INF5350 – Lecture 1

Obligatory exercises

Please submit by email latest 9-Sep-2019 to Tohid (tohidm@ifi.uio.no)

1. Briefly describe the task of each element in a CMOS image sensor signal chain.
2. What is the term used for the spectrums just below and just above the human visible spectrum? Can Silicon detect photons inside these spectral ranges? If so, explain why.
3. What does the term 'conversion gain’ (CG) mean and what is the formula to calculate it? Calculate CG in a pixel with Cfd=1fF. How many electrons does it take to create 1.2V voltage drop on such a capacitor?
4. How does conversion gain influence light sensitivity of an image sensor?
5. Convert [R,G,B]=[200,187,50] into [Y,U,V] space assuming 8-bit resolution.
6. What are the pros and cons of FSI and BSI image sensor technologies?
7. An HDTV CMOS image sensor of 1920x1080 pixels outputs 50frames/sec. What is the row readout time assuming every frame includes 20 dark rows for BLC corrections? What should the row time be to achieve 60Hz video rate (as in USA or Japan)?
8. What are the two main reasons why pixel values after A/D digitization can have an offset (black level pedestal)? Which of these effects vary with exposure time and/or temperature?
9. Briefly explain the purpose and basic principle of pixel defect correction.
10. Briefly explain the purpose and basic principle of color interpolation (aka demosaicing). How does this process affect the sharpness in the image? Can you think of a method to digitally compensate for the change in sharpness (using similar concepts to high-pass filtering in the analog)?
11. Briefly explain the purpose and basic principle of color correction using CCM.
12. What is meant by ‘linear response’ in the field of image sensors?
13. Which tone mapping function maintains linearity of the pixel values?