Neurophotonics HW3

Frame rate of the external trigger should be 20Hz, and duty cycle of 30% (15ms ON , 35ms OFF)

Set pixel format to MONO12 , Gain to 24dB.

Focus the camera, find the suitable image size (will be explained in the lab).

Record the following recording:

> **1. Read Noise** (no laser, cover the input, minimum exposure time(0.021ms), same game, blackLevel 20DU, . Can turn off the trigger) – 200 frames
>
> 2. **Dark Background** (no laser, blackLevel =0, exposureTime=15ms, everything else is the same. Can turn off the trigger) – 400 frames
>
> 3. **Recordings** – With the laser and trigger ON, blackLevel =0 , exposureTime=15ms
>
> - A. short – 30sec just to see the pulsations
> - B. long – during breath holding x 4 times , 30 seconds each time

Analysis:

1. Ask User For Recording Path
2. Determine an ROI (plot one frame then ask the user to draw a circle in it)
3. Calculate Read Noise Matrix (read noise in each window)
4. Calculate Pixels-Non-Uniformity (σ_{sp})
    - Average at least 500 frames (rec with laser), subtract background
    - Calc variance in each window (std_filter^2)
5. Calculate G[DU/e]
6. For every frame subtract the background
7. Calc Raw contrast per window

$$K^2_{raw_{per\_window}} = \frac{var(I\_window)}{\langle I_{window}\rangle^2}$$

8. Calc Fixed contrast per window

$$K_f^2 = K_{raw}^2 - K_s^2 - K_r^2 - K_{sp}^2 - K_q^2$$

$$K_s^2 = \frac{g}{\langle I \rangle},\ K_r^2 = \frac{\sigma_r^2}{\langle I \rangle^2},\ K_{sp}^2 = \frac{\sigma_{sp}^2}{\langle I \rangle^2},\ K_q^2 = \frac{1}{12\langle I \rangle^2},$$

K_s^2 – shot noise

K_r^2 – readout noise

K_{sp}^2 – spatial non – uniformity

K_q^2 – quantisation noise

9. Plot K_f^2 over time for the two recordings

10. For the recording with the breath experiment add markup (to the plot) where the breath hold started and ended.