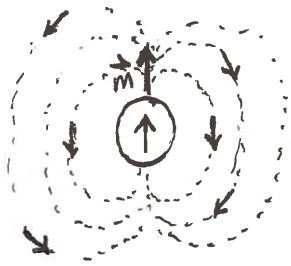
3/15/2019

LOCALIZED B-FIELD FROM MAGNETIC DIPOLE

ANALYTICAL SOLUTION, JACKSON

$$\vec{B}(\vec{x}) = \frac{\mu_0}{4\pi}\left[\frac{3\hat{n}(\hat{n}\cdot\vec{m}) - \vec{m}}{|\vec{x}|^3}\right] \quad (5.56)$$

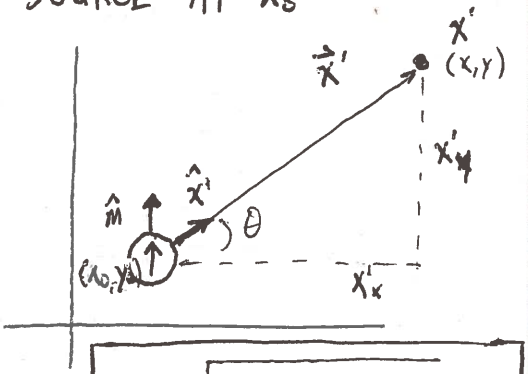


Where $\hat{n}$ is unit vector in direction $\vec{x}$

$\vec{m}$ is the magnetic (dipole) moment

TO IMPLEMENT THIS SOLN IN MATLAB I WILL SOLVE FOR THE X- AND Y-DIRECTED COMPONENTS OF THE FIELD SEPARATELY. OBSERVER AT X', SOURCE AT X_0

$$\vec{B} = \frac{\mu_0}{4\pi}\frac{3\hat{x}'(\vec{m}\cdot\hat{x}') - \vec{m}}{|\vec{x}'|^3}$$



$$B_x = \frac{\mu_0}{4\pi}\frac{3(\vec{m}\cdot\hat{x}')(\hat{x}'\cdot\hat{x}) - \vec{m}\cdot\hat{x}}{|\vec{x}'|^3}$$

($\hat{x}'\cdot\hat{x}$: x-component; $\vec{m}\cdot\hat{x}$: x-component)

$$|\vec{x}'| = \sqrt{(x-x_0)^2 + (y-y_0)^2}$$

$$x'_x = x - x_0, \quad x'_y = y - y_0$$

$$\hat{x}'\cdot\hat{x} = \cos\theta = \frac{x'_x}{|\vec{x}'|}, \quad \hat{x}'\cdot\hat{y} = \frac{x'_y}{|\vec{x}'|}$$

$$\vec{m}\cdot\hat{x}' = \frac{\vec{m}\cdot\vec{x}'}{|\vec{x}'|} = \frac{m_x x'_x + m_y x'_y}{|x'|}, \quad \vec{m}\cdot\hat{x} = m_x, \quad \vec{m}\cdot\hat{y} = m_y$$

$$B_x = \frac{\mu_0}{4\pi}\frac{3\,\frac{m_x x'_x + m_y x'_y}{|x'|}\cdot\frac{x'_x}{|x'|} - m_x}{|\vec{x}'|^3}$$

$$B_y = \frac{\mu_0}{4\pi}\frac{1}{|\vec{x}|^3}\,3\,\frac{m_x x'_x + m_y x'_y}{|x'|}\cdot\frac{x'_y}{|x'|} - m_y$$