The turbulence influence on average intensity of Gaussian beams

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As a basic beam, the Gaussian beam is widely studied for its simple form and applied in many areas, such as optical communications, laser radar, image analysis, and so on. It could also be used for comparison with other complex beams. In this paper, the average intensity of Gaussian beams is studied based on the Rytov theory, and the statistical moment of the turbulence phase perturbation is derived. Much work has been done by Andrews *et al.* [1,2], but some derivation process is not explained in detail [3]. In this paper, the work on the statistical moment of the turbulence is summarized and sorted out, the statistical moment of the turbulence is derived using Mathematica, and the final expression references that in [4]. An approximation that may cause a large bias is also pointed out. The final simple form of the polynomials is obtained by the hypergeometric function approximation with the curve fit in Matlab. The expression of the statistical moment of the turbulence is divergent at a large beam radius caused by the approximation of the Rytov theory; a window function is proposed to limit the divergence at the beam edge. This work provides theoretical basis for the application of the Gaussian beams.

References

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Preferred mode of presentation: Oral/Poster