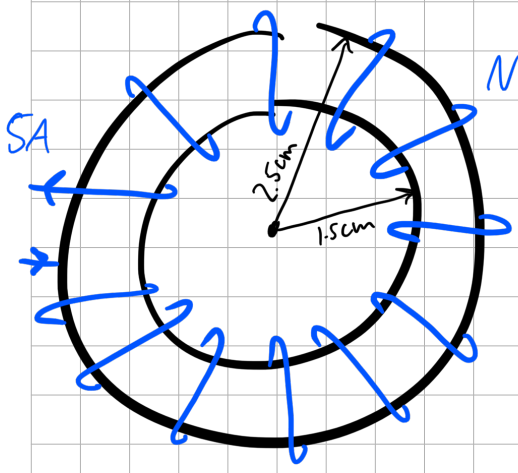
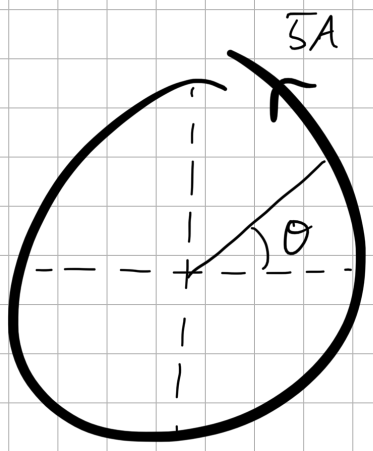
Stefan Tosti
400 367 761
MATLAB Set 16 - Analytical Solution





We can assign each point on the winding an angle value
↳ For an angle of θ, $\phi' = \theta + 2(k-1)\pi$, where k is the current turn number that we are on

We can now find the location of the cylindrical coordinates
↳ $R = R_1 + R_2\cos\theta = R_1 + R_2\cos\phi'$

↳ $\phi = \frac{2(k-1)\pi}{N}$

↳ $z = R_2\sin\theta = R_2\sin\phi$

We will need to divide the wire into n segments, and thus will pick n+1 points...
↳ $\phi'_i = \phi'_{min} + \frac{\phi'_{max} - \phi'_{min}}{n}(i-1)$
↳ $\phi'_{min} = 0$ and $\phi'_{max} = 2\pi N$

We know that the Rectangular coordinates can be expressed as...
↳ $x_i = R_i\cos\phi_i$
↳ $y_i = R_i\sin\phi_i$
↳ $z_i = z_i$

We know that the i-th segment of a vector is given by...
↳ $\Delta L_i = (x_{i+1} - x_i)a_x + (y_{i+1} - y_i)a_y + (z_{i+1} - z_i)a_z$

The vector R_i points from the center of the i-th segment to the obsv. point...
$R_i = (x, y, z) - \left(\frac{x_{i+1} - x_i}{2}, \frac{y_{i+1} - y_i}{2}, \frac{z_{i+1} - z_i}{2}\right)$

Finally, we can show that...

$$H = \sum_{i=1}^{n} \frac{I \Delta L_i \times R_i}{4\pi |R_i|^3}$$