

ECE4522 Practicum 1: Image Deconvolution

Receive 5 additional points by submitting before 10/3/19 11:59 pm

Penalty will be imposed after 10/10/19 11:59 pm (1 point each hour; 5 points each day)

In this practicum you will process a black and white image. The original image file is saved as `pic.mat` in the Canvas under the Practicum 1 module.

(a) Load `pic.mat` into Matlab. In Matlab, what is its size? Display the image using the command `imshow(.)`.

(b) To reduce the numerical range of the image amplitudes prior to image compression, the image $xx[i, n]$ is differentially encoded along the horizontal to create $zz[i, n]$ using the following equation for each row

$$zz[i, n] = xx[i, n] - 0.9 xx[i, n - 1]; \quad i = 1, 2, \dots, 311; \quad n = 1, 2, \dots, 639, \quad (1)$$

with $xx[i, 0] = 0.0$ for $i = 1, 2, \dots, 311$. Describe the impulse response of the differential encoding operation.

(c) How did you invert the effect of that channel and restore the original image? The following filter is to be used on each row of zz to decode this image:

$$yy[i, n] = \sum_{k=0}^{N-1} 0.9^k zz[i, n - k]$$

where $N = 25$. Describe the impulse response $h[n]$ corresponding to this filter, and explain why this would work (in some degree).

(d) Use the Matlab `conv` command to implement this decoding filter. Display the decoded image yy . Compare its quality to that of the encoded zz image and the original image xx .

(e) Try several other values of N and compare results with those obtained in (d). Comment for some smaller value of N (e.g., 10) and some larger value of N (e.g., 50).

(f) The decoder used in Procedures (c)-(e) is computationally expensive, and it does not perfectly decode the differential code. Can you think of a cheaper, perhaps better decoder? Implement it and report the result if you can, and explain why it works better.

Submit by e-mail to ece4522.temple@gmail.com

(a) A single Word or pdf file containing materials in the following order:

- Your name, Section, TUID
- All the required images, equations, and observations
- Key references (website, book, paper, or student name) if any (particularly if you reused a substantial portion of the Matlab codes)
- Matlab codes

(b) All Matlab codes in `.m` format

Important: The Matlab code has to be included in the Word or pdf file report, AND as a separate attachment.

A student may seek help, but the report must be his/her work and thus he/she must understand every word and every line of Matlab code reported.

Appendix

The following Matlab code implements some functions specified in Steps 1 and 2.

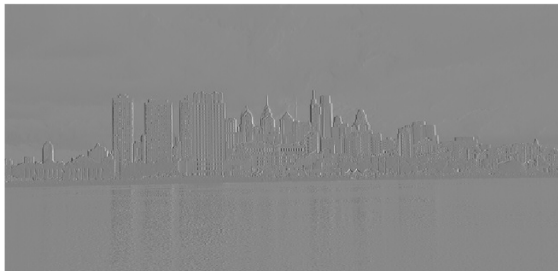
```
% ===== Matlab code sample for Practicum 1 =====  
% Simulation: Image Deconvolution  
  
clear  
close all  
  
%% (a)  
  
load('pic.mat');  
[height,width]=size(xx);  
  
whos  
  
figure(1)  
imshow(xx, [0 255])  
  
%% (b)  
  
for i=1:height  
    zz(i,:)=conv([1 -0.9], xx(i,:));  
end  
  
zz=zz(:,1:width);  
  
figure(2)  
imshow(zz, [-255 255])
```

Figures

Figure (a) shows the original image. Figure (b) shows the output of Step b. Figure (c) shows the expected image of Step d, and Figure (d) shows an example of the output image in Step f.



(a)



(b)



(c)



(d)