Abstracts

Even- and Odd-Mode Waves for Nonsymmetrical Coupled Lines in Nonhomogeneous Media

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A simple analysis of the eigenvectors, representing the fundamental uncoupled wave modes of a pair of nonsymmetrical coupled lines in nonhomogeneous medium, proves that these two modes reduce, under a given condition, to an even mode with equal voltage magnitudes and an odd mode with equal current magnitudes and opposite polarities. The condition, which may be cast in many representative forms, is called "congruence condition" and may be formulated simply, for a nonhomogeneous dielectric medium, by saying that the ratio of the per-unit-length conductor-to-ground capacitances must be the same in the empty and in the filled structure. The essential interest of congruence lies in the drastic simplification it introduces in the expressions of the eigenvalues and of the mode velocities and in the expressions of the mode admittances and impedances for the two coupled lines. Because of this simplification, a straight forward matrix derivation may be written to obtain closed-form expressions of the entries of the 4 x 4 Y-, Z-, and S-parameter matrices of the coupled-line 4-port. The simplicity of the definition of the fundamental modes in congruent structures introduces great conceptual clarity in the description of coupled-wave propagation. Experimental evidence is presented which proves the physical existence of the even-mode wave and of the redefined odd-mode wave in suspended-substrate broadside-coupled striplines. Practical structures of this type are very closely congruent.

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