

The estimation of physical properties of buried targets using the Cole-Cole equation in fictitious wave domain method

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Electromagnetic waves have been used for nondestructive measurements to investigate subsurface anomalies using its reflection. For example, we use Ground Penetrating Rader (GPR) survey to visualize shallow subsurface. Since the travel time of reflection signals tells us the position and the depth of objects in the subsurface, GPR survey has been widely used in many engineering fields.

On the other hand, it is still difficult for the conventional GPR survey to estimate physical properties of the subsurface targets, although there is great demand for estimating physical properties of buried targets has been increasing in recent years.

In our previous study, the possibility of estimating the physical properties of subsurface targets using the Cole-Cole equation has been shown when calculating the complex relative permittivity of the target media for the changes both in amplitude and in phase of the reflected EM waves. However, since the behavior of imaginary part of the complex relative permittivity against frequency usually shows its peak at the range of several GHz, the frequency band used for our proposed method would be limited.

Since the high frequency band, i.e. several GHz, is appropriate for the estimation of physical properties in the fictitious wave domain, we would like to see if the method is applicable to geoexploration of subsurface targets using the Cole-Cole equation. We discuss the validity of our previous conclusions based on the numerical results and try to propose survey methodologies to use the Cole-Cole equation.

Keywords: Cole-Cole equation, Fictitious wave domain method, Ground Penetrating Rader