

# mtcoils math

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## mtcoils

Static B field calculator for arbitrary configurations of coils

### The math

Each coil is defined by

- the (inner) radius  $R_{in}$
- a number of radial and axial turns  $N_r$  and  $N_z$
- the radial and axial wire thickness  $l_r, l_z$

And its field is obtained by summing  $N_r \times N_z$  coils of radius  $R_{in} + l_r(i + 1/2)$  ( $i = 0 \dots N_r - 1$ ) positioned at  $z_j = l_z(j - (N_z - 1)/2)$  ( $j = 0 \dots N_z - 1$ ). The composite coil is placed at the origin, the plane  $z = 0$  corresponding to the middle of the block. For the radial and azimuthal components of the field we use Eq. 24-25 in [1].

Arbitrary configurations are specified by a position vector  $r_0$  and a unit vector  $\hat{n}$  normal to the plane of the coil. The field at a point  $r$  will lay on the plane specified by  $x = r - r_0$  and  $\hat{n}$  and will be given by

$$\begin{cases} x = z \hat{n} + \rho \hat{u} \\ \vec{B} = B_z \hat{n} + B_r \hat{u} \end{cases}$$