SINGULAR INTEGRAL EQUATION FOR NON-STATIONARY PROBLEMS OF ELECTROMAGNETICS IN MATERIAL MEDIA

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In this report we consider the non-stationary electromagnetic problems. Assume that a medium filling bounded domain Q is characterized by the electric polarization vector $\vec{P} = \vec{P}(\vec{E}, x, t)$. Outside domain Q, the parameters of the medium are constant, i.e. e_0, m_0 . It is necessary to determine the electromagnetic field excited in the medium by an external field with unstable time dependence. Using volume singular integral equations [1], that describe harmonic scattering problems from inhomogeneous dielectric bodies, and Fourier transformation techniques, we obtain the following singular integral equation for the above-mentioned problems

$$\vec{E}(x,t) = -\frac{1}{3e_0}\vec{P}(x,t) - g_1\int_Q \frac{1}{R}\frac{\partial^2 \vec{P}(y,t')}{\partial r^2}dy + g_1\int_Q \frac{1}{R}\left(\frac{\partial^2 \vec{P}(y,t')}{\partial r^2}, gradR\right)gradR\,dy -$$

$$-g_2\int_Q R\left(\frac{\partial \vec{P}(y,t')}{\partial t}, grad\right)grad\frac{1}{R}dy + g_3 v.p.\int_Q \left(\vec{P}(y,t'), grad\right)grad\frac{1}{R}dy\Bigg) + \vec{E}_0(x,t)\,.$$

Here $\vec{E}^0(x,t)$ is the external electric field in free space; $R = |x-y|$ is the distance between points $x = (x_1, x_2, x_3)$ and $y = (y_1, y_2, y_3)$; $t' = t - R/c$; $(*,*)$ denote the inner product of vectors; $v.p.$ denote the singular integral, for which an infinitely small ball occupying the vicinity of the point $y = x$ is extracted from the domain of integration; and $g_1 = 1/\left(4pe_0c^2\right)$, $g_2 = 1/\left(4pe_0c\right)$, $g_3 = 1/\left(4pe_0\right)$. Further, through use of time steps method, we show the effective way for numerical solution of integral equation.

REFERENCES

[1] A.B. Samokhin, “Integral equations and iteration methods in electromagnetic scattering”, VSP, Utrecht, 2001.