Institute of Technical Physics

Low cost adaptable laser transmitter for groundbased orbital observations

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Theory and motivation

Ground based laser transmitters are necessary for

- satellite laser ranging
- ground based optical communication to satellites
- free space quantum information applications - optical time transfer

Beam steering

- tip/tilt mount equipped with two DC servo-motors
- placed in conjugate plane of output aperture
- total travel range: ±1mrad
- reproducable movement of motors <200nm

Requirements for laser transmitters:

- expand the laser beam to reduce diffraction limited divergence to several 10µrad
- enable reproducible fine steering of the beam in the µrad regime
- control beam divergence to compensate misalignment/achieve best performance

Presented design made of COTS components - easy upgrade of existing telescopes possible

Laser transmitter design



fiber collimator+ energy beam steering unit monitoring



f=500mm/*D*=10cm



shear plate

beam steering accuracy <1µrad



Divergence control

[deg]

orientation







- Shearing interferometer: - pattern orientation ϕ depends on defocus Δf Δfs $\tan \phi =$ $f^2 n \alpha_w$
- robust and alignment free
- Motorized beam exp.: - adjustment of divergence in sub-µrad regime
- Image processing:
- std. deviation of angle determination $\Delta \Psi = 2.6^{\circ}$
- achieveable divergence accuracy ca. 10µrad



Literatur

P. Senthilkumaran et al.; Applied Optics, Vol. 34, No. 7, 1995 D. Hampf et al.; Advances in Space Research, 2016

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