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论文

贝塞尔高斯涡旋光束在大气湍流中的传输特性

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摘要:

基于广义惠更斯-菲涅耳原理, 推导了贝塞尔高斯涡旋光束在湍流大气中传输时系统平均光强的解析表达式, 研究了贝塞尔高斯空心涡旋光束在湍流大气中的光强传输特性, 同时分析了大气湍流的强弱、涡旋光束的拓扑荷等对光束质量的影响. 结果表明: 贝塞尔高斯涡旋光束在大气湍流中传输时, 光强分布经历几个连续的变化, 相位奇异性也会在传输过程中消失, 该过程与涡旋光束拓扑荷的数目、光束的束腰宽度以及大气湍流的强弱等因素密切相关. 拓扑荷数目高的涡旋光束在湍流大气中传输时, 其奇异性的保持较拓扑荷数目低的涡旋光束要好. 另外, 基于桶中功率理论, 分析研究了涡旋光束的拓扑荷数目、大气湍流强弱和束腰宽度对贝塞尔高斯涡旋光束在大气湍流中传输时的光束质量的影响.

关键词: 光学涡旋 大气湍流 光束传输 桶中功率

Propagation of Bessel-Gaussian Beam with Optical Vortices in Turbulent Atmosphere

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Abstract:

Based on the extended Huygens-Fresnel integral, the analytic expressions for Bessel-Gaussian beams (BGBs) with optical vortices propagating in turbulent atmosphere are derived. The average intensity properties and the beam quality (Power in bucket) in the far field of Bessel-Gaussian beams with optical vortices propagating in turbulent atmosphere are investigated. It is found that intensity profiles of Bessel-Gaussian beams experienced successive variations and the phase singularity rapidly fades away during propagating in turbulent atmosphere. The process is closely related with the number of topological charge, the beam's waist width and the strength of atmospheric turbulence. The maintenance of singularity of vortex beams with larger topological charge in turbulent atmosphere is better than that for vortex beams with smaller topological charge. In addition, based on the theory of power in bucket, the influence of topological charge, the beam's waist width and the strength of atmospheric turbulence on the beam quality of Bessel-Gaussian beams is explored in detail.

Keywords: Optical vortex Atmospheric turbulence Beam propagation Power in the bucket

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