

Computer Work Unit 20 Mutual Inductance

There are two circular loops, with radii $R = 12 \text{ cm}$ on $z = 0 \text{ cm}$ plane and $r = 6 \text{ cm}$ on $z = \text{Height} = 30 \text{ cm}$ plane. Find the mutual inductance between the two loops by (1) calculating the flux inside the small loop caused by the large loop and (2) vice versa.

You can do this by your own method (especially by numpy array calculation, that would give the results much faster). If you have no clue, you may try the following steps:

For part (1):

1. Partition the area inside the small loop into m ring areas.
2. Assume the large loop has a current 1 A on it. Cut the large loop into n pieces, each with length ds .
3. Find the magnetic field at position p due to the current on each ds by Biot-Savart law.
4. Sum the magnetic field over all n pieces along the large loop to get the total magnetic field at p .
5. Time the magnetic field with the area of the ring to get the flux inside the ring, and sum over all m rings to get the total flux inside the small loop due to the current on the large loop.

$$6. M = \frac{N_s \phi_{sl}}{i_l} = \phi_{sl} \text{ for } N_s = 1, \text{ and } i_l = 1\text{A}$$

7. You can do similarly for part (2).

