Homework 2 Solutions
OPTI 415/515

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1. Wavefront Curvature Measurement This system compares the irradiance in two separated planes across the focus. The resulting signal is a function of the laplacian(2nd derivative) of the wavefront. Differences in phase will alter the irradiance at a given position from ideal.

2. Phase Diversity This test is similar to the Wavefront Curvature Test. By using monochromatic light, the two focal planes can be tested across the caustic of a system. The resulting data produces better results than a Wavefront Curvature test.

3. Focault Knife Edge Test A knife blade is placed near the center of curvature and moved across the wavefront. An observer is located outside of focus. If an ideal surface, the shadow created from the edge will be straight. Otherwise, shadow zones will exist along the boundary. This was one of the earliest tests for the quality of a lens/mirror system.

4. Wire Test This test is similar to the knife edge, but with a wire. This gives less qualitative data but better quantitative data.

5. Ronchi Test A Ronchi grating is a series of wires. This gives multiple shadows, to allow for many measurements at once across the aperture.

6. Hartmann Test A screen with a series of holes is placed at the pupil. Two images are taken inside and outside of focus. Aberrations can be determined from the movement of the spots on the images corresponding to a slope error. Additionally, the test averages out atmospheric turbulence, making it a great test for measuring mirrors.

7. Shack-Hartmann Test This test replaces the Hartmann Screen with a collimating lens and lenslet array. The shift of the lenlet focal point corresponds to a slope error. This system is used in adaptive optics for measuring air turbulence.

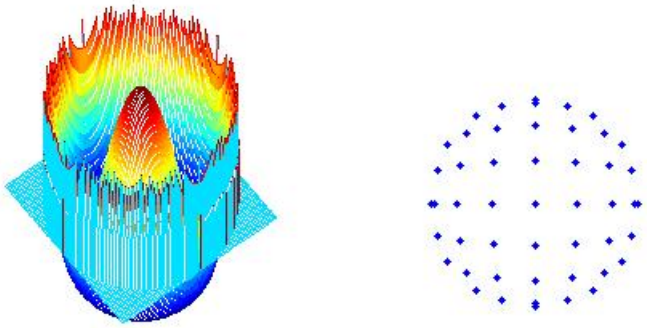

Figure 1: Input and Spot Pattern

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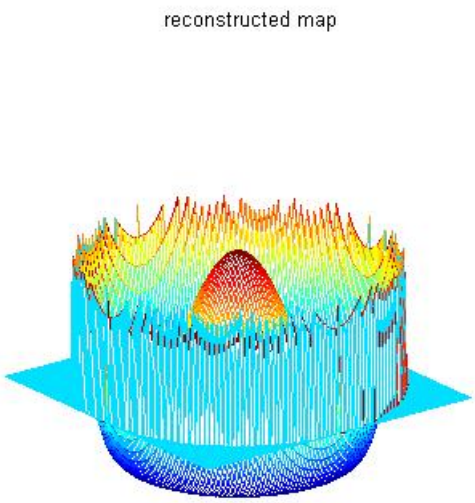
For my system, I setup so that $Z_{11} = 1$, giving spherical and defocus results. The input, spot pattern and reconstructed wavefront are given. Residual error is below 10^{-13}.

Southwell system



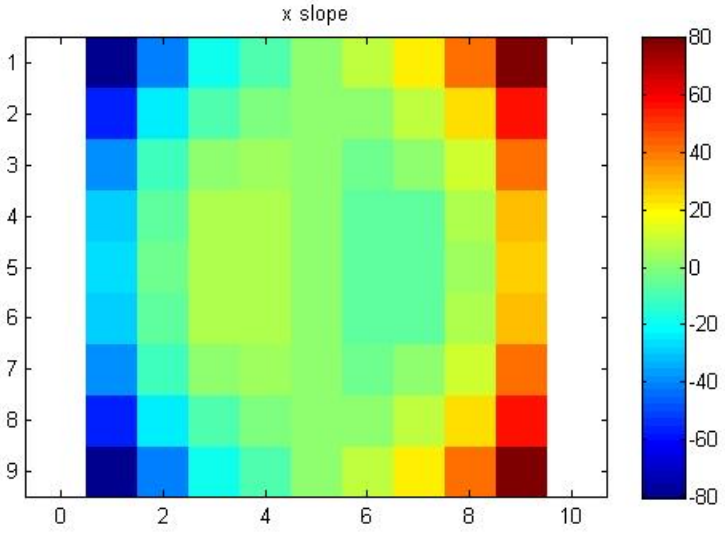


Figure 2: X slope

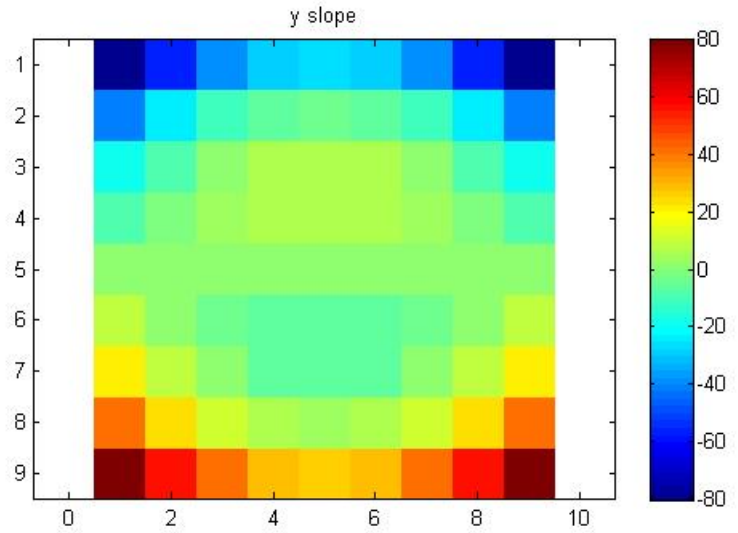


Figure 3: Y slope

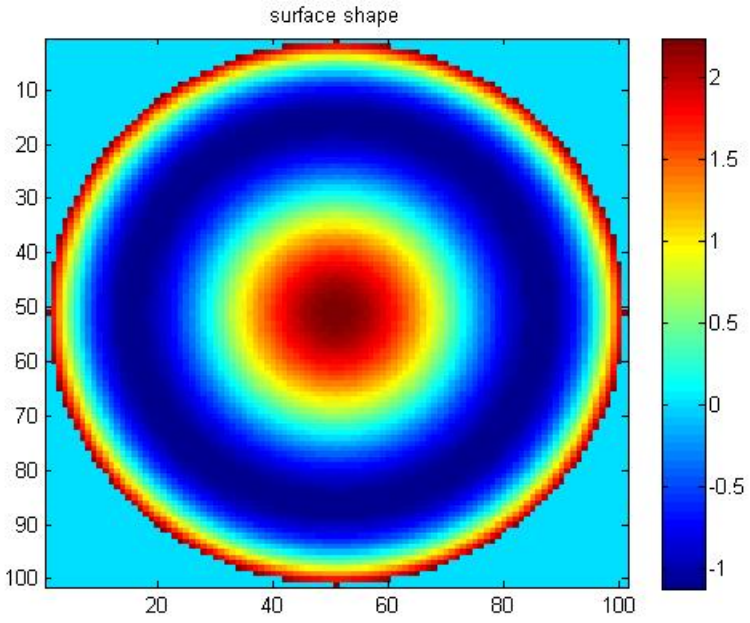


Figure 4: Reconstruction

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Now we look at noise reconstruction. A histogram is generated based on an input of 1um noise.