Abstracts

Mode-transformation and mode-continuation regimes on waveguiding structures

A.B. Yakovlev and G.W. Hanson. "Mode-transformation and mode-continuation regimes on waveguiding structures." 2000 Transactions on Microwave Theory and Techniques 48.1 (Jan. 2000 [T-MTT]): 67-75.

In this paper, modal-interaction phenomena on guided-wave structures are investigated using the theory of critical and singular points. It has been previously shown that classical mode coupling is controlled by the functional characteristics of the dispersion equation in the vicinity of a Morse critical point (MCP), which is real valued for typical structures in the lossless case. The purpose of this study is to demonstrate that two distinct regimes of modal behavior exist in the vicinity of the mode-coupling region, which arise due to the presence of frequency-plane branch points of the dispersion function. These branch-point singularities are intimately associated with the MCP. It is further noted which of the two regimes governs modal behavior depends on the path of frequency variation or on the presence of loss for time-harmonic problems. Specifically, classical mode coupling is associated with frequency variation between these branch points leading to mode transformation. This traditional mode-transformation behavior is eliminated for the path of frequency variation lying outside of this region resulting in mode continuation (no exchange of physical meaning between modes). The presence of these branch points completely explains the observed phenomena and allows for the conceptualization of the dispersion function in the vicinity of modal interactions.

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