Layer-oriented MCAO for extended objects

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Classic adaptive optics

Nighttime

Solar

Computational load much heavier in solar AO
Star-oriented MCAO correction

Several SH sensors sense the wavefront distortions along different directions.

1-2 arcmin

Up to 1 arcmin
Tomographic reconstruction

Telescope pupil
Star-oriented MCAO correction

Telescope pupil

Reconstruction algorithm is fed with added information on atmospheric profiles
The star-oriented approach on extended objects does not make use of the entire field information.
Layer-oriented MCAO correction

Triangulation is possible in the entire atmospheric volume
Layer-oriented approach: the wavefront distortions are sensed continuously over the entire field.
Wide-field sensors

Turbulence at the pupil globally shifts the image
Wide-field sensors

High-altitude turbulence distorts the image
Layer-oriented MCAO

Turbulence at the conjugate layer shifts the image
Layer-oriented MCAO

Turbulence in an un-conjugated layer distorts the image
Layer-oriented MCAO

Both the mirror and the sensor are optically conjugated to the turbulent layer

Sensors conjugated to high-altitude layers

Sensor conjugated to the ground
• Ribak “Separation of atmospheric layers” SPIE 2004

• Kellerer “Layer-oriented AO for solar astronomy” Applied Optics 2012

• Marino & Woger “Feasibility study of a layer-oriented wavefront sensor for solar telescopes” Applied Optics 2014

• Kellerer “Further considerations on layer-oriented adaptive optics for solar telescopes” Applied Optics 2014