OPTI: 523

Independent Project Plan

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For my independent project, I would like to design part of a high temperature solar furnace. I am very interested in concentrating solar energy, specifically high temperature applications. The furnace will consist of two mirrors, so that the focal area is behind the primary mirror. The furnace will track the sun in both azimuth and elevation, and the secondary mirror will be able to move along the optical axis so that the focal point can be “defocused”. This defocusing would provide some control over the concentration ratio at the focal area. This adds some flexibility to the system and could allow for some gradual heating of the target that is at the focal area. The system will be designed to achieve a relatively high maximum concentration ratio of 20,000 suns. This type of system could be used to drive thermo-chemical cycles, such as the reduction of metal oxides, or for other industrial heat applications.

I would like to try and design the mount for the secondary mirror in this kind of a system.

This project will include:

1. Overall geometric design of the system
   1. The size, focal lengths, and relative positions for the mirrors
   2. Top level error budget, this will probably have a lot of assumptions in it but I need some requirements to work towards
2. Detailed design of the mount for the secondary mirror
   1. Angular and positional requirements
   2. Stability requirements
   3. Interface to structure (but ***not*** the actual structure that ties the primary and secondary mirrors together)
   4. Means of movement along the optical axis (just the mechanical components, not the electrical, the motor and controller would be handed off to someone else)

There are three main aspects of this project that I find really interesting, and that I think I will learn a lot from. First is the design and specification for a non-imaging system. As I said this is something I am very interested in and I think I will learn a lot by specifying the requirements for this kind of a system. Second is the motion of the secondary mirror, I think it will be good to design something that moves, and still has to meet the stability requirements to achieve the desired concentration ratio. Lastly this mirror will be mounted opposite from the mirror in assignment 4. The secondary mirror in this system will have to go from horizon pointing, to pointing down. I have never designed this kind of mount, and I think it will be interesting to see how it changes the way the mounts deform the mirror.

The outcome I am hoping for is to have an actual working design for a mirror mount that will hold a secondary mirror sufficiently to achieve 20,000 suns, and provide translation along the optical axis.