IMCO 2021 Report

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Report: In Groups of Two People

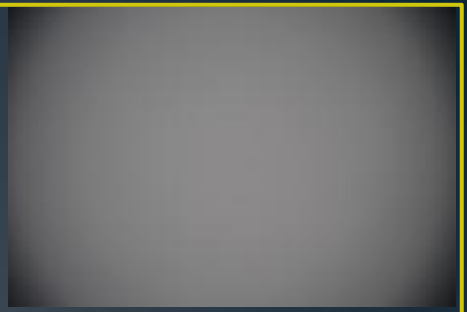
Question	Topic	Points
1	Vignetting Correction	7
2	Spectral Measurements	5
3	Color Correction	5

- Deadline

17/10 Midnight (you can submit after but there's a penalty: 0.5 points for each hour you are late)

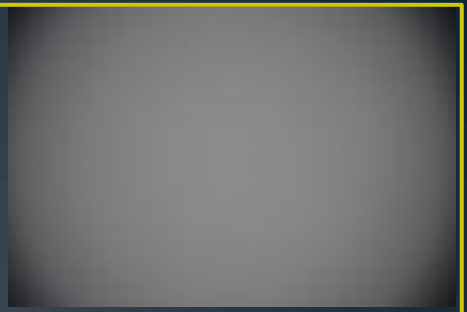
Read good the questions. Be sure you answer what I ask.
Be sure that the code I ask you to send works. I will not spend time trying to fix it if it doesn't run.

1. Vignetting Correction



- We saw during the class that one of the defects that cameras have is Vignetting (also called Lens Shading).
- In this exercise, you need to provide a solution for characterizing and correcting Vignetting in JPEG images.
- You can think of an algorithm on your own; or you can find one in the existing Literature. Either is fine; but consider that your solution should work for hundreds of different cameras! Ideally, your solution won't be computationally expensive.
- You will implement the correction algorithm in Python, and test it on at least 2 different images. I will test your method with my camera.

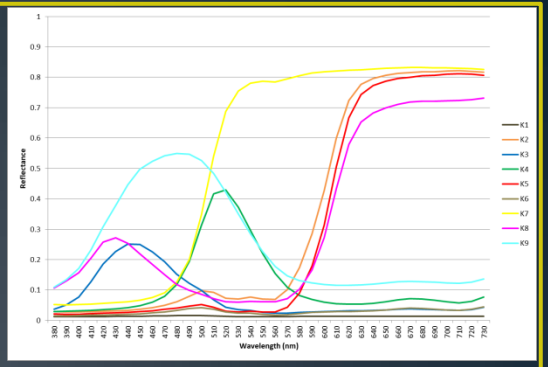
1. Vignetting Correction



- You will send me:
  - An explanation of the method you are using (and the article if you found one).
  - Your implementation code.
  - Your test and result images.
  - Your analysis based on your results and on the method you chose. For example:

    what could go wrong?
    what could be improved?
    how easy/difficult is for your solution to be used?
    (feel free to add any extra information or observation you have)

2. Spectral Measurements



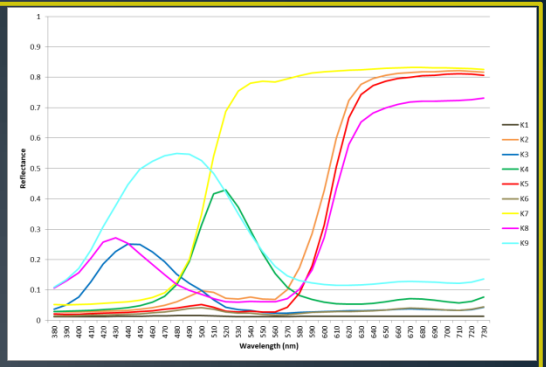
- During the class, we learnt how color is formed based on the illuminant, the observer, and the spectral reflectance of an object.

- In this exercise, you will compute the Lab color "from scratch".

- You will use the Spectral Measurements given in the "04-b_ColorChart" Excel file that we used during the TP01.

- I will give you the following data:
  - The Observer (i.e., Color Matching Functions): CIE1931_CMF.csv
  - The Illuminant (the spectral distribution of incoming light): D65.csv, A.csv

2. Spectral Measurements



- You will then implement the code in Python that allows computing a Lab value from the illuminant, spectral measurements and observer.

  To double check that your results are correct, you can use the 04-c_SpectralCalculator10nm Excel provided in the TP01; or you can use the Colour Science Toolbox in Python we used in the TP02 (small rounding errors are OK).

- How many Lab colors have the "a" channel > 20 when you use the illuminant D65? And how many when you use the illuminant A?

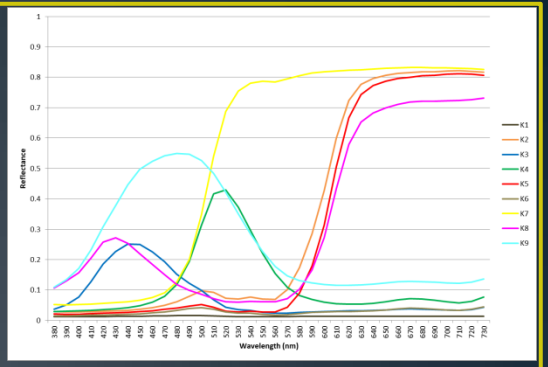
- Convert colors of patches in columns C and K in the "Color Chart" spreadsheet from XYZ to sRGB. Create a TIFF image containing the patches in the following arrangement (each patch is100x100 pixels, and filled with its sRGB color).

C1	C2	C3	C4	C5	C6	C7	C8	C9
K1	K2	K3	K4	K5	K6	K7	K8	K9

Create the TIFF for both Illuminants: D65 and A.

If you think you need to do Chromatic Adaptation between D65 ↔ A, check this site: http://www.brucelindbloom.com/Eqn_ChromAdapt.html

2. Spectral Measurements



- You will send me:
  - The code you used to compute the Lab and sRGB values.
  - A Table with all 99 Lab values for each illuminant.
  - The TIFF files I requested.
  - Your explanation as to why you think the number of patches with “a” > 20 is different between the Illuminant D65 and the Illuminant A.

3. Color Correction

- We implemented several methods that we can use to correct the color in the images so that they match better the measured colors.

- In this exercise, you will apply the methods to a new scenario; and you will analyze the results.

- I will send you two JPEG images:
  - DSC00234: the JPEG image created by the camera using AWB.
  - DSC00234_Standard_DeepPrime_DCP: the JPEG image exported from DxO PhotoLab, using the Standard Preset, DeepPrime denoising and the DCP profile obtained by calibrating the camera.

- Your first task will be to implement the Root Polynomial correction method (refer to the Python Notebook from the TP02).

3. Color Correction

- Next, you will obtain three corrected versions of the DSC00234 image: Linear, Poly2nd and Root2nd. Based on the Delta-E2000 values and the Histogram of the Delta-E2000 values of each method, you will choose the one you think is the best. Let's call it DSC00234_Correction_Best.

- Next, you will use the code again to extract the Color Checker in the DSC00234 and DSC00234_Standard_DeepPrime_DCP images; and you will compute the average Delta-E2000 and the histogram of the 24 Delta-E2000 values between:
  (1) The Reference and the DSC00234; and
  (2) The Reference and the DSC00234_Standard_DeepPrime_DCP

  Note that in this case you do not need to correct these images!

3. Color Correction

- You will send me:
  - Your implementation for the Root Polynomial color correction method.
  - The three DSC00234 corrected images; and their corresponding average delta-E 2000 and delta-E histograms.
  - Your justification regarding which one of those three corrected images is the best.
  - The average delta-E2000 and the delta-E2000 histogram between the reference Color Checker; and the Color Checker in the images DSC00234 and DSC00234_Standard_DeepPrime_DCP.
  - You analysis comparing the delta-E results between DSC00234, DSC00234_Standard_DeepPrime_DCP and DSC00234_Correction_Best:
    - Which one gives more accurate results? Do the results make sense?
    - Is there something you don't understand or can't explain?
    - Are the colors with high delta-E (or low delta-E) always the same?
    - Feel free to add any other observation/remark you may have.

For Your Information

- We will have internships at DxO soon!
  Our subjects are related to Image Processing and/or Deep Learning; but sometimes we have “C++ coding” subjects too.

- Check regularly the offers here:

https://www.welcometothejungle.com/fr/companies/dxo

Or here:

https://www.linkedin.com/company/dxo-labs/

- I will probably send an e-mail to the mailing list when the subjects have been decided; but feel free to let me know if what we do in DxO is of your interest anytime.