Abstracts

Rectangular modes and dyadic Green's functions in a rectangular chirowaveguide. I. Theory

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An analytic solution of electromagnetic-wave propagation in a rectangular chirowaveguide is represented in this paper in terms of spectral-domain dyadic Green's functions (DGF's) in a general form. The method used here is a combination of a wavefield decomposition method and DGF eigenfunction expansion technique. This DGF decomposition method avoids having to use the modified and normalized vector wave functions, which are found difficult to satisfy the boundary conditions of chirowaveguides in which the reconciliation of Dirichlet and Neumann conditions is impossible. On the other hand, this method can be generalized to a chirowaveguide of arbitrary cross section and is found reducible to a nonchiral case. It is observed that in a similar fashion to the conventional rectangular waveguide, the duality between the electric and magnetic types of DGF's in the rectangular chirowaveguide does not exist. To show the reducibility of the generalized DGF's for bi-isotropic media, we summarized the procedure of utilizing the formulas and proved in detail that the form of the DGF's can be reduced to that for chiral media and achiral (isotropic) media. Exactly the same DGF's are obtainable for the isotropic media by reducing the general formulas. The electric and magnetic fields in the rectangular chirowaveguide due to a point dipole excitation oriented in the y-direction are derived. The detailed numerical analysis includes the novel features of the dispersion relations, the effects of chirality on the novel features of the rectangular chirowaveguides, some newly discovered features, and vector field plots and contour plots of higher order modes of electric and magnetic fields.

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