Characterization of an Atmospheric Optical Communication Channel

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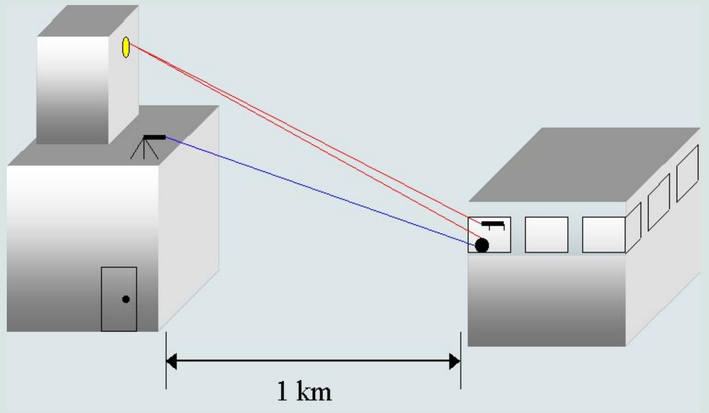
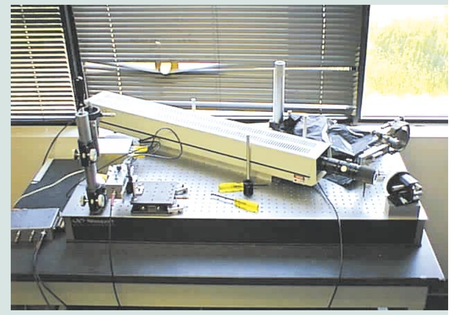
INTRODUCTION

- An integral step in establishing a line-of-sight optical communications link is the characterization of the Earth's atmosphere as a communications channel. The atmosphere is a "turbulent" channel.
- The turbulent Earth's atmosphere can be modeled as a series of thin "phase screens" that, depending on various factors such as temperature and weather conditions, provide different levels of randomization of the wavefront of a laser that is transmitted through the atmosphere.
- C_N^2, the refractive index structure constant, is the main parameter used to describe the strength of atmospheric turbulence.
- C_N^2 can be determined by measuring the fluctuations in intensity of a laser as it travels through the atmosphere.

Experimental Setup

Engineering Bldg.

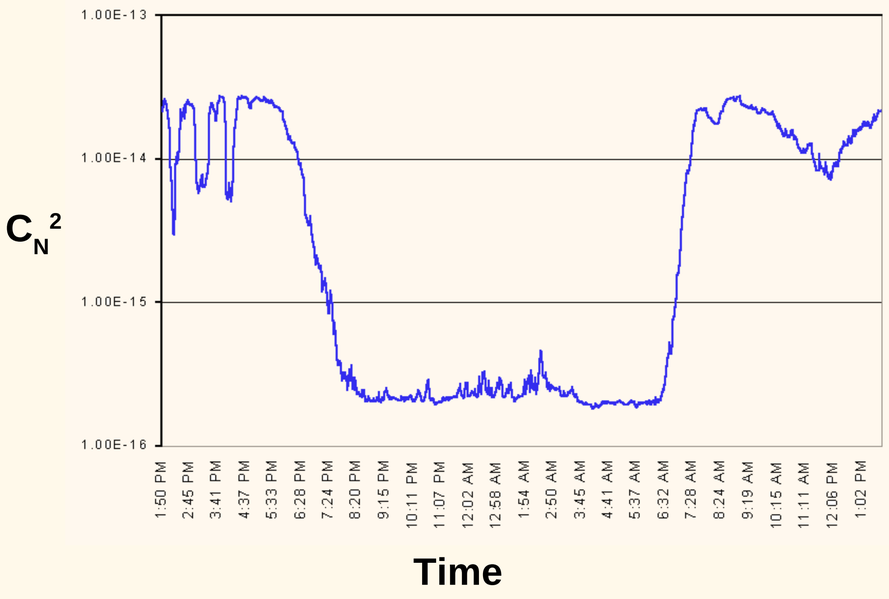




Chesapeake Bldg.

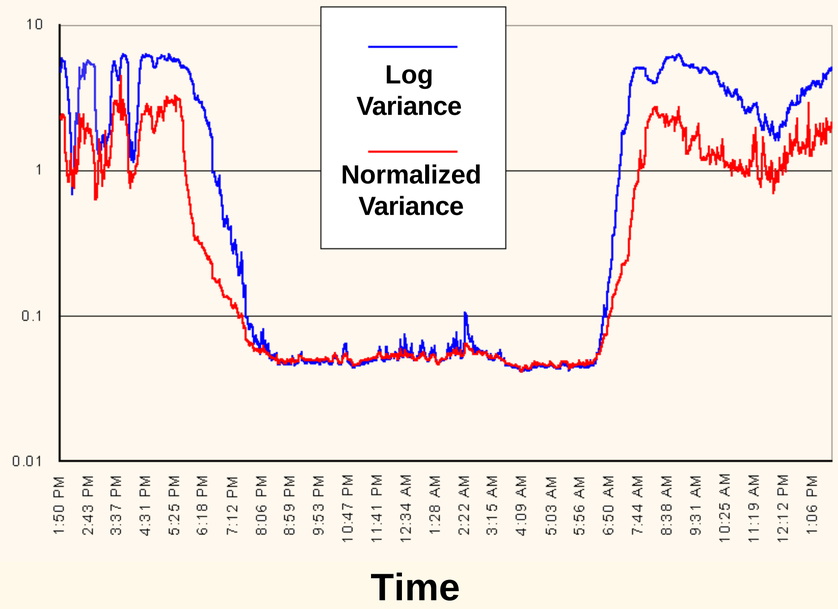
- One laser is placed in the Chesapeake Building while a retro-reflector is placed on the roof of the Engineering Building. This laser travels from the Chesapeake to the reflector then back to the Chesapeake Building.
- Simultaneously, another laser is placed on top of the Engineering Building and is shot directly to the Chesapeake Building where the intensities of both lasers are recorded by photodetectors.

Turbulence Levels for 24 Hour Period



Data shows higher turbulence levels during daytime hours. Low atmospheric turbulence and less activity are seen during dark hours.

Signal Variance Over 24 Hour Period



Log intensity variance and normalized intensity variance converge for low atmospheric turbulence and diverge at high turbulence levels.

CONCLUSIONS

- Turbulence during the night time can be classified as weak turbulence which should fit the Rytov model.
- Turbulence levels rise during the day time.
- High temperatures increase the level of turbulence in the atmosphere.

FUTURE DIRECTIONS

- Atmospheric effects on intensity of laser.
- Atmospheric effects on wavefront of laser.
- Minimizing atmospheric effects using adaptive optics.
- Effects on fluctuations of the received signal produced by varying the receiving aperture size.