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Propagating aberrated laser beams

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Abstract content
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We outline a theory for the calculation of the laser beam quality factor of an aberrated laser beam. We provide closed form equations which show that the beam quality factor of an aberrated TEM00 Gaussian beam depends on all primary aberrations except tilt, defocus and x-astigmatism. We extend this concept to defining the mean focal length of an aberrated lens and show that this quantity depends on all Zernike aberrations of ordinal number 0 or 2 except piston. The models are verified experimentally by implementing aberrations as digital holograms in the laboratory. Lastly, we show how the definition of the two concepts may be of use in controlling thermal aberrations in laser resonators using adaptive optics, thereby improving the quality of the beam generated and also reducing the effects of thermal lensing.

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