Section 9 - Exercise #3, #9

McLean seminar
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Section 9 – Exercise #3

3 Derive the amplifier gain A_g for a detector with a capacitance of 0.1 pF and a source follower gain of 0.75, if a 16-bit A/D with a 10-volt swing is used and the value of $g = 25$ electrons/DN.

Total gain: $A_g = \dfrac{V_{fs} * C}{2^n * g * e}$

$V_{fs} = 10$ volt

$C = 0.1$ pF

$n = 16$

$g = 25$ electrons/DN

$e = 1.6 \times 10^{-19}$

$A_{sfd} = 0.75$

$$A_g = \frac{10 * (0.1 \times 10^{-12})}{2^{16} \times 25 \times (1.6 \times 10^{-19})} = 3.81$$

Here, the source follower gain is 0.75

Therefore, the amplifier gain for a detector is 3.81/0.75 = 5.08

Section 9 – Exercise #9

9 What additional procedures are required to calibrate a CCD-based polarimeter camera?

1. Dark Frame Calibration
- Take dark frames with the CCD to account for the inherent electronic noise and thermal noise of the camera.

2. Flat Field Calibration
- Capture flat-field images using an evenly illuminated light source (preferably unpolarized) to correct for pixel-to-pixel sensitivity variations, dust particles, and optical imperfections.

3. Instrumental Polarization Correction
- Measure and correct for instrumental polarization, which is polarization induced by the optics of the camera system itself (lenses, filters, and the CCD).

4. Rotation Matrix Calibration
- If the polarimeter uses rotating wave plates or other polarization modulation techniques, determine the rotation matrix or Mueller matrix that characterizes the polarimeter's response.