Abstract:
This study focused on observing turbulence from scintillation measurements from a fixed known light source detected with a Hartmann Turbulence Sensor (HTS). The goal of the experiment was to detect anisotropic turbulence patterns across a one kilometer test range, longer than previous variations of this experiment. The HTS and laser were set up on a concrete runway, and data was taken over a period of two weeks over six to eight hours at a time. Usually, light detected in the HTS is analyzed using its centroid position, but in this study, the light measurements are analyzed using intensity values captured by the HTS to look for patterns corresponding to scintillation index. The scintillation index, a unitless measure of turbulence strength, can be calculated from HTS scintillation measurements, and compared to several ways of gathering it.

Methodology:
The setup of this experiment consisted of the HTS mounted onto a trailer. The HTS and laser were set up on a concrete runway, and data was taken over a period of two weeks over six to eight hours at a time. Usually, light detected in the HTS is analyzed using its centroid position, but in this study, the light measurements are analyzed using intensity values captured by the HTS to look for patterns corresponding to scintillation index. The scintillation index, a unitless measure of turbulence strength, can be calculated from HTS scintillation measurements, and compared to several ways of gathering it.

Analysis:
In parallel with the HTS setup, a scintillometer was running on the same 1-km range. The HTS gives an array of both wavefront tilt values, and intensity, or brightness values, but usually the tilts are used in analysis. Using the intensity array, its mean normalized intensity can be calculated from each data capture respectively. The mean normalized variance is the scintillation index, so plotted alongside different means of gathering it can gauge the usefulness of determining turbulence strength from the HTS.

Conclusion:
The mean normalized intensity variance over each data capture provide a decent estimation for scintillation index, and therefore, turbulence strength, without the use of wavefront tilt data. In comparison to the calculated scintillation index, and with the scintillation index from the scintillometer, the normalized intensity variance seems to follow the pattern and values quite well. In the future, data would improve if r0 gathered from the HTS in multiple ways is used to calculate several scintillation index graphs to compare.