

9th International Conference on

Optics, Photonics & Lasers

July 02-04, 2018 | Berlin, Germany

Design of compact micro-reduction lens based on thin lens aberrations

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Statement of the Problem: Reduction lens has been used in many applications for a long time. However, as the requirement for space limitations is the key issues of design, the fundamental theory for thin lens layout becomes crucial. The compact micro-reduction lens has only 10 mm total axial length, and 3 mm back focal length. The reduction ratio (image/object) is -0.212 and has diffraction image performance.

Methodology & Theoretical Orientation: The design evolved from Seidel aberration theory. In finding initial solution for compact structures and long back focal length, a thin lens layout with “+,-” and “-,” structures have been investigated.

Findings: A thin lens layout with “+,-” configuration has less BFL than that of the “-,” structure's. The axial glass length of the first lens can reduce air thickness for compact requirements and balance aberrations, which leading the high contrast performance of the reduction lens.

Conclusion & Significance: The compact micro-reduction lens has designed based on Seidel aberration theories. An initial solution with “-,” structure can balance the Petzval curvature aberration and have longer BFL for mechanical constraints. The image performance reaches diffraction limit under the -0.212 reduction ratio.

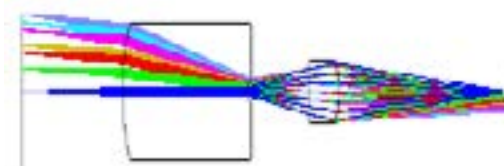


Figure 1. Compact reduction lens has diffraction limit image performance and 10 mm total axial lens, including 3 mm back focal length. The reduction ratio is -0.212

Recent Publications:

1. Kuang Lung Huang, Jin Jia Chen, Te Sue Liu and Chao Hsin Chen (2016) Design of 110-degree field of view objective for endoscopic applications. Imaging and Applied Optics Congress
2. Shu Wei Yang, Kuang Lung Huang and Rong Seng Chang (2016) Design of Fisheye Lens. Imaging and Applied Optics Congress ISBN:978-1-943580-15-6.
3. Jin Jia Chen, Ze Yu Huang, Te Sue Liu, Ming Da Tsai and Kuang Lung Huang (2015) Free form lens design for light-emitting diode uniform illumination by using a method of source–target luminous intensity mapping. Applied Optics 54(28):E146-E152.
4. Te Yuan Wang, Jin Jia Chen, Kuang Lung Huang and Chuen-Ching Wang (2015) Complementary optimization method of freeform lens design for uniform illumination with extended light emitting diode sources. Optical Engineering 54(9):095102-1-095102-8.
5. Kuang-Lung Huang, Yi-Huai Siao, Tsung-Hsien Lin, Pei-Jung Wu, Bor-Shyh Lin and Chien-Yu Chen (2015) Prior Study of the Stereo Electronic Eyepiece.

Biography

Kuang Lung Hunag has his expertise in Lens Design and Optical Engineering. He used to work in optical industry for many years. Currently he is a full time Faculty of Department of Materials and Energy Engineering, MingDao University, Changhua, Taiwan, ROC. He is also in charge of several projects related to lens design and optical engineering.

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