Daniel Jong

EECS 101

January 27 2023

EECS 101 Lab 2

C = (S + Na + NP)A

a. Expression for the variance of measurement C is

   Var(C) = Var(S + NA + NP)

   Var(C) = Var(S) + Var(NA) + Var(NP)

   Var(C) = S + 2 + S

   Var(C) = 2S + 2

b. The signal to noise for the measurement C is

   (S + A*(NA + NP)) / (sqrt(Var(C))

   = S / sqrt(S + 2)

c. The minimum value of S where the signal to noise will exceed 50 is

   S / N = S / sqrt(S + 2)

   50 = S / sqrt(S + 2)

   2500 = S^2 / (S + 2)

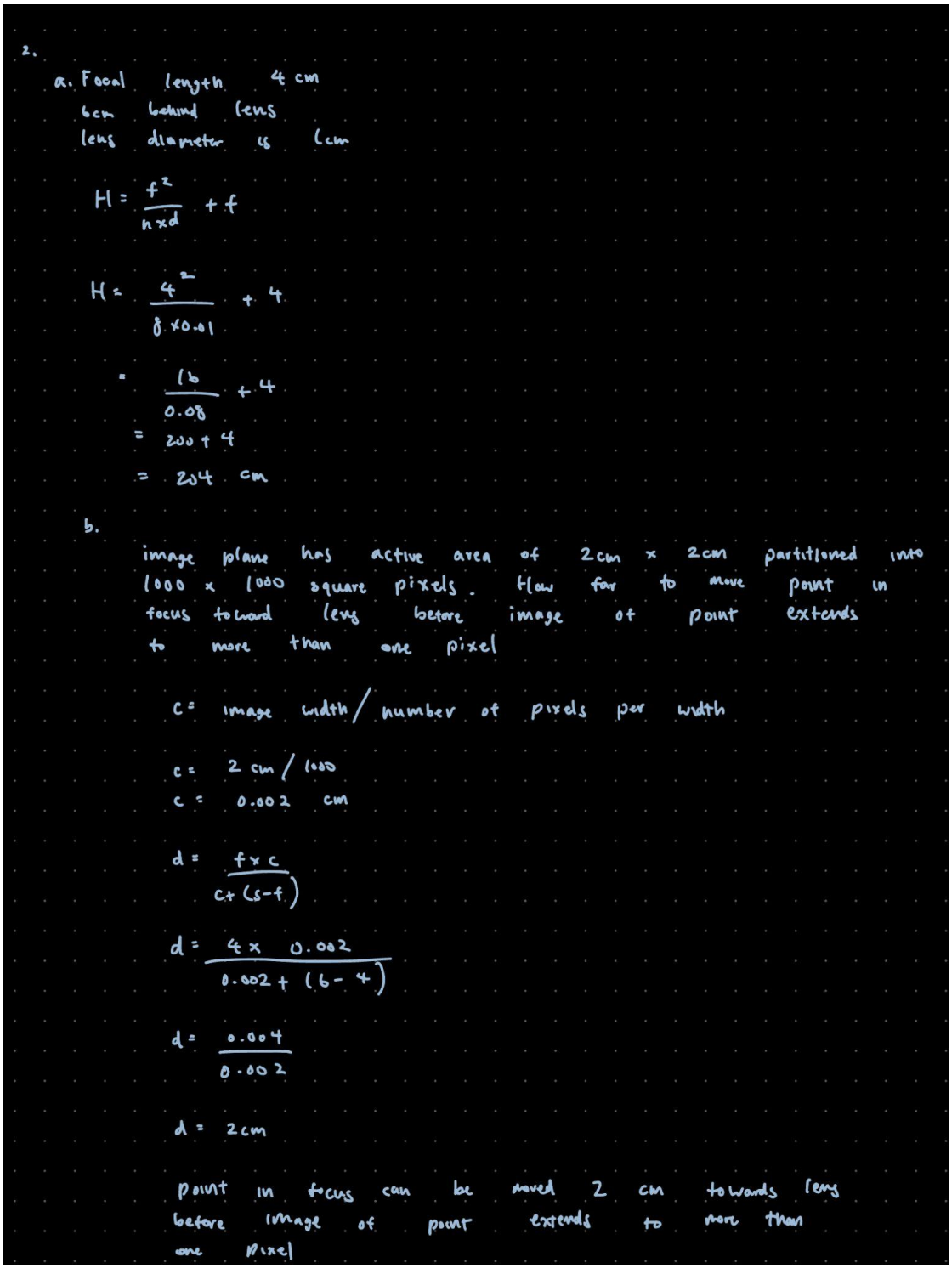
   2500 (S + 2) = S^2

   S^2 - 2500S - 5000 = 0

   (S - 50)(S + 100) = 0

   S = 50

With an imaging system using a lens with the focal length to be 4cm of having an image plane 6cm behind the lens with the lens diameter to be 1 cm, the distance of the lens to get an image without blur



2.

a. Focal length 4 cm
6cm behind lens
lens diameter is 1cm

$$H = \frac{f^2}{n \times d} + f$$

$$H = \frac{4^2}{8 \times 0.01} + 4$$

$$= \frac{16}{0.08} + 4$$

$$= 200 + 4$$

$$= 204 \text{ cm}$$

b.

image plane has active area of 2cm x 2cm partitioned into 1000 x 1000 square pixels. How far to move point in focus toward lens before image of point extends to more than one pixel

c = image width / number of pixels per width

c = 2 cm / 1000

c = 0.002 cm

$$d = \frac{f \times c}{c + (s - f)}$$

$$d = \frac{4 \times 0.002}{0.002 + (6 - 4)}$$

$$d = \frac{0.004}{0.002}$$

d = 2cm

point in focus can be moved 2 cm towards lens before image of point extends to more than one pixel

$\mu = SA$

$D_D^2 = Au + \sigma_c^2$

variance of D

$\sigma_D^2 = Au + o_c^2$

$o_c^2 = A^2 o^2 A + o_a^2$

$E[(D - SA)^2] = E[D^2 - 2SAD + SA^2]$

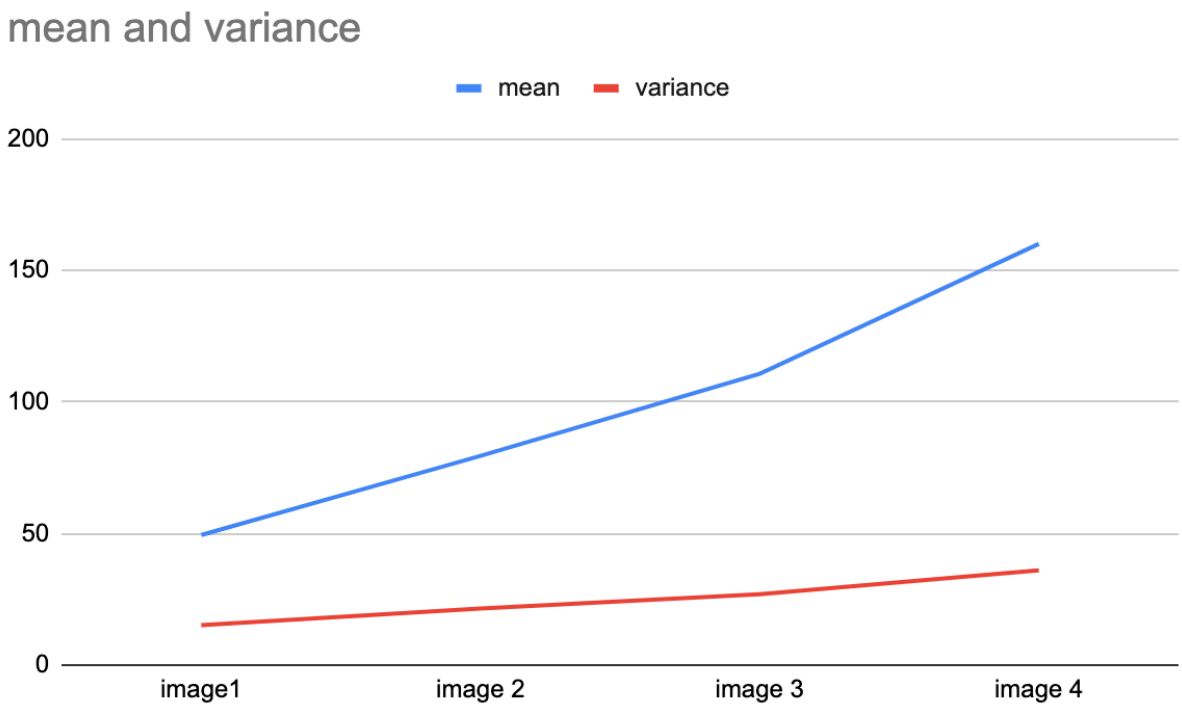
$E[D^2] - 2SAE[D] + SA^2$

$\sigma^2 2D = E[D^2] - (E[D]^2)$

$\sigma^2 2D = A^2 \sigma^2 A + S + \sigma^2 2Q - SA^2$

$\sigma^2 2D = Au + \sigma^2 2C$

$\sigma^2 2C = A^2 \sigma^2 A + o^2 2Q$


mean and variance
mean
variance
200
150
100
50
0
image1
image 2
image 3
image 4