Abstracts

The Capacitances and Surface-Charge Distributions of a Shielded Balanced Pair

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The capacitance matrix of a straight pair of uniform wires symmetrically placed in a shield is determined theoretically. Exact expressions for the elements of the capacitance matrix are determined as particular elements of the inverse of an infinite matrix which relates the Fourier coefficients of the surface-charge densities on the inner conductors and the shield to the applied voltage excitations on the cable conductors. If the wire diameter is small relative to the wire separation, and if the wire separation is small relative to the shield diameter, then accurate numerical approximations for the elements of the capacitance matrix are obtained to any degree of accuracy by suitably truncating the infinite matrix. Once the elements of the capacitance matrix are determined, then the distributions of the surface-charge densities on the peripheries of the inner conductors, and the shield are determined for any arbitrary excitation of the cable structure. In particular, the various capacitances associated with the cable structure, e.g., the direct, ground, and mutual capacitances, are determined from a comparison of the surface-charge densities resulting from a "balanced" excitation and a "longitudinal" excitation. The Fourier coefficients of the surface-charge densities are required to determine the propagation parameters and the associated propagation modes of the cable structure. The surface-charge distributions are evaluated numerically for a typical standard production cable using 22-gauge wires. The results of this paper will be extended by a perturbational method to include twisted wires in a shield; also, certain types of asymmetries in the cable geometry will be considered. Hence, the propagation constants and the associated propagation modes of unbalanced and/or twisted shielded pair cables can also be determined.

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