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Combined Aberrations in the Shrink Apertures

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Abstract:

In the resolution of an optical system, the Two Lines Resolution plays an important role. According to Raleigh criterion of resolution, the resolving power increases as the first minimum of the Point Spread Function moves towards the centre of the pattern. It means the resolution of an optical system can be judged from the knowledge of the PSF of the system. Thus, the more fundamental parameter to be studied. The Two Lines Resolution is a three dimensional function. In this study the Two Lines Resolution is considered as a two dimensional function since the optics deals with two-dimensional signals and due to the particular importance of the effect of diffraction or aberration or both on the optical imaging system can be specified by the Point Spread Function. The Two Lines Resolution study also describes the effect of image motion. Atmosphere turbulence and other external factors. Which are treating as degrading parameter of optical system. Throughout this thesis quasi-monochromatic Two Lines Resolution is considered. Polychromatic Point Spread Function can be defined if the point source object has the wavelength range more than its average wavelength.

Key words: Defocus, Aberration, Intensity etc.

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1.1 INTRODUCTION:

It is necessary to obtain qualitative and quantitative information regarding the imaging systems in order to evaluate their performance. In the image field science, there are two well-defined and developed functions to analyze the performance of an optical system in the image formation on the basis of diffraction theory. These two are point spread function (PSF) and optical transfer function (OTF). The point –spread function is an important tool in modern optical design and evaluation of an image. The analysis of PSF still attracts many investigators because it provides criteria concerning image performance that are directly related to the image formation of the lens system. . By considering the point spread function as a measure of the energy scatter, MAGIERA, MAGIERA and PLUTA (1980) have analyzed and determined the position of the best focal plane for defocusing and spherical aberrations. The effect of focus error on any diffraction-limited image has been described in terms of an operator by OJEDA (1983). This permits the diffraction of special functions to analyze the effect of focus on the PSF. The effect of the aberration function on the diffraction image produced by an optical system has been studied thoroughly by Nijboer, Mahan, etc., (BORN and WOLF, 1984). STANISLAW (1986) has derived an approximate PSF formula for a illuminated circular pupil with rotationally symmetric aberrations.

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1.2 MATHEMATICAL FORMULATION

The integral with respect to θ is easily recognized as one occurring in connection with the Fraunhofer diffraction pattern at a circular aperture. It is equal to $2\pi J_0$ (Z r), where J_0 is the Bessel function of the first kind and zero order.

$$G_F(P) = -\frac{iA}{\lambda}\frac{a^2}{s^2}\exp\left(i\frac{s^2}{a^2}Y\right)2\pi\int_0^1 f(r)\exp\left[-\frac{1}{2}i\phi_d r^2 - \frac{1}{4}i\varphi_S r^4 - \frac{1}{3}i\Phi_C r^3 Cos^3\theta\right]J_0(Zr)rdr$$

Let $$\Omega = \frac{A}{\lambda s^2}\exp\left[i\frac{s^2}{a^2}Y\right]$$

The above Expression then become

$$G_F(P) = 2\pi i\Omega a^2\int_0^1 f(r)\exp\left[-\frac{1}{2}i\phi_d r^2 - \frac{1}{4}i\varphi_S r^4 - \frac{1}{3}i\Phi_C r^3 Cos^3\theta\right]J_0(Zr)rdr$$

In the expression (2.15), the right hand side $G_F(P)$ is a function of ϕ_d, φ_s, Φ_c and Z. Hence it may be replaced by $G_F = (\phi_d, \varphi_s, \Phi_c, Z)$ to give,

$$(\phi_d, \varphi_S, \Phi_c, Z) = 2\pi i\Omega a^2\int_0^1 f(r)\exp\left[-\frac{1}{2}i\phi_d r^2 - \frac{1}{4}i\varphi_S r^4 - \frac{1}{3}i\Phi_C r^3 Cos^3\theta\right]J_0(Zr)rdr$$

1.3 RESULTS AND DISCUSSIONS:

The graphs are drawn for the combined aberration of the filters coma, defocus and spherical aberrations which are depicted in the below figures keeping the defocus parameter from π to 2π From 1-3 figures and 4 to 6 it is 2π and spherical aberration is at high degree of apodisation i.e. 2π we are getting resolution only in the case of figure -1 the shrink apertures resolutions are studied.

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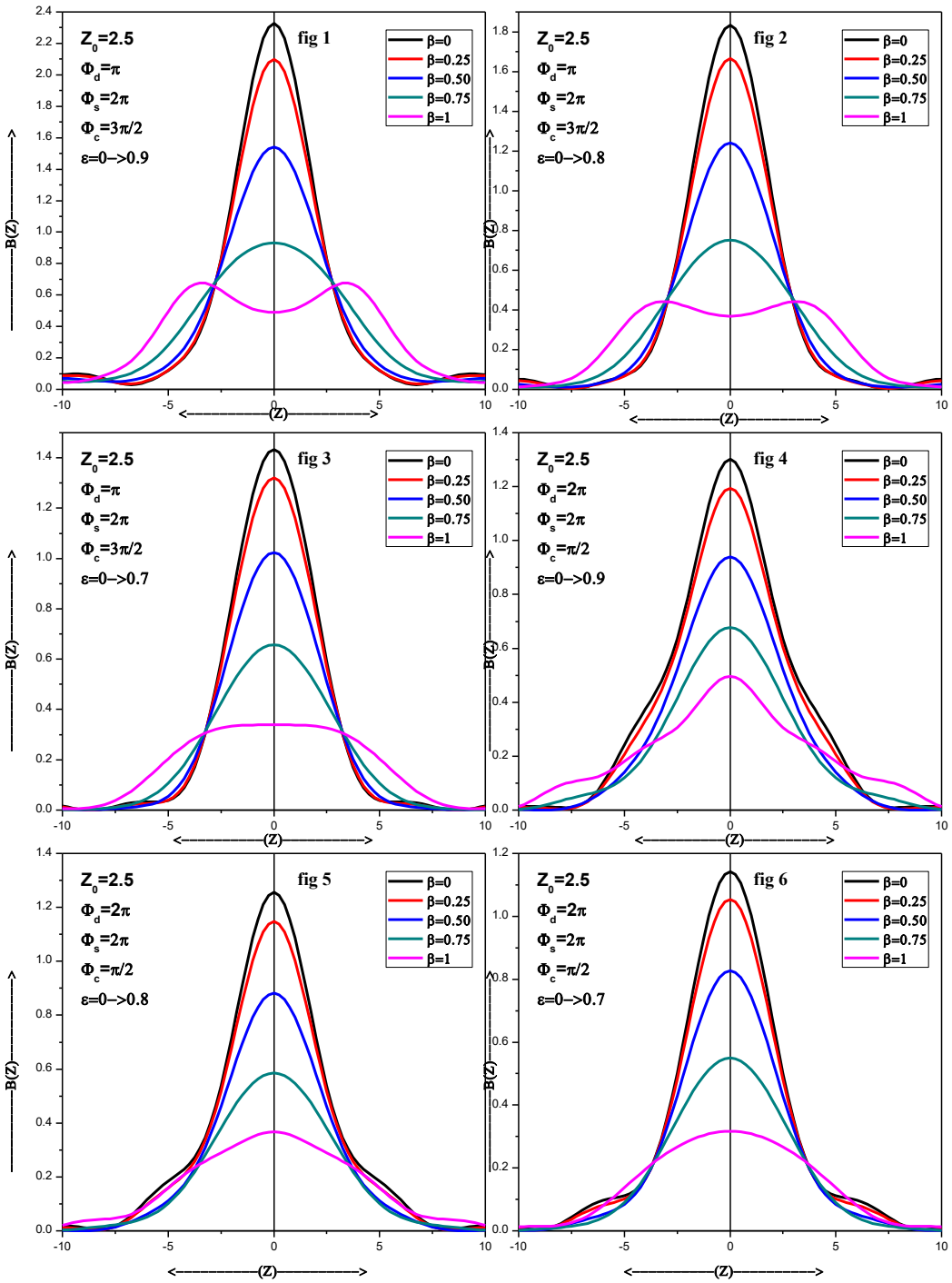

1.4 REFERENCES:

1. D. A. Paulson, “Experimental characterization of atmospheric turbulence supported by advanced phase screen simulations,” Dissertation submitted to the Faculty of the Graduate School of the University of Maryland (2020).
2. B. Guan, H. Yu, W. Song, et al., Spatial Property of Optical Wave Propagation through Anisotropic Atmospheric Turbulence (Wiley, Wireless Communications and Mobile Computing, 2021).
3. L. C. Andrews, R. L. Phillips, R. Crabbs, et al., “Deep turbulence propagation of a Gaussian-beam wave in anisotropic non-Kolmogorov turbulence,” Proc. SPIE 8874, 887402 (2013).
4. M. Beason, L. Andrew, and I. Toselli, “Calculating structure function constant from measured Cn2 in non-Kolmogorov and anisotropic turbulence including inner scale effects,” Appl. Opt. 58, 6813–6819 (2019).
5. C. Chen, H. Yang, S. Tong, et al., “Two-frequency mutual coherence function for Gaussian-beam pulse propagating along a horizontal path in weak anisotropic atmospheric turbulence,” Appl. Opt. 54, 18–26 (2015).
6. D. A. Paulson, C. Wu, and C. C. Davis, “Randomized spectral sampling for efficient simulation of laser propagation through optical turbulence,” J. Opt. Soc. Am. B 36, 3249–3262 (2019).
7. N. A. Ferlic, M. van Iersel, D. A. Paulson, et al., “Propagation of Laguerre-Gaussian and Im Bessel beams through atmospheric turbulence: a computational study,” Proc. SPIE 11506, 115060H (2020).
8. J. M. Steward and B. L. Cole, “What do color vision defectives say about everyday tasks?” Optom. Vis. Sci. 66, 288–295 (1989).
9. M. I. Suero, A. L. Pérez, F. Díaz, et al., “Does Daltonism influence young children’s learning?” Learn. Individ. Differ. 15, 89–98 (2005).
10. C. Pattie, H. Dlay, S. Mullally, et al., “Living with color-vision deficiency at school: a thematic analysis of accounts of color-deficient adults, children, and their parents,” in 43rd European Conference on Visual Perception (ECVP) (2021).
11. P. Cumberland, J. S. Rahi, and C. S. Peckham, “Impact of congenital colour vision deficiency on education and unintentional injuries: findings from the 1958 British birth cohort,” BMJ 329, 1074–1075 (2004).
12. E. J. Patterson, R. R. Mastey, J. A. Kuchenbecker, et al., “Effects of color-enhancing glasses on color vision in congenital red-green color deficiencies,” Opt. Express 30, 31182–31194 (2022).