

Analysis of Transient Electromagnetic Dipole

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Introduction

Propagation characteristics of an electromagnetic pulse generated by an electric dipole can be used for a variety of applications such as geological mapping of mineral deposits on the ocean floor, cellular or mobile communications and detection of unexploded ordnance. However the characteristics of the transient pulse when travelling in a dissipating medium are complex since the wave number is not linear and the dipole source creates a field that incorporates the near, intermediate and far fields. Consequently, the propagating pulse shifts from that of the excitation pulse and near field response to its spatial and time derivatives. This work focuses on demonstrating computational analysis of a transient electric dipole with non-zero rise and decay time.

Use of COMSOL Multiphysics

This work implements Maxwell's equations in the RF module and optimizes solver parameter settings to resolve the transient nature of the pulse.

Expected Results

The predicted electric field resulting from a transient pulse applied to an electric dipole is shown in Figure 1.

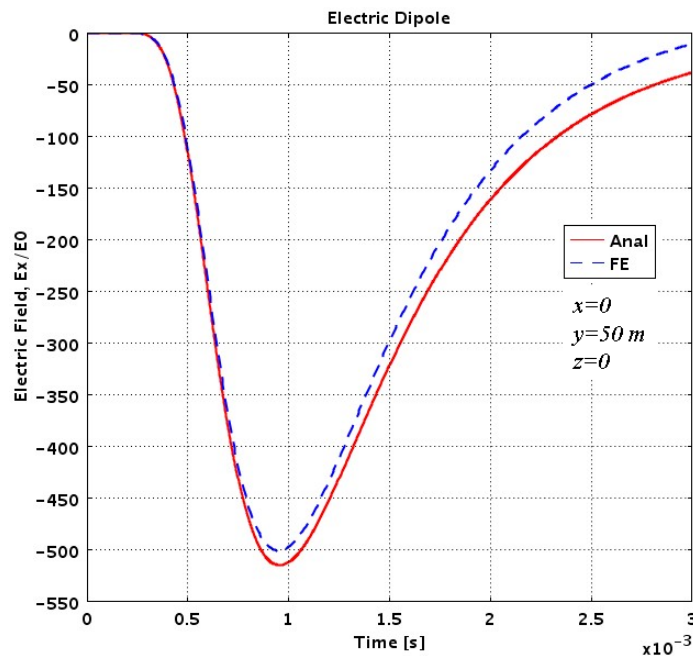


Figure 1: Electric field due to passage of transient pulse with non-zero rise and decay time through electric dipole.

Excellent agreement is found between the results predicted by an analytical solution for propagation in a dissipative medium and those predicted in the computational analysis.

Conclusion

These results clearly show the successful development of computational models to predict the electromagnetic field developed due to a transient pulse through an electric dipole. The analyses can be used to study the effects of properties of the dissipating medium and pulse characteristics on the electric fields that are generated.