Differentiability of a projection functional in ray-tracing processes: applied study to estimate the coefficients of a single lens with conic surfaces

Téllez-Quiñones A, Malacara-Doblado D, García-Márquez J.

Abstract

In optical design, many error functions can be used to generate an optical system with desired characteristics. These error functions are optimized by iterative algorithms. However, these error functions should be theoretically and mathematically differentiable to be optimized. In this paper, the differentiability of an error function is partially justified. The error function herein is called the projection functional. This proposed projection functional can be used to estimate the coefficients of an arbitrary lens with conic surfaces by means of the spot distributions on two planes produced by a fixed Hartmann plate. The differentiability of the projection functional is required to guarantee the existence of its Jacobian matrix, which is a suitable condition to minimize this functional by iterative methods. Numerical examples of the functional minimization are given.