Abstracts

Some Important Properties of Waveguide Junction Generalized Scattering Matrices in the Context of the Mode Matching Technique

Some important properties for the generalized scattering matrix [S] of waveguide step discontinuities, in the context of the mode matching technique, are derived by considering the conservation of the complex power and self reaction across the discontinuities. Apart from their theoretical significance, these properties are useful for the numerical verification of the mode matching technique when designing waveguide circuits. The properties are shown to apply in the general case of junctions between lossless inhomogeneously filled waveguides, and they are proven to remain valid irrespective of the number of modes retained in the field expansions. During the process of deriving these properties, the mode matching technique for a waveguide step discontinuity is revisited and some subtle theoretical issues are resolved. In this framework, the selection of the appropriate testing modes for enforcing the field continuity conditions across the discontinuity is rigorously justified. In addition, two distinct mode matching formulations corresponding to the two possible orthogonality relations among the eigenmodes of lossless waveguides are proven to be equivalent. Finally, it is shown that the correct application of the field boundary conditions across the step discontinuity implies requirements on the number of modes used to represent the fields, in each waveguide, which are compatible with the relative convergence criterion.

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