

Exercises to inf5442_h14_1

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1. Briefly describe the task of each element in a CMOS image sensors signal chain.
2. How is the energy of a photon related to the wavelength, and what determines the wavelength of a photon?
3. What is a micro-lens, and what is it used for in image sensors?
4. What does the term 'conversion gain' (CG) mean?
5. How does conversion gain influence light sensitivity of an image sensor?
6. Suppose a green LED illuminates a $10 \times 10 \mu\text{m}^2$ pixel with $0.5 \mu\text{W}/\text{cm}^2$ and that the requirement of the sensor's responsivity is $50 \text{V}/\text{sec}$. If we assume a QE of 40%, what will CG have to be in order to achieve the responsivity requirement?
7. How many photons per 20msec will hit a $10 \times 10 \mu\text{m}^2$ pixel that is being illuminated with $1 \mu\text{W}/\text{cm}^2$ green light (550nm) from a light-emitting diode?
8. If one doubles the lens f-number, what happens to the light intensity on the sensor?
9. An image sensor at $5 \times 5 \text{mm}^2$ has an opening angle of 45° in the diagonal. What is the focal length?
10. How does RGB color space differ from YUV?
11. Convert $[R,G,B]=[200,187,50]$ into $[Y,U,V]$ space assuming 8-bit resolution.
12. A blackbody at room temperature (300K) radiates max energy at which wavelength?
13. What is the photon flux equivalent to a monochromatic green (550nm) light of 1lux?