

Mode Calculation of Optical Waveguides

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We present a second kind integral equation (SKIE) formulation for calculating the electromagnetic modes of optical waveguides, where the unknowns are only on material interfaces. The resulting numerical algorithm can handle optical waveguides with a large number of inclusions of arbitrary irregular cross section. It is capable of finding the bound, leaky, and complex modes for optical fibers and waveguides including photonic crystal fibers (PCF), dielectric fibers and waveguides. Most importantly, the formulation is well conditioned even in the case of nonsmooth geometries. Our method is highly accurate and thus can be used to calculate the propagation loss of the electromagnetic modes accurately, which provides the photonics industry a reliable tool for the design of more compact and efficient photonic devices. We illustrate and validate the performance of our method through extensive numerical studies and by comparison with semi-analytical results and previously published results.