Path-Resolved Optical Profiler System (PROPS), PR-10-1000

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.

Unique Advantages

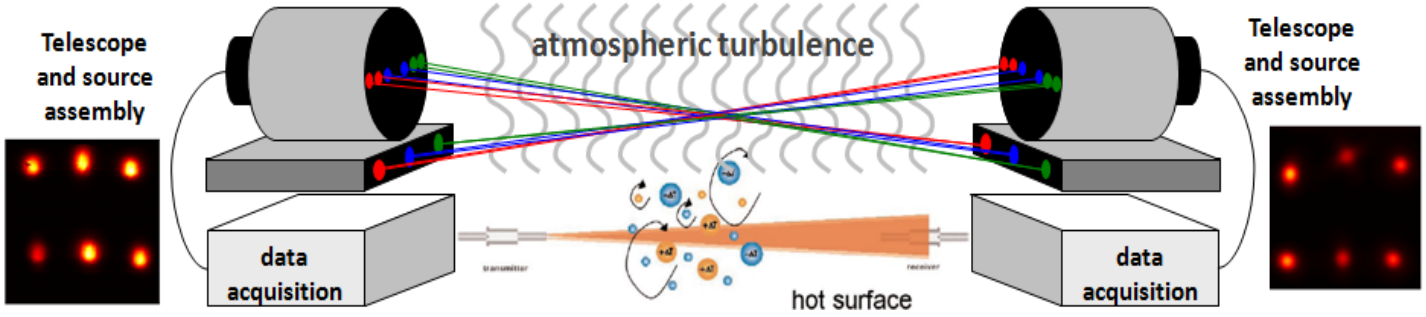
- **Resolves C_n^2 turbulence strength along path**
- **Automatic computation of:**
  - **Rytov number**
  - **Scintillation index**
  - **Fried's coherence diameter**
  - **Isoplanatic angle**
  - **Cross-wind speeds**
  - **Greenwood and Tyler frequencies**
- **10 km stand-off between terminals**
- **Automatic collection, processing, & reporting**
- **Operator data quality feedback**
- **Output supports ATMTools and WaveTrain**

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**

Operation

Identical PROPS optical transceiver terminals are placed on each side of a propagation path which typically extends up to 5 km or longer 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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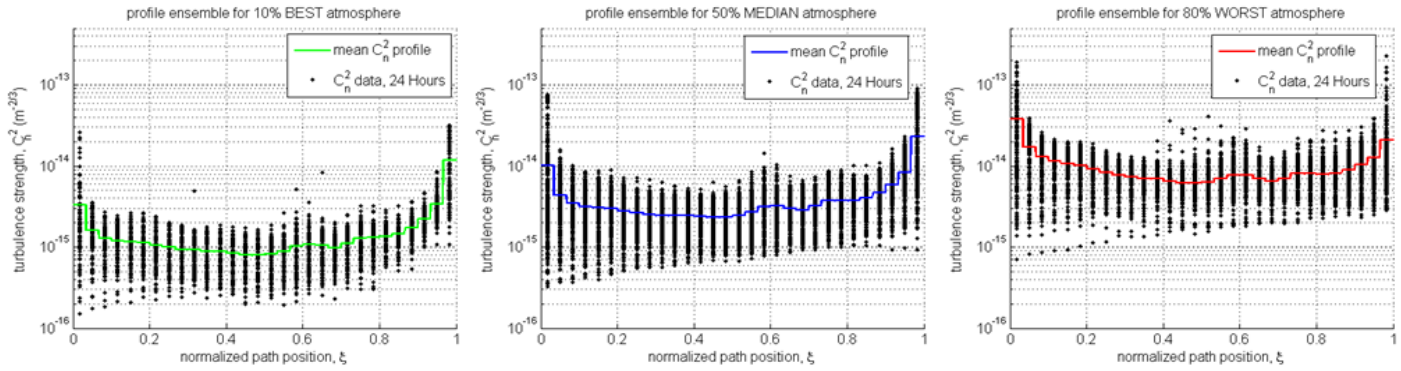
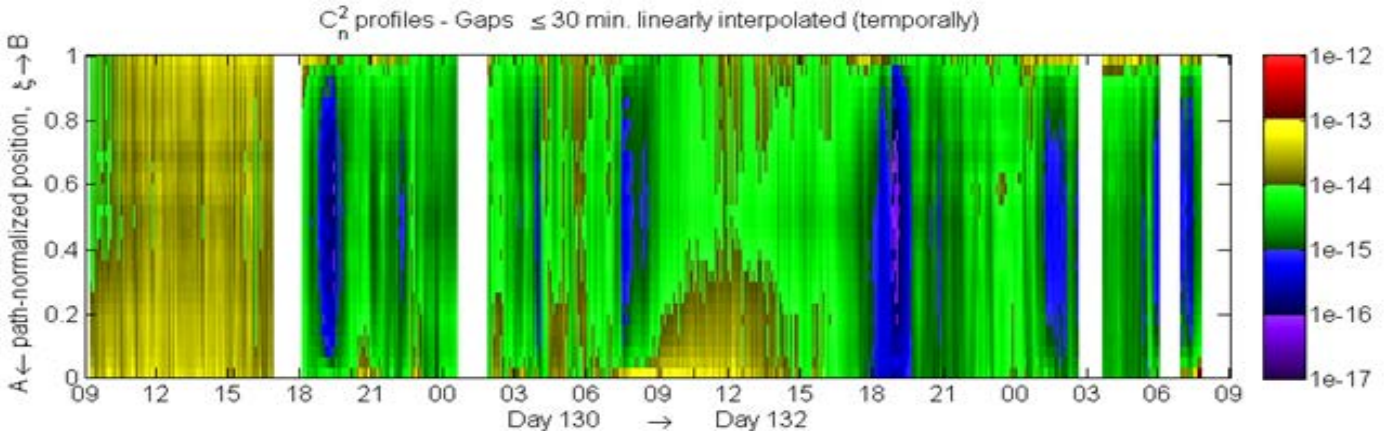
Path-Resolved Optical Profiler System (PROPS), PR-50-1500

Measured Turbulence Profiles

Example PROPS reports from operating over a 3.2 km path for a 48 hour period are shown by the low (left), medium (center), and high (right) ensemble of C_n^2 measurements resolved into 30 range bins. In this case, PROPS indicates regions of high and low turbulence strength at ~100 meter resolution principally related to changes in terrain.
Shown below is a time history of the same resolved C_n^2 measurements. The logarithmic color scale highlights the substantial diurnal (horizontal axis) and spatial variation (vertical axis) in observed turbulence strength. From these full C_n^2 profiles, derivative atmospheric parameters such as mean C_n^2, Fried's atmospheric coherence size, isoplanatic angle, scintillation index, Rytov number, etc. are computed and reported.





Description	Specification
Path length	0.5 to 10 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	3x 1W diode lasers
Optical wavelengths	near IR, ~1000 nm
Power Consumption	950 W (typ.)
Transceiver + tripod Footprint and weight	1.25 meter footprint 50 kg
Data acquisition, control, comm.	laptop computer with standard UPS, RF wireless LAN point-to-point

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