ASTR/OPTI 428/528

Lecture 9: Project 1 Ideas

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Project 1

- General theme is Wave Propagation through Turbulence.
- 3-5 group members
- Consider a phenomenon, measured quantity, idea, and explore it using math and simulations.
- Hardcore mathematical analysis is not expected, but understanding the ideas, framing a question, and exploring how it works by simulation is.
- Deadline will be announced, but is definitely after the first week of March.
- Results will be given as an in-class presentation.

Ideas

- Much of the usual analysis assumes no scintillation. What happens if we include it?
  - Propagate beyond a phase screen before looking at it with some method.
  - Study the field with an interferometer or a telescope.
  - Describe and measure the ways in which scintillation affects the measurements.
  - What can be learned from the scintillation? What can it be used for? When can we ignore it?

more ideas...

- Make a fake AO system using a magical wavefront sensor
- Study the timescales of speckles in the focal plane.
- Using a simple approximation for an AO system with processing lag (i.e. the turbulence has moved since you measured it), explore the effects and suggest ways to fix it.
- Use long-exposure images of stars to estimate the phase structure function. Use simulations to test your method and use real images from telescopes to try it for real. Compare seeing-limited with AO images. What happens if the telescope is shaking?
- Simulate a laser communications system using two identical telescopes looking at each other over some distance. How should you focus the telescopes: Collimated or focused on the other telescope?

more ideas...

- Using simple models and numerical simulation, study what happens if you try to do AO in strong scattering? ($r_0 < \sqrt{\lambda z}$)
- How would you model pulse propagation through turbulence? How does it relate to imaging? How does it affect the design of a laser communications system?
- What is the effect of optical bandwidth on imaging? Simulate an image with and without speckle noise.
- Model an imaging interferometer (e.g. 4D) measuring a surface through turbulence.
  - Actually try it!
- Model a Lyot coronagraph and show the effect of turbulence. When should you not bother using a coronagraph?
- etc. etc.