Video Signals

Date: 17/01/2018

Ex.1.[10pts.]Given the black (value 1) and white (value 0) image on the right, we want to apply the region filling morphological operator with the following structuring element:
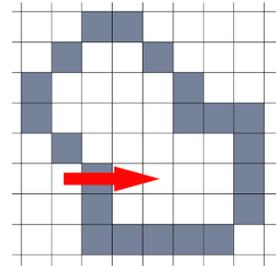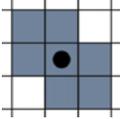
The starting point will be the one indicated by the arrow.
Define the morphological filling operator and, for every iteration specify the pixels filled.
Is there any outflow issue? If yes, specify the critical pixel/s and propose a solution.

Es.2. [10 pts.]A 3x4 grey scale image presents the following grey values:
Using the Laplacian operator find the edges:
Assume a zero padding outside of the image apply a laplacian filter and, on the resulting matrix draw on the image a possible position for the edges. [7 pts.]
Describe how the Laplacian algorithm can be used in order to get a sub-pixel resolution for the edges.

2	4	1	3
0	3	1	4
2	4	1	5

Es.3. [Matlab Code - 10 pts.]

A lazy TV journalist has to broadcast a news report from a city very far from his studio. He decides to use a chromakey effect instead of traveling to the other side of the world. In other words, in order to trick the audience, he records himself in front of a green screen and then replace the green background with a still image of the skyline of the city in which he is supposed to be. Unfortunately, for him, some details of the TV logo printed on his microphone have exactly the same colour as the green background. Given a frame of the acquired video (*frame.png*, RGB image) and the fake background image (*skyline.jpg*, RGB image), write a MATLAB implementation of the chroma key effect taking in consideration the problem introduced by the green logo:

Matlab List of possible functions

```
figure
imread
imcrop
imfilter
imopen
imclose
imshow
```

a) Read, load and visualize the two images;
b) Assuming a pure green background in the frame image, using a margin of ±20 on each colour channel (8bit unsigned integer), select the frame pixels that are not background.
c) Assuming that the skyline image has a greater size then the frame one, crop it in order to obtain an image with the same size as the frame one (start from the up-left corner).
d) Using a square structuring element with width 3 and a morphological operation of your choice, remove the contribution of the logo from the mask obtained in b).
e) Using the binary image obtained in point d), merge the frame image and the cropped skyline image, obtained in point c), in order to obtain the wanted result.

Solutions

Ex.1

This is the filling sequence and the red pixels represent the outflow points.

|							
		🟥					
	🟥		4	4			
	3	3	3	3			
	3	2	2	2			
		2	1	1	2	3	
			1	1	1	2	
			2	1	1	2	
						🟥	
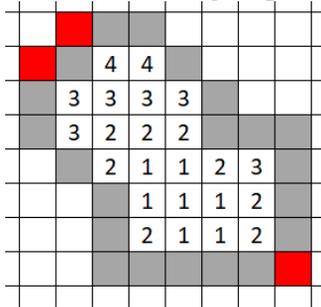
In order to prevent outflow we can impose that the boundary is a 4-connected boundary.

Ex.2

Assuming the zero padding outside the image, using a laplacian filter like:

0	1	0
1	-4	1
0	1	0

We will get the following result.

-4	-10	4	-7
7	-3	5	-7
-4	-10	6	-15
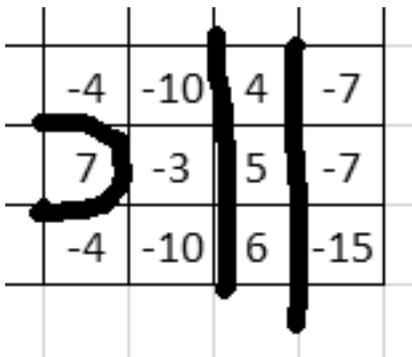
The black lines represent an estimation of the edges as zeros of the laplacian transform.

Ex.3

```
close all
clear all
clc

%a)
A = imread('frame.png');
figure;imshow(A)
bg = imread('skyline.jpg');
figure;imshow(bg)

%b)
margin = 20;
bg_color = [0 255 0];
mask = A(:,:,1)>(bg_color(1)-margin) & A(:,:,1)<(bg_color(1)+margin);
mask = mask & (A(:,:,2)>(bg_color(2)-margin)&A(:,:,2)<(bg_color(2)+margin));
mask = mask & (A(:,:,3)>(bg_color(3)-margin)&A(:,:,3)<(bg_color(3)+margin));
```

```matlab
%c)
bg = imcrop(bg,[00 size(A,2) size(A,1)]);

%d)
b = strel('square', 3);
mask_closed = imclose(~mask, b);

%e)
B = A.*uint8(mask_closed) + bg.*uint8(~mask_closed);
figure()
imshow(B)
```