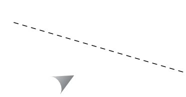
Abstract

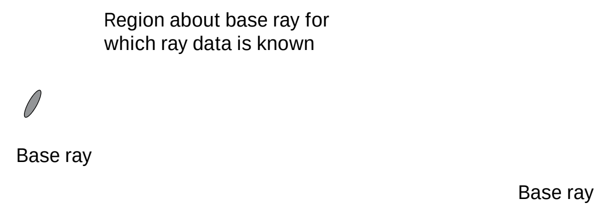
Differential ray tracing is a well-known technique in geometrical optics. There are a variety of applications for this technique. In this paper, the definition for differential ray tracing is given and some applications for differential ray tracing in CODE V are presented. General methods for computing differential ray information are briefly discussed.

Definition of Differential Ray Tracing

Consider some general optical system. For this system, locate a Cartesian coordinate system in the object space and one in the image space (in this paper, image space quantities are distinguished by a prime: ´). Now consider some ray through the system, such as the one shown in Figure 1.



These functions can be quite complicated and generally cannot be determined in closed form for anything but the simplest of optical systems. Note, however, that it is generally possible to determine the output position and direction of a ray for any given input position and direction. That is, given an input ray (with initial position and direction of r_0 and u_0, for example), one can trace the ray through the system to determine its output position and direction (r'_0


Region about base ray for
which ray data is known
Base ray
Base ray

This is commonly done by defining a complex radius of curvature, , as follows:

$$\frac{1}{q} = \frac{1}{R} - i\frac{\lambda}{\pi w^2}$$

where λ is the wavelength of light and i is the square root of negative one. The complex radius of curvature of the Gaussian after propagation through the system can be determined from the input Gaussian and the differential ray information as follows:

[redacted]

The width of the output Gaussian and its wavefront radius of curvature then can be determined from the complex radius of curvature.