

Natural modes of weakly guiding optical fiber

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Abstract

The eigenvalue problem for generalized natural modes of an inhomogeneous optical fiber is formulated as a problem for the Helmholtz equation with Reichardt condition at infinity in the cross-sectional plane. The generalized eigenvalues of this problem are the complex propagation constants on a logarithmic Riemann surface. The original problem is reduced to a spectral problem with compact integral operator. Theorem on spectrum localization is proved, and then it is proved that the set of all eigenvalues of the original problem can only be a set of isolated points on the Riemann surface, and it also proved that each eigenvalue depends continuously on the frequency and can appear and disappear only at the boundary of the Riemann surface. The existence of the surface modes is proved. The Galerkin method for numerical calculation of the surface modes is proposed. Some results of the numerical experiments are presented. © 2010 IEEE.

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