Path-Resolved Optical Profiler System (PROPS), PR-05-600

Description

MZA's Path-Resolved Optical Profiler System (PROPS) measures turbulence strength along a line of sight. Turbulent wavefront measurements are sampled with a telescope-mounted sensor on both sides of the propagation path from multiple sources, from which C_n^2 is derived. These turbulent fluctuations significantly affect high resolution imaging sensors and can reduce efficiency of laser beam projection for directed energy, illumination and optical communications. The same phenomena also give insight into other aspects of the atmospheric path, including evapo-transpiration measures critical to water and agricultural management activities.

Applications

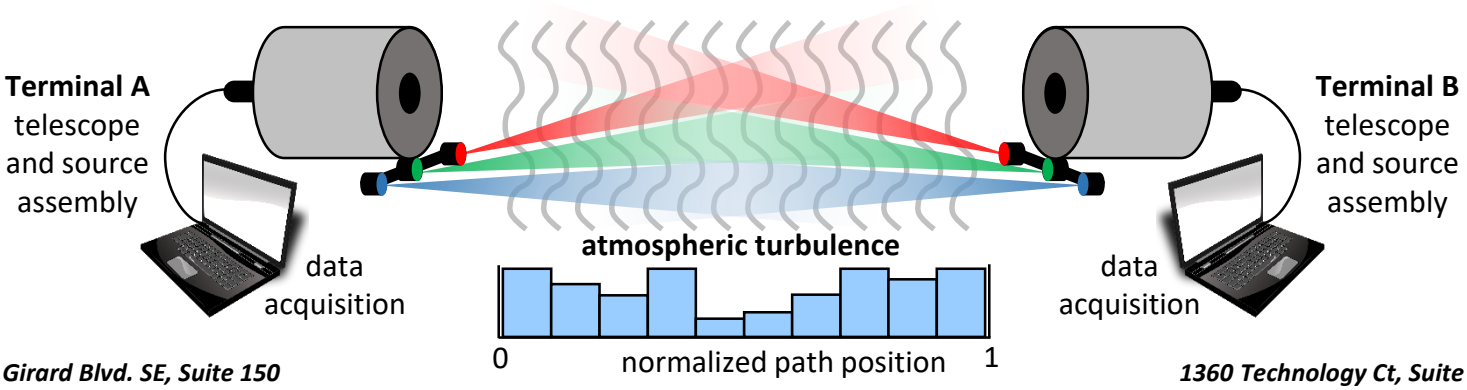
- **Laser propagation path characterization**
- **Atmospheric imaging diagnostics**
- **Optical communications link performance**
- **Evapo-transpiration and water management**
- **Include profiles in wave-optics simulations**
- **Enables custom MATLAB analysis**

Unique Advantages

- **Resolves C_n^2 turbulence strength along path**
- **Automatic computation of:**
  - **Rytov number**
  - **Scintillation index**
  - **Fried's coherence diameter**
  - **Isoplanatic angle**
  - **Cross-wind speeds**
  - **Greenwood and Tyler frequencies**
- **Time-resolved wavefront measurements**
- **5+ km range between terminals**
- **Automatic collection, processing, & reporting**
- **Operator data quality feedback**
- **Eye-safe, non-laser sources**
- **Output supports ATMTools and WaveTrain**

Operation

Identical PROPS optical transceiver terminals are placed on each side of a propagation path which typically extends 5-10 km given favorable atmospheric transmission. The terminals transmit multiple wavelength sources and image each source with sensitive cameras which record the deviation or "dancing" of each source and its intensity fluctuation. These measurements are processed and communicated bi-directionally over a network connection. The unique geometry of PROPS enables resolution of changes in turbulence along the path resulting from the surface features along that path. PROPS processing also estimates cross-wind speeds as seen from both sides of the path. PROPS automatically collects, processes, catalogs, and reports these data for future reference. Output data is uniquely formatted to enable theoretical turbulence calculations and for customized wave-optics simulations.



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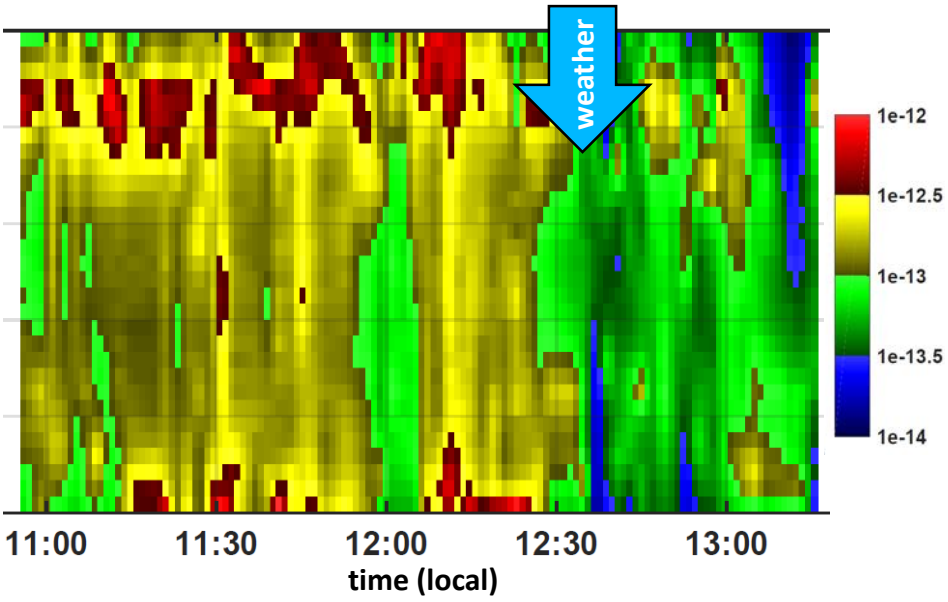
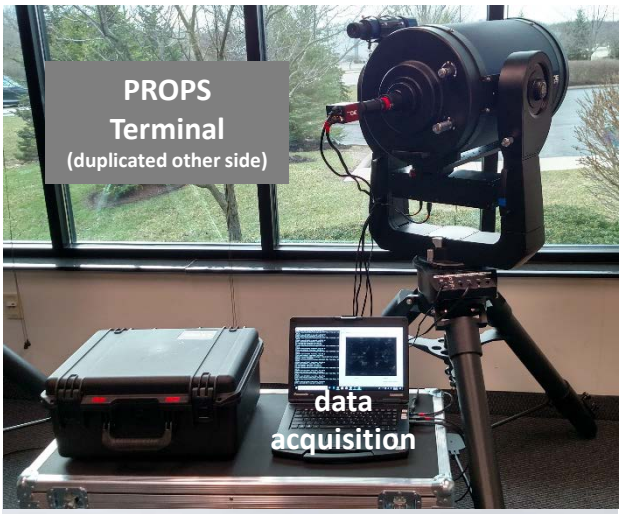
Measured Turbulence Profiles

Example PROPS results during test operation over ground path for several hours are shown below. The C_n^2 measurements are resolved into 30 range bins over the path at each one-minute increment. PROPS indicates regions of high and low turbulence strength principally related to changes in vegetation along the path. The logarithmic color scale highlights the spatial variation (vertical axis) in observed turbulence strength, as well as the marked change in turbulence conditions when a weather event moved into the test area. From these full C_n^2 profiles, derivative atmospheric parameter such as Fried's coherence diameter r_0, isoplanatic angle, Rytov number, etc. are computed and reported in a form convenient for further atmospheric analysis.





Description	Specification
Path length	0.5 to 5+ km
Number of C_n^2 bins	30 bins over propagation path
C_n^2 profile frequency	Full C_n^2 profile calculated every minute
Optical sources	Multiple ~800 mW visible LEDs
Optical wavelengths	visible, 450-650 nm
Power Consumption	950 W (typ.)
Transceiver + tripod Footprint and weight	12" aperture telescope, 1 meter footprint, 50 kg transportation cases included
Data acquisition, control, comm.	laptop computer with PROPS software, (UPS & wireless LAN recommended)

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