SURP Week 5

Continued Parameter Calculation

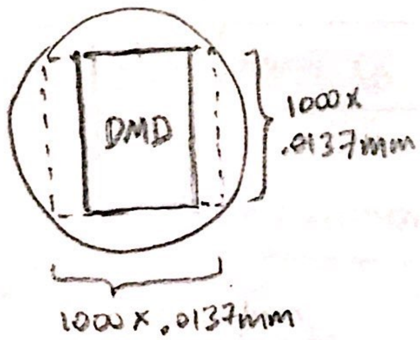
Collimator

Collimator input is direct output from DMD after relay optics, so

$$F/\#_{col} = F/\#_{relay} = \boxed{4.53}$$

$$f_{col} = F/\#_{col} \, D_{col}$$ Need to know lens size

Using DMD size to estimate minimum lens size



$$D_{col} = \sqrt{2(13.7)^2}$$

$$f_{col} = F/\#_{col} \, D_{col}$$

$$= (4.53)\left(\sqrt{2(13.7)^2}\right)$$

$$= \boxed{87.71\,mm}$$

Magnification of Spectograph

The magnification can be found using the ratio between sensor and DMD height

$$M_{spec} = \frac{Y_{sensor}}{Y_{DMD}} = \frac{(.0137)(1000)}{(.006)(2000)} = \boxed{.88}$$

Scanned with CamScanner

Camera

First, using collimator f-number and spectrograph magnification to calculate $F/\#_{cam}$.

$$F/\#_{cam} = M_{spec} F/\#_{col}$$
$$= (.88)(4.53) = \boxed{3.97}$$

Assuming the camera lens is the same size as the collimator

$$f_{cam} = M_{spec} f_{col} = (.88)(87.71)$$
$$= \boxed{76.82 \text{ mm}}$$

Number of pixels for one micro-mirror

This can be found by using the plate scale constants for the DMD and detector

$P_{DMD} = 1.50''$ $\quad P_{sensor} = .75''$

$$\omega'_{DMD} = \frac{AFOV}{P_{DMD}} = \frac{AFOV}{1.50''} \qquad \omega'_{sensor} = \frac{AFOV}{P_{sensor}} = \frac{AFOV}{.75''}$$

$$\Rightarrow \omega'_{sensor} = 2\omega'_{DMD} \Rightarrow \boxed{2 \text{ pixels for 1 micro-mirror}}$$

Micromirrors per slit and pixels per slit

Assuming the telescope focussed light directly to the DMD, we could use

$w = \phi f_{tel}$ where ϕ is the angular slit width width equal to seeing resolution ($\phi = 3''$)

Then, $N_{mirrors} = \frac{w}{(.0137mm)}$

For the number of pixels per slit,

$w' = w\left(\frac{f_{cam}}{f_{col}}\right)$, $N_{pixels} = \frac{w'}{(.006mm)}$

However I am unsure how the relay optics changes the first step.

Diffraction angle and groove density

These are related by

$\frac{1}{N}\sin\theta = \lambda$, however N and θ

so far are both unknown.

My guess is to approximate that

$$\theta \approx \arctan\left(\frac{\omega'}{f_{cam}}\right)$$

then solve for N with

$$N = \frac{\sin\theta}{\lambda}$$ where $\lambda = .55\,\mu m$