CONCLUSION

This communication deals with problems related to the application of time-domain reconstruction techniques to some particular situations such as soil probing. We have examined the following points.

1) For the limitation of the observation depth due to screening effects of conducting layers, a practical setup based on a TEM mode propagation perturbed by the unknown medium is proposed. This solution could sensibly reduce these screening effects.

2) In exploring the influence of the finite extent of the probing wave, the source of the wave is modeled by a flanged parallel plate guide. Partial results in frequency domain, corroborated by time-domain simulated probings, already show that such a setup provides an adequate probing wave if the aperture is large enough with regard to the considered medium, especially its conducting behavior at low frequency.

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The Response of a Two-Wire Transmission Line to Incident Field and Voltage Excitation, Including the Effects of Higher Order Modes

YEHUDA LEVIATAN, STUDENT MEMBER, IEEE, AND ARLON T. ADAMS, SENIOR MEMBER, IEEE

Abstract—**The surface currents on a two-wire transmission line induced by incident field excitations are investigated using the spectral concept. A simple solution is obtained for plane wave excitation. A solution for voltage source excitation, in which the induced current may be given, at least approximately, by means of the so-called leaky-wave concept, is considered. The influence of the electrical dimensions of the structure on the currents and the relative importance of the higher modes are examined by numerical examples.**

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The authors are with the Department of Electrical and Computer Engineering, Syracuse University, Syracuse, NY 13210.

I. INTRODUCTION

In this communication a study has been made of surface currents on two-wire (parallel cylinder) transmission lines induced by incident field excitations. The basic assumptions are that the wires are perfectly conducting, parallel, infinitely long, and that the radius of each wire is very small compared to the wavelength of the excitation. Thus, the induced currents along the wires are oriented in the direction of the cylinder axis of each wire, they are independent of the azimuthal angle around each wire, and hence each wire may be replaced by an equivalent filament. Boundary conditions are applied at the wire surface so that wire thickness is taken into account. Previous work related to this problem includes Schelkunoff's Laplace transform solution [1] and Marin's transient solution [2], [3] of the two-wire problem.

The formulation of the problem is effected by using the spectral concept. The excitation field has been resolved into its Fourier (spatial) components and the induced current has been expressed in terms of a superpositon integral. First, the case of plane wave excitaiton has been treated. This led to a straightforward solution of the integral representation and a simple solution for the induced current. Attention has also been paid to voltage source excitation. In this case, which has been treated previously by Marin [2], by deforming the contour of integration in the induced current formulation and applying Cauchy's theorem, one obtains the solution in terms of the so-called leaky modes, the TEM mode, and a continuous spectrum.

The influence of the electrical dimensions of the structure on the induced currents and the relative importance of the higher modes are examined by concrete numerical examples. By looking at the results, one can see, as expected, that the attenuation constants of the higher modes decrease as the distance between the wires is increased. These studies apply particularly to problems involving high-frequency excitation such that the wire separation is comparable to or larger than a wavelength, in which case the usual TEM mode anlaysis is inadequate.

II. FORMULATION OF THE PROBLEM

The problem considered involves arbitrary excitation of a two-wire line. Fig. 1(a) shows the special case of plane wave excitation of the two-wire transmission line. The two wires are perfectly conducting, infinitely long parallel cylinders oriented in the z direction and separated by a distance d. The radius of each wire is a, and we assume that a is small compared to λ, the wavelength of the excitation, and compared to d. For convenience, the cylinder around the z axis will be referred to as the left cylinder. Similarly, the second cylinder will be referred to as the right cylinder. Fig. 1(b) shows the special case of voltage excitation of the two-wire transmission line. It is noteworthy that the excitation considered here is arbitrary, plane wave excitation and voltage excitation being special cases which are treated in Sections III and V, respectively. A time dependence exp $(j\omega t)$ is assumed throughout. It is convenient to split the arbitrary excitation into a superposition of symmetric (even) and antisymmetric (odd) excitations. The symmetric excitation yields a magnetic wall at $y = d/2$. Similarly, the antisymmetric excitation yields an electric wall at $y = d/2$. Since the radius a is electrically small, we consider only the longitudinal component of the induced current and