi \tag{2}$$

$$B_{z0}(x,y,z) = \int_0^{2\pi} \frac{R(R-xcos\phi-ysin\phi)}{(x^2+y^2+z^2+R^2-2xRcos\phi-2yRsin\phi)^{3/2}} d\phi \tag{3}$$

Then we can get the magnetic field by a transformation

$$B_x(x,y,z) = B_{x0}(x,y,z-d/2) + B_{x0}(x,y,z+d/2) \tag{4}$$

$$B_y(x,y,z) = B_{y0}(x,y,z-d/2) + B_{y0}(x,y,z+d/2) \tag{5}$$

$$B_z(x,y,z) = B_{z0}(x,y,z-d/2) + B_{z0}(x,y,z+d/2) \tag{6}$$

1.1 Solution

1.1.1 Equation to be solved

1.1.2 Numerical method used

Gaussian quadrature method is applied.

1.1.3 Results

The value of the triple integral is 0.09603.

1.1.4 Discussions