computeDipoleH0Norm

Compute the norm factor for magnetic field generated by an Dipole in its zero position. That means the maximum H-field magnitude in zero position with no position shifts in x or y direction. So that norm factor is related to the center point of coordinate system in x and y direction and to the dipoles initial z position. Which can be seen as sphere magnet for far field of the sphere. The norm relates that a dipole magnet in center of a sphere with a radius has certain field strength in related distance. In example a sphere of 2mm radius has in 5mm distance a field strength of 200kA/m

It is simplified computation for the dipole equation for one position in inital state without tilt in z-axes tor bring on a free choosen field strength to define the magnet. Because far field of sphere can be seen as dipole.

$$\overrightarrow{H}_0(\overrightarrow{r_0}) = \frac{1}{4\pi} \cdot \left(\frac{3\overrightarrow{r_0}\left(\overrightarrow{m_0}^T \overrightarrow{r_0}\right)}{|\overrightarrow{r_0}|^5} - \frac{\overrightarrow{m_0}}{|\overrightarrow{r_0}|^3} \right)$$

$$H_{0norm} = \frac{H_{mag}}{|H_0(r_0)|}$$

Contents

Syntax

```
H0norm = functionName(Hmag, m0, r0)
```

Description

H0norm = functionName(Hmag, m0, r0) compute scalar norm factor related to dipole rest position. Multiply that factor to dipole generated fields which are computed with the same magnetic moment magnitude to imprint a choosen magnetic field strength magnitude on the dipole field rotation.

Examples

```
% distance where the magnetic field strength is the value of wished
% magnitude, in mm
r0 = [0; 0; -5]
% field strength to imprint in norm factor in kA/m
Hmag = 200
% magnetic moment magnitude which is used generate rotation moments
m0 = [-1e6; 0; 0]
% compute norm factor for dipole rest position
H0norm = computeDipoleH0Norm(Hmag, m0, r0)
```

Input Argurments

Hmag real scalar of H-field strength magnitude to imprint in norm factor to define a dipole sphere with constant radius and field strength at this radius.

m0 vector of magnetic moment magnitude which must be same as for later roatition of the dipole.

r0 vector of distance in rest position of magnet center.

Output Argurments

H0norm real scalar of norm factor which relates to the zero position of the dipole sphere and can be multiplied to generated dipole H-field to imprint a magnetic field strength relative to the position of sensor array. The imprinted field strength magnitude relates to the rest position z0 + rsp.

Requirements

- Other m-files required: None
- Subfunctions: None
- MAT-files required: None

See Also

- rotate3DVector
- generateDipoleRotationMoments
- Wikipedia Magnetic Dipole


```
function [H0norm] = computeDipoleH0Norm(Hmag, m0, r0)
    arguments
        % validate inputs as real scalars
        Hmag (1,1) double {mustBeReal}
        m0 (3,1) double {mustBeReal, mustBeVector}
        r0 (3,1) double {mustBeReal, mustBeVector}
    end

    % calculate the magnitude of all positions
    r0abs = sqrt(sum(r0.^2, 1));

    % calculate the the unit vector of all positions
    r0hat = r0 ./ r0abs;

    % calculate field strength and magnitude at position
    H0 = (3 * r0hat .* (m0' * r0hat) - m0) ./ (4 * pi *r0abs.^3);
    H0abs = sqrt(sum(H0.^2, 1));

    % compute the norm factor like described in the equations
    H0norm = Hmag / H0abs;
end
```

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