

激光技术与器件

非傍轴余弦平方-高斯光束的传输特性

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摘要: 基于功率密度的二阶矩方法, 通过数值模拟研究了非傍轴余弦平方-高斯光束的束宽, 远场发散角和M2因子。计算结果表明: (1) 束腰宽度 $W_0(0)$ 随 $w_0/?$ 的增大而增大。当 $w_0/?$ 较大 ($w_0/? \geq 0.5$) 时, 束腰宽度随着偏心参数的增大而减小。(2) 当 $w_0/\lambda \rightarrow 0$ 时, 远场发散角趋于渐近值 $\theta_{0\max} = 63.4350$, 与偏心参数 $??$ 无关。(3) 在非傍轴范畴, 余弦平方-高斯光束的M2因子不仅与偏心参数 $??$ 有关, 而且还与初始束腰宽度和波长之比 $w_0/?$ 有关。当 w_0/λ 足够小时, M2因子可小于1。对给定的偏心参数 $??$, M2因子随 $w_0/?$ 的变化并非总是单调的。M2因子随 $w_0/?$ 的增大而增大, 当达到最大值后又逐渐减小, 最后渐近趋于一稳定值。

关键词: 激光光学 非傍轴余弦平方-高斯光束 功率密度 M2因子

Propagation characteristics of nonparaxial cosine-squared Gaussian beams

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Abstract: On the basis of the second-order moment of the power density, the beam width, far-field divergence angle and M2 factor of nonparaxial cosine-squared Gaussian beams are illustrated and analyzed with numerical simulation. The conclusions are as following. (1) The waist width $W_0(0)$ increases with increasing $w_0/?$ parameter. $W_0(0)$ decreases with increasing decentred parameter $??$ when $w_0/?$ is relatively large ($w_0/? \geq 0.5$). (2) As the parameter $w_0/? \rightarrow 0$, the far-field divergence angle approaches an asymptotic value of $\theta_{0\max} = 63.4350$, which is independent of the decentred parameter $??$. (3) In the nonparaxial regime, the M2 factor of cosine-squared Gaussian beams depends not only on the decentred parameter $???$ but also on the initial waist-width to wavelength ratio $w_0/??$. The M2 factor may be less than 1 as w_0/λ becomes small enough. The M2 factor does not always vary monotonically with $w_0/??$ for different decentred parameter $??$. The M2 factor increases with increasing $w_0/??$ and reaches the maximum value, then gradually decreases, and finally tends to be a saturated value.

Keywords: laser optics nonparaxial cosine-squared Gaussian beam power density M2 factor

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