DIP Homework #3

Due Date: **June 15 (Saturday), 18:00**

There are three problems for this assignment:

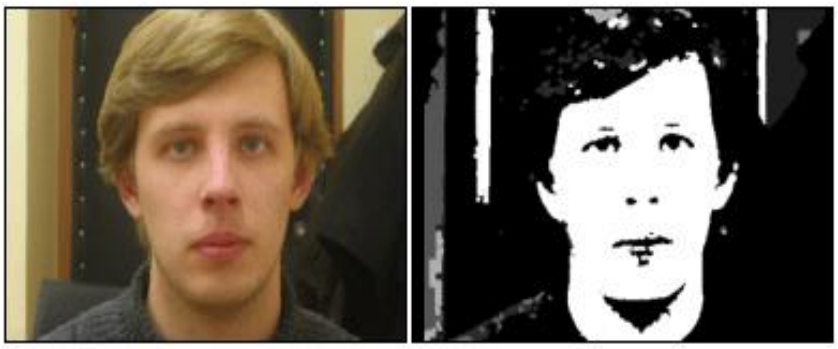
Problem 1: Skin Detection (required for every student)

- Use the HSV color space for skin color detection.
- Employ the following thresholds in your initial attempt:

$$6^\circ \le H \le 38^\circ$$
$$0.23 \le S \le 0.68$$

  Note that if H is normalized to lie in [0, 1], then you should use $\frac{6}{360} \le H \le \frac{38}{360}$ instead. Also note that these parameter range settings are only initial rough estimate; and therefore, if the result is not satisfactory, try to modify the thresholds gradually by yourself.

- test images: **skin_det_1.bmp**, **skin_det_2.bmp**.
- Examples:



Problem 2: Image Processing in the Frequency-Domain

You have the options to choose one (**just one is needed**) out of the following problems:

(1) **Butterworth Lowpass Filtering and Highpass Filtering**

- test images: **cameraman.bmp, lena.bmp**
- You should try various combinations of cutoff frequency D_0 and filter order n, and compare their results.
- Examples:

lowpass-filtered

highpass-filtered

(2) **Gaussian Lowpass Filtering and Highpass Filtering**

- test images: **cameraman.bmp, lena.bmp**
- Examine the effect of σ, which controls the shape of the Gaussian frequency weighting function.

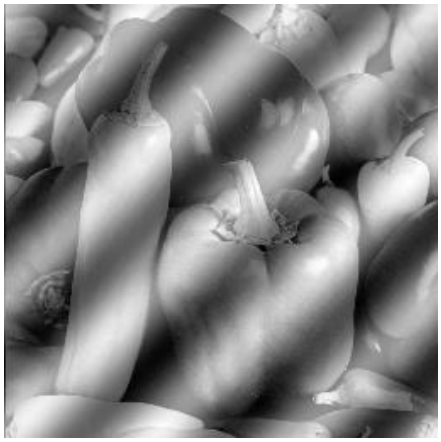
(3) **Restoration of a Motion-Blurred Image**

- test images: **CarPlate2_blur2.bmp**
- Although it's possible to obtain the parameter ***a*** by examining the nulls of the 2-D spectrum of the blurred image, for simplicity, you can try these possible values for ***a***: 0.1, 0.12, 0.14, 0.16, 0.18, and 0.2.
- Examples:

motion-blurred images

(4) **Removal of Periodic Noise**

- test image: **periodic_noise2.bmp**
- First observe the periodic noise in the given image. Try to identify the noise frequencies from the 2-D magnitude spectrum of the given image. Then apply a frequency-domain notch filter to remove the periodic noise component.
- Examples:



the test image with a periodic noise

original

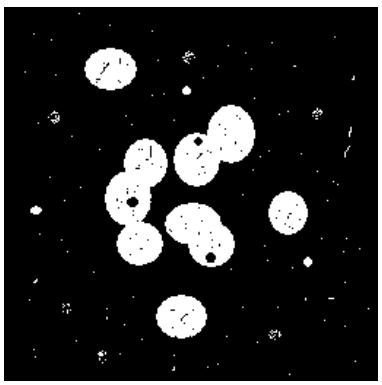
Problem 3: Morphological Processing

Same as Problem 2 above, you have the options to choose one (**just one is needed**) from the following problems:

(1) **Noise Removal in Binary Images**

Apply morphological erosion and dilation operations a number of times to remove the noises in the given binary image while retaining the shapes and sizes of the original objects in it. Note: Do NOT use median filtering in this problem.

- test images: **noise_remov_morph.bmp**
- You need to write erosion function and dilation function first.
- Examples:



a noisy binary image

(2) **Moving Object Detection**

The following figures show snapshots from certain visual surveillance systems (視訊監控系統). Please apply morphological processing (e.g., erosion, dilation, opening, closing, etc.) to enhance the silhouettes (剪影) of the people in the images and reduce noises and holes as possible as you can.

- test images: **morph-problem1.bmp**, **morph-problem2.bmp**
- Examples:




Note: For all the assigned problems, in addition to those given test images, you are welcome to use other test images as well.