**带波前倾斜修正的自适应光学波前畸变校正实验研究**

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**摘要**：光波经过大气湍流传输后波前产生畸变，其中倾斜分量约占整体畸变量的80%，对波前畸变的影响增加，直接导致无线激光通信的性能下降，有必要引入偏摆镜对波前倾斜量进行单独修正。采用偏摆镜和变形镜组合的自适应光学系统，基于zernike模式分解到驱动器电压的自适应光学二重闭环控制算法，分别对光波经室内、600m、1km、5km、10km、100km不同距离传输后的波前畸变进行修正。实验结果表明：波前畸变的程度以及波前的变化速度均随着通信距离的增大而增大，在不同距离条件下，仅偏摆镜闭环后，波前相位分别由9.5m、15m、12.5m、22m、35m、450m降至5m、10m、7.5m、8m、20m、300m；仅变形镜闭环后，波前相位分别降至8m、9m、9m、20m、15m、300m；当偏摆镜和变形镜同时闭环后，波前相位降至0.2m、2.1m、0.4m、3.1m、5m、200m。偏摆镜和变形镜同时闭环的修正效果要优于单独偏摆镜的修正效果以及单独变形镜的修正效果，弱湍流条件下波前修正效果要优于强湍流修正效果。

**关键词**：自适应光学；zernike模式；变形镜；偏摆镜

**Experimental Study on Adaptive Optical Wavefront Distortion Correction with Wavefront Tilt Correction**

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**Abstract**: The wavefront of light wave is distorted after it passes through atmospheric turbulence, and the tilt component accounts for 80% of the total distortion. The influence on wavefront distortion increases, which directly leads to the performance degradation of wireless laser communication. It is necessary to introduce a fast steering mirror to modify the wavefront tilt separately. The adaptive optical system is composed of fast steering mirror and deformable mirror, based on Zernike mode decomposition to driver voltage the double control algorithm, the wavefront distortion of light wave after indoor, 600 m, 1 km, 5 km, 10 km and 100 km transmission is corrected. The experimental results show that: After the closed-loop of the tilt mirror, the wave front phase decreased from 9.5 m, 15 m, 12.5 m, 22 m, 35 m, 450 m to 5 m, 10 m, 7.5 m, 8 m, 20 m, 300 m, respectively; Only after the deformable mirror closed-loop, the wavefront phase decreased to 8m、9m、9m、20m、15m、300m, respectively; When the tilt mirror and the deformable mirror are closed at the same time, the wavefront phase decreases to 0.2m、2.1m、0.4m、3.1m、5m、200m. The correction effect of closed-loop of tilt mirror and deformable mirror at the same time is better than that of single tilt mirror and deformable mirror, and the correction effect of weak turbulence is better than that of strong turbulence.

**Key words**: Adaptive Optics, Zernike Mode, Deformable Mirror, Fast Steering Mirror.