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Green's function approach to analyze ground-penetrating radar ground wave

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Ground-penetrating radar is increasingly used to estimate soil water content. While there are some empirically justified models for measuring water content for the near subsurface, there is some lack of theoretical approaches describing the air-ground wave. Uncertainties, which may influence the results of air-ground wave measurements, are the depth dependency of the ground wave and the rarely regarded reactive near field properties of the emitting antenna.

Here, a semi-analytical approach using Green's function to solve Maxwell's equations for a layered planar medium is presented. We confront the method with full wave three dimensional numerical examples and comment on the practical application of this theory.