Modal Analysis and Beam Propagation in Bent Fibers

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After three or four decades, fiber optics is still finding new applications both in communications and more recently in high-power lasers and amplifiers for medicine and materials processing. These new applications often require bending the fiber to ensure single mode operation and therefore maintain a high brightness output. Bent fibers also offer a means for polarization control. In these cases numerical models are needed that accurately handle the radiation loss resulting from the bending while keeping all relevant field components. To this end, we have developed a suite of tools for modeling bent fibers that address these issues. Our numerical models are triangular-grid finite difference based in cylindrical coordinates so that radiation loss is naturally handled as a curvilinear coordinate system effect, rather than by artificially adding on an index ramp as is typically done. Our suite of codes includes both full vector and semivectorial eigenmode solvers and beam propagation codes. These tools have recently been modified to include Kerr effect nonlinearities, and thus both the model derivation and its applications for predicting self-focusing effects in MW fiber amplifiers will be presented.