Abstract

Statistical Modeling of Light Propagating Through a Semi-Transparent Cone

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Received: Fri, 15 Mar 2002 19:16:51

How does the light propagate through a transparent medium? The answer is straightforward — along the straight line. In the optic fiber, in contrary, the light can propagate in any direction even in the orthogonal if the fiber is bent accordingly. The important factor, however, is the curvature of the bending. If the radius of curvature is small enough the light can escape. Modes of light propagating through the fiber are well studied in framework of classical and wave optics both. Here, we study the propagation of light in different geometries such as a cone, a truncated cone, a pyramid, a parabolic cone, or a hyperbolic cone. A code has been written to analyze different geometries, different refraction indices and absorption coefficients, and the input parameters of the beam (such as aperture, different angular distributions, and diameters of the beam). The objective was to analyze the output parameters (and modes) of optical details concentrating mainly on angular and spatial distributions of light on the screen located on a given distance from the cone and finding the geometry which provides the most even distribution (in one case) and the most sharp distribution of intensity (in the second case). Mathematically the problem is formulated as the transport equation in semi-transparent medium (no dispersion) with semi-reflective semi-transparent boundary conditions. Rays of light passing through the medium had unit intensity at the entry point. While propagating the rays split and multiply on the boundary losing the intensity and, as a result, form a unique distribution of light on the screen. Optimization of spatial distribution had been carried out. This research can be used in undergraduate teaching and as the illustration of method of statistical modeling and basic optical principles.

Filename: Serkov-S
Last document update: Wed Jul 10 08:15:31 MDT 2002