ExerciseSheet03

General Info

Intro

This assignment is about pixel space operations in MATLAB.

Submission

Please submit one zipped file named `ID_ES03.zip` where `ID` stands for your id (e.g. `se14m666_ES03.zip`) containing:

- An m-file called `ES03.m` which contains a (well documented) cell for each problem on this sheet or individual m-files named after the problems.
- All additional functions and/or files (such as images)

Any comments/explanations should be included in the m-files as comments.

Assignments

ITF

Implement MATLAB functions that create popular ITFs and a function to apply an ITF to an image:

- `window(center, width)`
- `gamma(rho, center, width) %the latter two arguments are optional`
- `sigmoid(center, width)`
- `applyITF(image, itf)`

Contrast Enhancement

Out of your personal image collection, find an image with poor contrast or very dark **and** very bright areas and enhance it by applying a suitable ITF (do not just call Matlab's automagic function(s)). See Figures 1 and 2 for illustration. Create a figure that displays

- original image
- enhanced image
- histogram of original image
- histogram of enhanced image
- applied ITF

Explore:

- What is the effect of histogram equalization on the channels of color images (try several color models)?

Figure 1: Room, original grayscale

Figure 2: Room, contrast enhanced with a *global* ITF

Figure 3: Room, posterized with 3 levels

Posterize

Implement a posterize-filter that reduces the number of grey levels in an image and thereby creates a poster-like (or Warhol-like) effect (See Figure 3). Have your filter accept the number of levels (and the percentage of pixels for each level) as an additional argument:

```
posterized = posterize(IM) % three levels by default
posterized = posterize(IM, 5) %  number of levels as additional arguments
posterized = posterize(IM, [0.3 0.2 0.1 0.2 ]' )
    % percentages for the levels: 30%, 20%, 10%, 20%.  completed to add up to 100%
```

Create a figure that displays

- original image
- posterized image
- histogram of original image
- histogram of posterized image
- applied ITF

Explore:

- Apply this approach to color images (See Fig 4 for inspiration).

[1] http://www.widewalls.ch/10-faces-by-andy-warhol-february-2015/

Figure 4: Warhol effect(s) on Marilyn Monore[1]

ITF effects

Reverse-engineer an effect (like cross-processing or similar) of your favourite image processing tool (gimp, picasa, instagram,etc.).

Select an effect and apply it to some original image (of your choice), thereby producing an effect-image. Then try to reverse-engineer the applied effect by approximating it with global ITFs. Apply your approximated ITF to the original image (thereby producing an approximated effect image) and see if (or how well) you can reproduce the effect. (See Figures 5, 6, 7, 8 for inspiration).

Create a figure that displays

- original image
- effect-image
- histogram of original image
- histogram of effect-image
- approximated ITF
- approximated effect image
- histogram of approximated effect image

Hints, Ideas:

- compare color/grey values of the images before and after transformation
- again, grey value images are easier, however a lot less fun. Just treat the channels of a color image (in a suitable color model) individually
- you might want to add a vignetting effect

Figure 5: Storm, with some example (retro) effect applied

Figure 6: Storm, with some other example (retro) effect applied

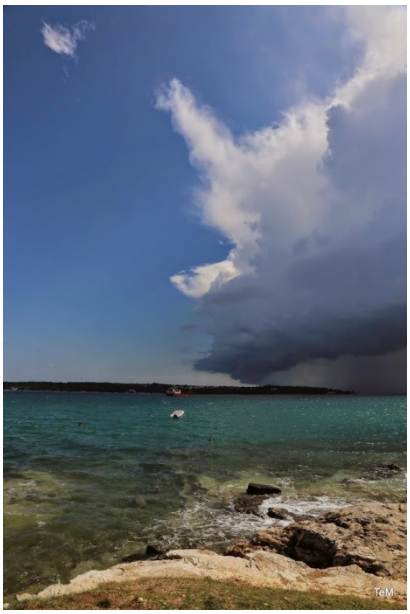

Figure 7: Storm, with yet another example (retro) effect applied

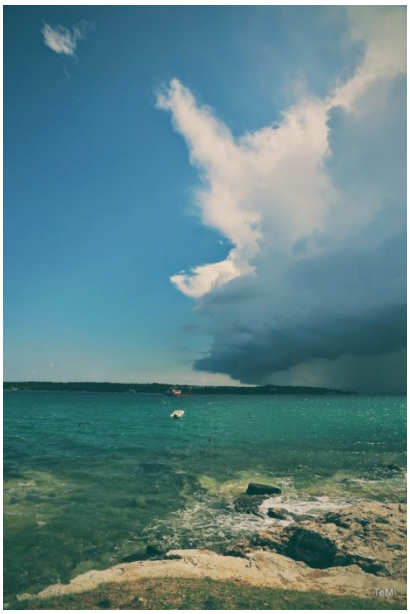

Figure 8: Storm, with still yet another example (retro) effect applied

Figure 9: Children Halloween drawing. Original image taken under (poor) indoor lightning conditions.

White Balance

Implement manual white balance.

A white object might not be recorded as white depending on lightning conditions (although it still might be perceived as white). This can be corrected by a simple white balance adjustment (See Fig. 9 and 10 for the effect). Your solution should read an image, display it and let the user select a white pixel (or better yet a white area). Based on the selected white point you apply below white balance correction. Create a figure that displays

- original image
- enhanced image
- histogram of original image
- histogram of enhanced image

Calculation

Assuming 8-bit RGB images, the values of the enhanced image (R, G, B) are calculated from the (primed) values of the original image (R', G', B'). The values of a selected white point (or area) in the image are (R_w, G_W, B_w). The calculation is then given as:

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 255/R_w & 0 & 0 \\ 0 & 255/G_w & 0 \\ 0 & 0 & 255/B_w \end{bmatrix} \begin{bmatrix} R' \\ G' \\ B' \end{bmatrix}$$

Figure 10: Children Halloween drawing. White balance corrected.