

## Polynomial Ray Aberrations Computed in Various Lens Design Programs

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## Abstract

The specific definition for each polynomial ray aberration term computed in six current lens design programs is presented. A comparison between programs was performed that found significant variances in term definitions. Several anomalous term computations are reported. In addition, certain characteristics of the compared programs are contrasted, and a consistent aberration term definition scheme is recommended for adoption by all programs.

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Academic Program. Consultant Partner Program. In optical design, aberrations occur when light from one point of an object doesn't converge into or diverge from a single point after transmission through the system. The non-linear terms in Snell's Law cause deviations from perfect imagery: optical systems that form images will produce images that aren't as sharp. Spherical aberration: This occurs when there is increased refraction of light rays striking a lens or when there is a reflection of light rays striking a mirror near the edge versus closer to the center. Petzval field curvature: Named after physicist Joseph Petzval, one of the founders of geometrical optics, this is an aberration in which a flat object cannot be brought into focus on a flat image plane. 4. Ray Tracing: Using your own ray tracing program, simulate the experimental setup and compare your results with your measurements of the spherical aberration. Also simulate a lens doublet that will minimize the aberration (i.e. focus the various rays to a single point). Discuss your findings. 5. Michelson Interferometer: Observe and describe the fringe pattern for the "no lens" case and the "normal lens" case. Astigmatism of a lens depends on the lens design, but cannot be fully corrected for a single lens. Also, it does not disappear simply by using a narrow aperture stop, preventing light from going through the outer region of a lens. Nevertheless, anastigmatic optical systems (i.e., systems not exhibiting astigmatism) can be designed with a suitable combination of lenses. See the article on astigmatism for more details. Coma. Software can be used to reduce various kinds of aberrations substantially. There are various algorithms for improving the image sharpness, which can work reasonably well at least if there is not too much image noise. Geometric image distortions can be well corrected, but one may lose some outer regions of the image. The specific definition for each polynomial ray aberration term computed in six current lens design programs is presented. A comparison between programs was performed that found significant variances in term definitions. Several anomalous term computations are reported. In addition, certain characteristics of the compared programs are contrasted, and a consistent aberration term definition scheme is recommended for adoption by all programs. © 1973 Optica Publishing Group. Full Article | PDF Article. OSA Recommended Articles. Faster LASL Lens Design Program. Berlyn Brixner Appl. Opt. 12(11)

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