Efficient and spurious-free integral-equation-based optical waveguide mode solver

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Abstract: Modal analysis of waveguides and resonators by integral-equation formulations can be hindered by the existence of spurious solutions. In this paper, spurious solutions are shown to be eliminated by introduction of a Rayleigh-quotient based matrix singularity measure. Once the spurious solutions are eliminated, the true modes may be determined efficiently and reliably, even in the presence of degeneracy, by an adaptive search algorithm. Analysis examples that demonstrate the efficacy of the method include an elliptical dielectric waveguide, two unequal touching dielectric cylinders, a plasmonic waveguide, and a realistic micro-structured optical fiber. A freely downloadable version of an optical waveguide mode solver based on this article is available.