Scattered Fields Computed from the Ramp Response

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The use of Ramp Response to compute the back scattered fields (*D.L. Moffatt, IEEE Trans AP-17, 299-307, 1969*) from conducting targets represents a long neglected technique. This has now been improved by including penetrable targets and refining the contribution from the shadowed part of the target. The accuracy of this ramp computation has been demonstrated for dielectric and conducting targets including spheres, cones, double backed cones , an ogive, blocks and a pyramid. This approach has also been used to develop an image of a buried A.P. mine (*S. Nag and L. Peters, IEEE Trans. AP-49, 32-40, 2000*).

The ramp response was derived from Physical Optics to obtain

$$f_r^m(t) = -\frac{1}{\pi v^2}\int A\left(\frac{vt}{2}\right)dt \tag{1}$$

where A is the transverse cross sectional area of the target at the position $z = \frac{vt}{2}$, where the incident ramp waveform becomes non zero, and v is the phase velocity in the ambient medium. The time t is modified in the shadowed region of the target since the path is now along the surface of the target and the magnitude of the incident wave is adjusted to account for focusing. Eq. (1) is modified by including a reflection coefficient for penetrable targets. Finally $f_r(t)$ is Fourier transformed and multiplied by $(jw)^2$ to obtain the usual scattered fields in the frequency (jw) domain. This approach is far simpler than the usual Physical Optics computation.

Recent results show that this approach gives very accurate results in the Rayleigh region and the early time scattering at higher frequencies. It is only required that scattered fields from creeping waves, multiple edge diffraction, etc., be added to obtain the late time response as will be discussed.

Finally, this modified approach results in an improved version of Physical Optics as will be demonstrated using the nose-in incidence case for a conducting cone. The ramp response from the wedge on the back of the cone (shadow region) is accurately predicted via this ramp approach whereas Physical Optics needs to use the Physical Theory of Diffraction for this task.