Fields from point sources using the aperture field method

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the difference in the signal directions is small, but the difference in the polarizations is large. Otherwise, the two approaches have similar performance.

REFERENCES


By using field equivalence principles it is found that the far field may be determined from the aperture plane (xy-plane) distribution of the tangential electric field intensity $E_{\text{tan}}$ given by

$$E_{\text{tan}} = -\frac{II}{2j\omega\varepsilon_0} \left\{ \delta'(x)\delta(y)\hat{x} + \delta(x)\delta'(y)\hat{y} \right\}.$$  
(3)

This corresponds to a point aperture in a perfectly electrically conducting screen. According to [3], the radiation electric field intensity $E(r)$ at $r$ in a usual spherical $r, \theta, \phi$-coordinate system is given by

$$E(r) = \frac{jk}{2\pi} \frac{e^{-jkr}}{r} \left\{ (f_x \cos \phi + f_y \sin \phi) \hat{\theta} + (-f_x \sin \phi + f_y \cos \phi) \cos \theta \hat{\phi} \right\}.$$  
(4)

where

$$f_x \hat{x} + f_y \hat{y} = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} E_{\text{tan}} e^{jk \sin \theta \cos \phi \hat{z} + jk \sin \theta \hat{r}} \, dx \, dy.$$  
(5)

Thus

$$f_x = -\frac{II}{2j\omega\varepsilon_0} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \delta'(x)\delta(y) e^{jk \sin \theta \cos \phi \hat{z} + jk \sin \theta \hat{r}} \, dx \, dy$$

and similarly

$$f_y = -\frac{II}{2j\omega\varepsilon_0} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \delta(x)\delta'(y) e^{jk \sin \theta \cos \phi \hat{z} + jk \sin \theta \hat{r}} \, dx \, dy.$$  
(6)

Insertion of (6) and (7) into (4) gives the well-known expression for the $E$-field of the Hertzian dipole

$$E(r) = \frac{jk}{4\pi} \frac{e^{-jkr}}{r} \mu_0 \sin \theta \hat{\theta}.$$  
(7)

REFERENCES

