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EME 199 Proposal

**Background and Purpose**

This experiment revolves around a height offset monitoring camera that records the directed energy deposition process. After the camera was installed, our graduate researchers observed some distortion in the camera’s images. They suspected that the distortion occurs as the heat from the deposition accumulates in the camera and its mounting apparatus.

Therefore, our objective is to characterize and quantify the heat transfer into the camera using an approximation for the clad temperature and clad area. We will then use these calculations to determine a failure condition for the camera and identify its critical component along with its thermal limit. Finally, we will validate our calculations by attaching thermocouples to the camera and conducting a circular deposition until a steady state response is reached. This constant heat addition will allow us to investigate a worst-case scenario for the camera. If necessary, a thermal management solution will be designed and implemented to mitigate overheating.

**Method**

We want to investigate a worst-case scenario for the camera so that our thermal management solution is robust. This scenario may involve running the deposition at maximum laser power and conducting a circular deposition such that the clad remains stationary relative to the camera (constant heat addition).

If possible, we may also measure the impulse response during the deposition to determine how fast the system responds to heating.

*Experimental Variables (subject to change)*.

* Assumed:
  + Maximum laser power = heat diffusion out of substrate
  + Highest clad temperature = 2000 °C
  + Maximum camera working temperature = 70 °C
  + Emissivity of clad
* Independent: ambient temperature, maximum clad temperature, average clad temperature, average clad area using AM Camera Analyzer
* Dependent: thermocouple temperatures

**Procedure (subject to change)**

We plan on attaching thermocouples on the camera and its mounting apparatus to measure the temperatures of the following locations: the rim of lens, inside the camera housing, the cameras back surface, the welding glass, the plate in front of the camera, and the plate above the camera.

*Purpose of each thermocouple (why we are measuring the temperature at each location)*.

* Rim of lens: the lens is very likely a critical component since it captures the image
* Inside camera housing: the air inside could be overheating the camera's PCB
* Back of camera: convection behind the camera () is important for heat transfer calculations
* Welding glass: adds options for heat transfer calculations
* Plate in front of camera: adds options for heat transfer calculations
* Plate above camera: adds options for heat transfer calculations

Diagram

Description automatically generated

Figure : Diagram of prospective thermocouple locations on camera