COHERENT COMMUNICATIONS, IMAGING AND TARGETING PHASE PLATE CHARACTERIZATION

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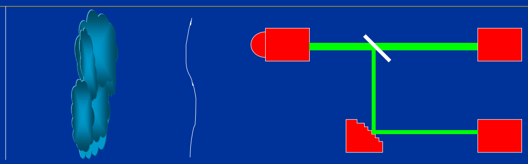
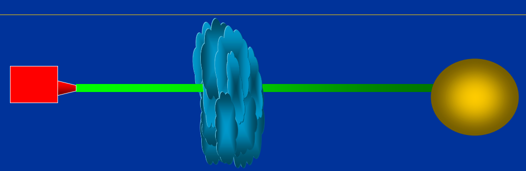
INTRODUCTION

The Coherent Communication, Imaging and Targeting (CCIT) project uses adaptive optics to propagate a laser light through the atmosphere and compensate for the aberrations due atmospherically induced distortions. In this system, the transmitter aims a laser at the target and the target returns the laser. The returning light is then processed to identify atmospherically induced aberrations in a process which produces a hologram that is applied to a Spatial Light Modulator (SLM). The outgoing laser is then reflected off the SLM and sent to the target with the corrected wavefront. The project consisted of simulating the CCIT system in a controlled environment.

Adaptive Optics are used to correct for atmospherically induced distortion in plane waves

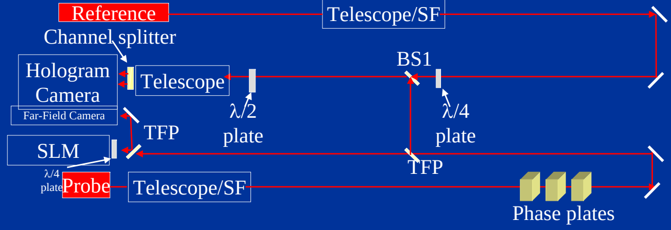


Coherent Communication, Imaging and Targeting uses adaptive optics to correct for atmospherically induced distortions. A laser light is aim at a target and the Target returns a signal which is process to correct for the aberrations. The corrected signal is sent to target.



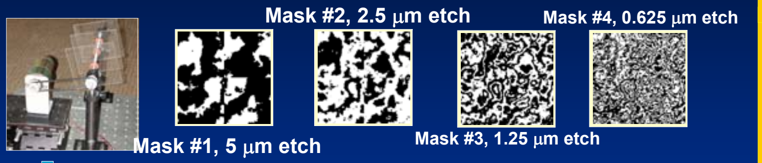
SYSTEM DESIGN

The probe beam passes through the phase plates. The probe beam is combined with the Reference beam at the hologram camera to obtain the Intensities (I_{sin} , I_{cos})



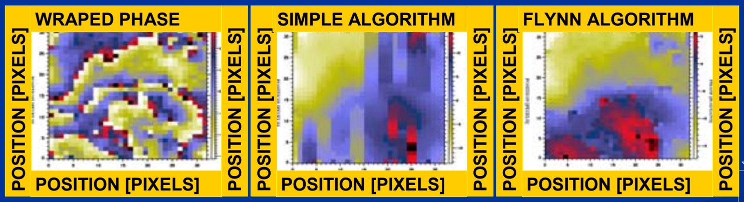
THE PHASE PLATES

The phase plates were etched based on the four different mask shown below. The phase plates are rotated by a variable speed motor to simulated a moving atmosphere.



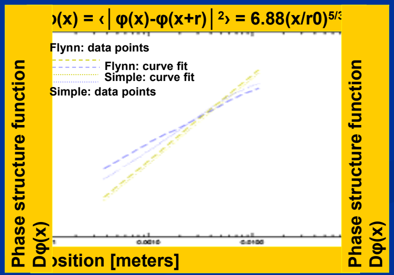
UNWRAPING THE PHASE

Once the hologram camera records the I_{sin} and I_{cos} intensities of the phase the phase is determined by the equation, φ=artangen(I_{sin}/ I_{cos}). The phase is unwrap to make the phase continuous as it is in the atmosphere. Two different algorithm were used to unwrap the phase. we believe that flynn algorithm is better due to the smoother phase transitions on the.



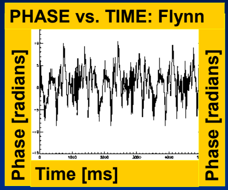
USING THE UNWRAP FUNCTION TO DETERMINED THE PHASE STRUCTURE FUNCTION

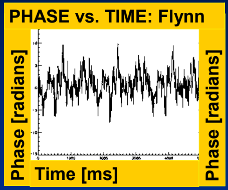
The phase was used to determine the phase structure function in order to determine Fried parameter (r_0). The data from the two unwrapping algorithms was plotted and curve fitted in order to determined $r_{0.}$ As we can see from the graph shown below that the two unwrapping algorithms give r_0~1.7 [mm].



PHASE AVALUATION AS A FUCNTION OF TIME

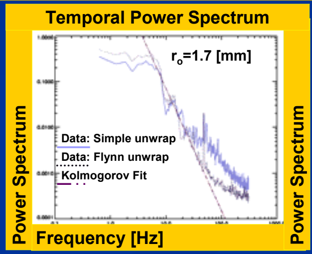
The phase plates were running at ~ 7.5 [cm/s] along the aperture in order to simulated a moving atmosphere. The results are shown below.





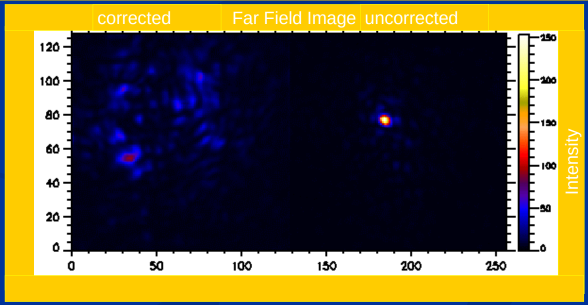
FITTING THE DATA TO THE TEMPORAL POWER SPECTRUM

The data was fit to a Kolmogorov power spectrum. The results are shown on the graph below. The result further verified our previous results. Mainly r_0~1.7 [mm]



SYSTEM PERFORMANCE

Given that r_0~1.7[mm] and the sub aperture of our adaptive optics is ~ .365[mm] we anticipated that our system should performed well. The results can be seen below



CONCLUSION

The result of our system showed that adaptive optics can greatly improve the performance of Coherent Communication

REFERENCES:

1) Thomas J. Flynn, "Two dimensional phase unwrapping with minimum weighted discontinuity", J. Opt. Soc. Am. A 14, 2692-2701 (1997)

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