Path-Resolved Optical Profiler System (PROPS), PR-50-1500

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 $C_n^2(z)$ 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

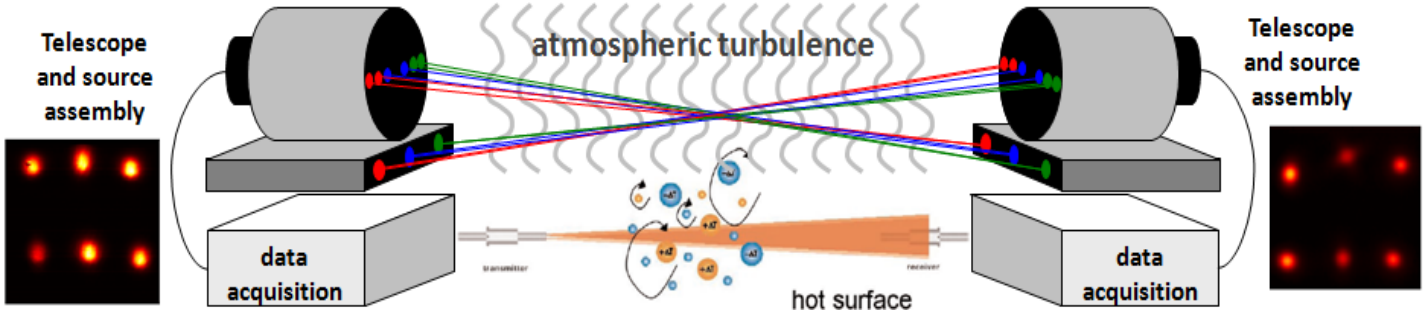
- **Resolves C_n^2 turbulence strength along path**
- **Automatic computation of:**
  - **Rytov number**
  - **Scintillation index**
  - **Fried's coherence diameter**
  - **Isoplanatic angle**
  - **Cross-wind speeds**
  - **Greenwood and Tyler frequencies**
- **Long-range 50 km stand-off between terminals**
- **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 50 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 using a built-in wireless link. 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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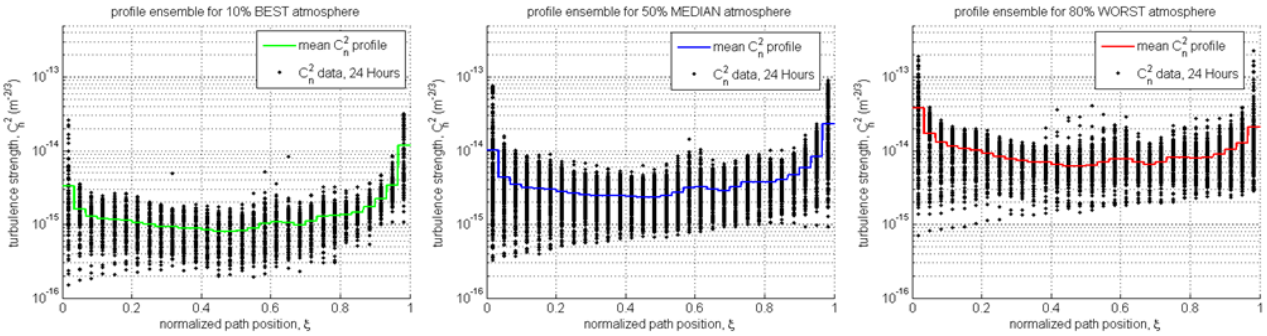
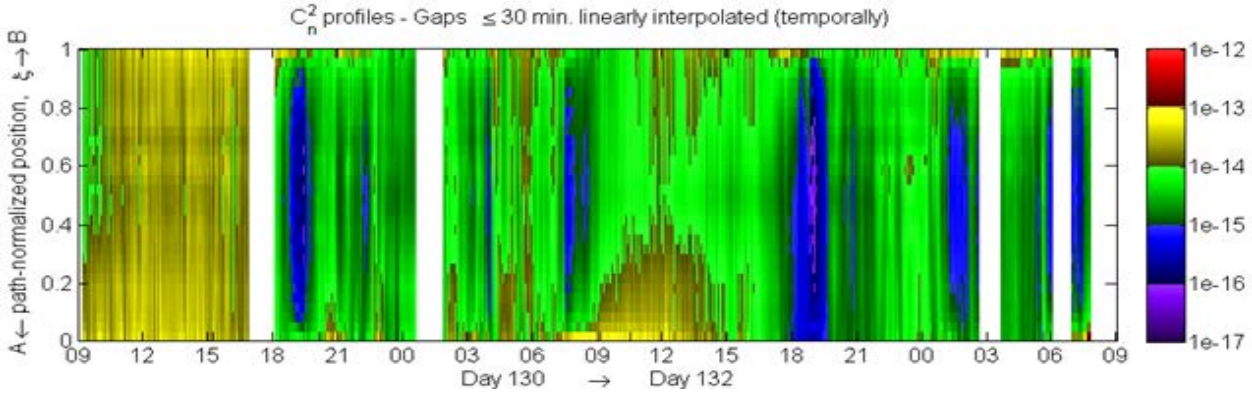
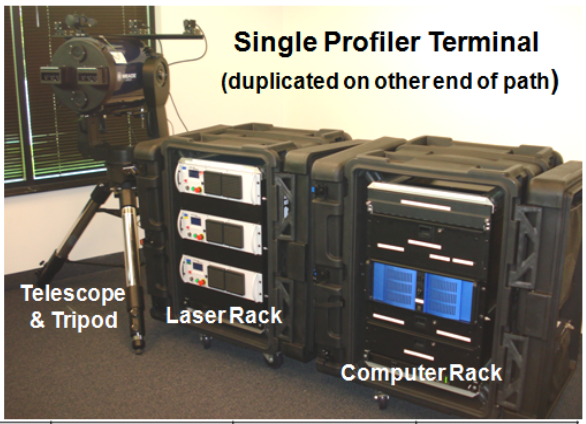
Measured Turbulence Profiles

Example PROPS 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.





Gen2 Capabilities	
Range [km]	2-200
Bins	1-40



System Safety	
Unaided NOHD [m]	261
Aided NOHD [m]	1,830
OD Required (1530-1598 nm)	4+
NSHD [m]	261

Spectrum [nm]	
CW Sources*	Filters
1532.6	1526 - 1540
1588.7	1582 - 1593
1595.3	1589 - 1603
*CWL ± 1 nm; BW = 1nm (FWHM); Random Pol.	

Electrical Req.'s (per side)	Power Draw [W]		Input Voltage [VAC]			Frequency [Hz]			Input Connections (NEMA 5-15P)
	Max.	Typ.	Min.	Typ.	Max.	Min.	Typ.	Max.	
Computer Rack	1,800	< 550	82	120	144	57	60	63	1
Laser Rack	1,800	< 400	82	120	144	57	60	63	1

Physical Req.'s (per side)	Weight [lbs]	Footprint [ft]	Max. Dist. To Tripod [ft]	Misc.
Tripod & Telescope	175	4 (Circle)	N/A	Combined Rx and Tx apertures :~ 1.5' x 3' (HxW) region with clear line-of-site to other unit required.
Computer Rack	315	3 x 3.5	10	Access to one side after setup required
Laser Rack	315	3 x 3.5	10	Access to one side after setup required

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