STUDIES ON INAGE TRANSMISSION THROUGH GRADED INDEX MEDIA

by

ARUNA ROHRA

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Department of Physics
Indian Institute of Technology, Delhi
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ARUNA ROHRA

ABSTRACT

The present thesis is a study of imaging characteristics of rotationally symmetric graded index media. Due to their lens action those media can be used as image relays as well as lens elements in optical systems. Both these applications necessitate the study of aberration of graded index media and some work on this subject has already been reported. We have carried out an aberration study of images formed by media with specific refractive index profiles which are of special interest as imaging systems.

Conical graded index media are characterised by the property that they can magnify or demagnify images during transmission. We have carried out an aberration analysis of these media. Explicit expressions for third-order aberration coefficients of a typical conical graded medium have been obtained and it is found that the aberrations can be controlled by varying the grading parameters. We have also studied the total aberration of

such a medium obtained by raytracing and found that the fifth-order aberration can be approximated by the fifth-order aberration of a SELFOC medium.

Since curvature in fibers is inevitable, the propagation characteristics of curved graded index media are also of considerable interest. We have carried out a detailed aberration analysis of images transmitted through curved graded index media.

Since such a system does not possess rotational symmetry, even order aberrations are also present, which tend to zero as the radius of curvature tends to infinity. We have obtained analytical formulae for the second- and third-order aberration coefficients of a graded index medium bent along the arc of a circle. These formulae have hthen been used to obtain the aberration, upto third order, in a SELFOC medium bent along the arc of a circle. Calculations using typical values of grading parameters show that the curvature contribution to aberration is a very sensitive function of the

grading parameters of the medium.

As an application of these studies, we have made an aberration loss analysis of a micro-optic directional coupler used in optical communication system. The loss obtained by us theoretically is in agreement with the experimentally measured value. Further, we have shown that the loss can be considerably minimized by judiciously choosing the length of the SELFOC rod lens used as the coupler.

In connection with optical communication studies, media with a power law profile have received much attention recently. In such media pulse dipsersion can be minimized by an appropriate choice of the index exponent. We have studied the aberration of media with such an index profile and found that the meridional ray aberration can be minimized for the optimum profile in accordance with the pulse dispersion results.

CONTENTS