TIME DOMAIN WAVE FORM IN ELECTROMAGNETIC SCATTERING BY A CONDUCTING WEDGE

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In order to find the size of the scatters, it is important to study the time domain wave form in electromagnetic scattering by a conducting wedge. For which a simple model i.e., step function and delta function are selected as a pulse source.

A analytical expression for the electromagnetic scattering by a conducting wedge in steady state as shown in Fig. 1

$$\frac{E_z^s(\rho,\omega)}{E_0(\omega)} = \frac{4\pi}{\Phi_0}\sum_{n=1}^{\infty} J_{\nu n}(\frac{\omega}{c_0}\rho)\ e^{j\frac{\nu n}{2}\pi}\ \sin(\nu n\phi s)\ \sin(\nu n\phi)$$

$$- e^{j\frac{\omega}{c_0}\rho\ \cos(\phi s-\phi)} \tag{1}$$

where $\nu n = \frac{n\pi}{\Phi_0}$, $\Phi_0 = 2\pi - \Phi_W$

In which the first term gives total field by scattering and second incident field.

To obtain the time domain in electromagnetic field, following Fourier transform is used:

$$E_z^s(\rho,t) = \int_{-\infty}^{\infty} E_z^s(\rho,\omega)\ e^{j\omega t}\ d\omega \tag{2}$$

In generally, it is very difficult to perform the above integral. Fortunately the transfer function or integrand including $J_{\nu n}(\frac{\omega}{c_0}\rho)$ in expression has a simple form of the integrand, so that it can be easily integrated in this case.

For the numerical example two models are used

(a) Step function

$$U(t) = \begin{cases} 1 & t > 0 \\ 0 & t < 0 \end{cases} \tag{3}$$

For which the time domain in field expression is exactly obtained as

$$E_z^s(t,\rho,\phi,\phi s) = \frac{2}{e^{j\pi/2}\Phi_0}\sum_{n=1}^{\infty} e^{j\frac{\nu n}{2}\pi}\ \sin(\nu n\phi s)\ \sin(\nu n\phi)$$

$$\left\{\frac{e^{j\frac{1}{2}\nu n\pi} - e^{-j\frac{3}{2}\nu n\pi}}{\nu_n}\right\} \left\{\frac{\rho/c_0}{t+\sqrt{t^2-(\rho/c_0)^2}}\right\}^{\nu n} - 1 \tag{4}$$

(b) Delta function

For which the field expression is also exactly obtained as

$$E_z^s(t,\rho,\phi,\phi s) = \frac{2e^{j\pi/2}}{\Phi_0\sqrt{t^2-(\rho/c_0)^2}} \sum_{n=1}^{\infty} e^{j\frac{\nu n}{2}\pi} \sin(\nu n\phi s) \sin(\nu n\phi)$$

$$\cdot\frac{(\rho/c_0)^{\nu n}\left\{e^{j\frac{1}{2}\nu n\pi} - e^{-j\frac{3}{2}\nu n\pi}\right\}}{\{t+\sqrt{t^2-(\rho/c_0)^2}\}^{\nu n}} - \delta\{\rho/c_0 \cos(\phi s-\phi) + t\} \tag{5}$$

In Fig. 2(a)(b) the numerical data are shown. This effect for Fig. 2(a) looks like the transient curve for the electrical circuit of L and R. Therefore transient effect for $\Phi_W=0$ is largest. No transient phenomenon $\Phi_W=180°$ observes.

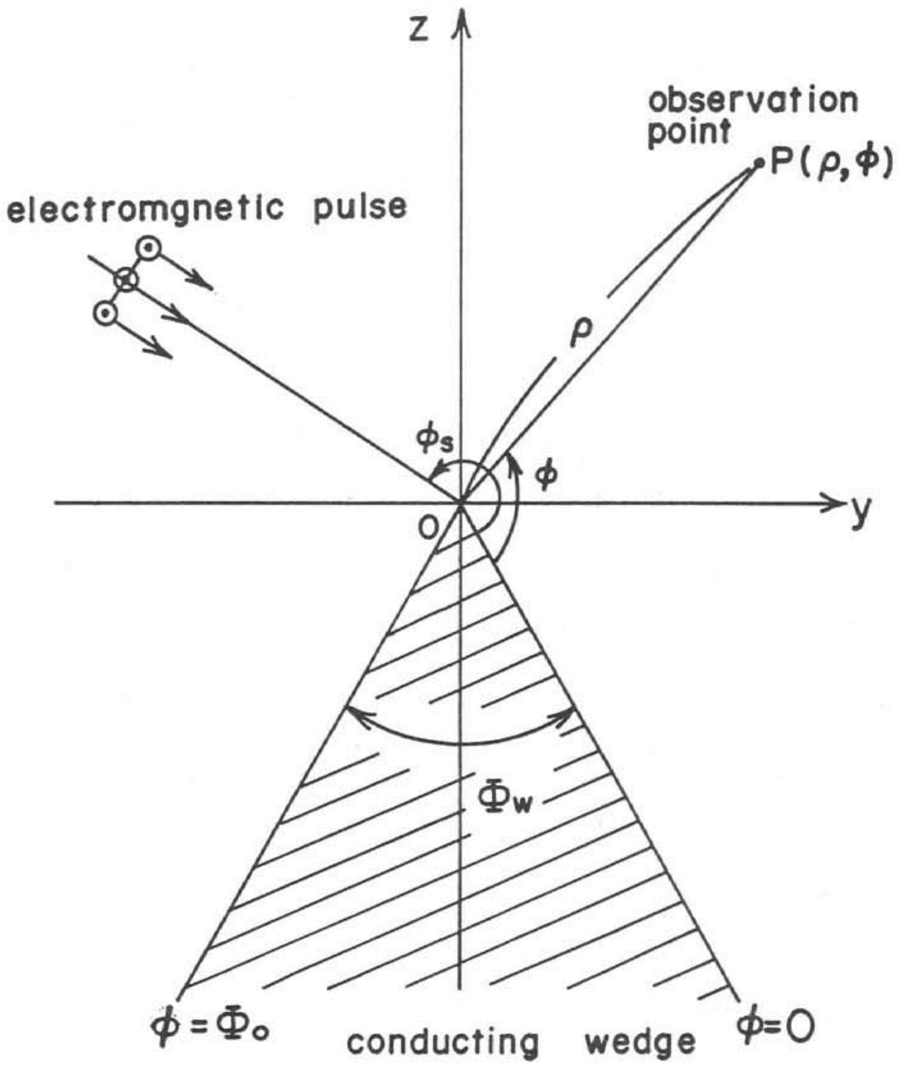

Fig.1 Geometry of the problem

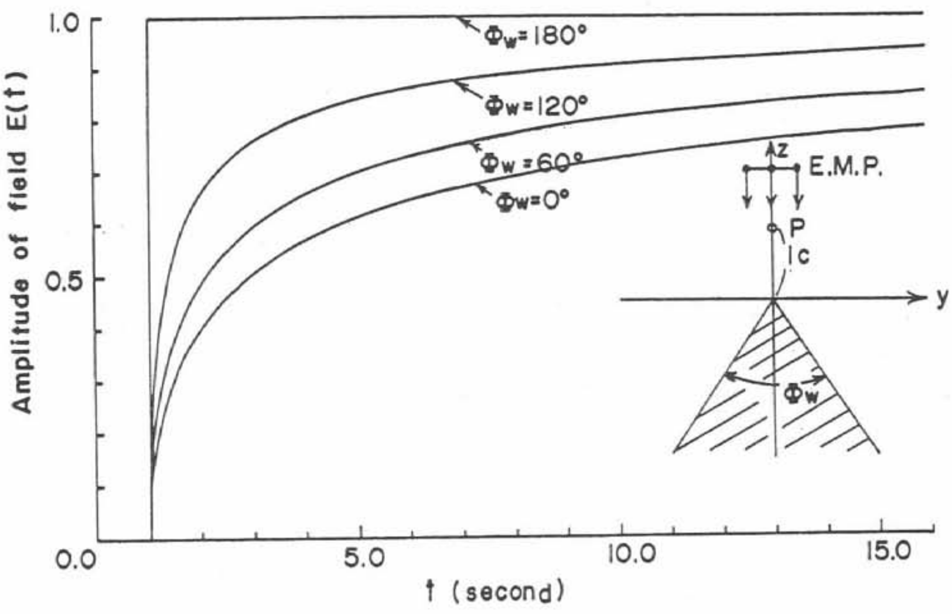

Fig.2(a) Time domain wave form for the step function

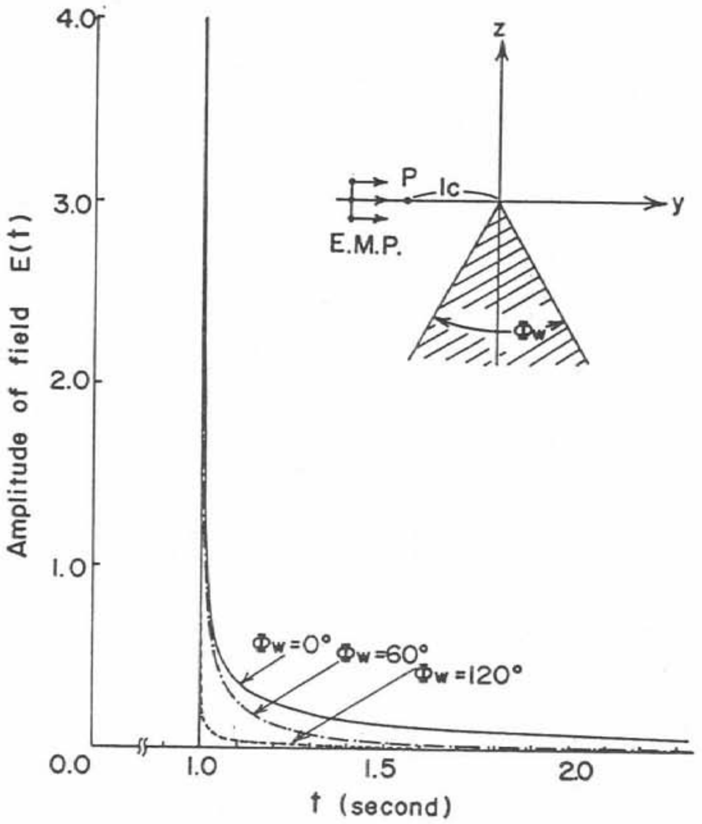

Fig.2(b) Time domain wave form for the delta function