ECSE 4530 Image Processing

<u>HW 8</u>

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```
%% ===================================8.1====================================
```

myjpeg Function

```
function myjpeg (im, tau)
im = double(im);
im = im - 128;
fun = @(block_struct)...
    mydct(block_struct.data,tau);
imb = blockproc(im,[8 8],fun);
imout = imb + 128;
imout = max(min(imout,255),0);
figure;
imshow(imout,[0 255]);
end

function out = mydct (block, tau)
    dct = dct2(block);
    dct(abs(dct) < tau) = 0;
    out = idct2(dct);
end
```

Main Function

```
guardian = imread('guardian.png');
myjpeg(guardian,10);
myjpeg(guardian,25);
myjpeg(guardian,75);
```

Matlab Result

Tau = 10 (106 KB)

The result is shown above for tau = 10, only a little detail was lost compare with the original guardian picture. The halo around the character were blurred but most other details were retained.

Tau = 25 (74 KB)

The result is shown above for tau = 25, we can start to see little blocks within the picture. The monster's legs appeared to be blurrier than the original picture since the legs contains high frequency.

Tau = 75 (57 KB)

The result is shown above for tau = 75, blocks are highly visible, most details from the monster's legs, halo around the character and even the mini map are lost in the image. General shape became blocky and blurrier.

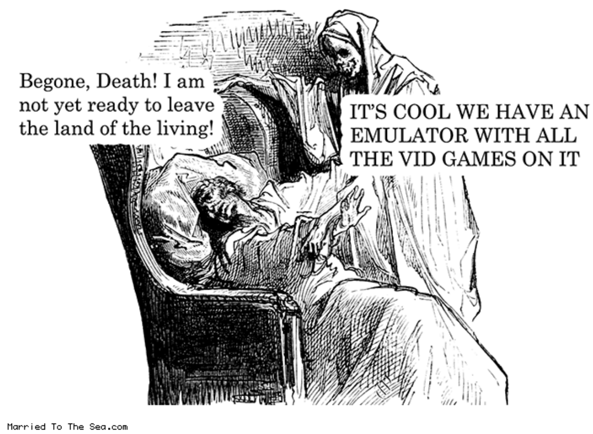
Overall, as the Tau increase, the size of the image decrease, the size of the image dropped from 106 KB to 57 KB when Tau increased from 10 to 75. We can see perceptible differences when Tau reached 30ish.

```
%% ==================================8.2==================================
```

Main Function

```
%% 2a
PSF = fspecial('motion',21,11);
death = imread('death.png');
death1 = imfilter(death,PSF,255);
imshow(death1);
```

Matlab Result



Original Death

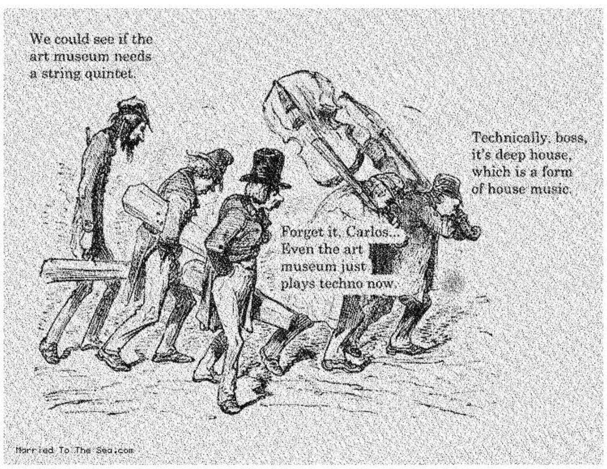
PSF filtered Death

The original and the PSF filtered Death picture are shown above. Clearly the picture has become blurrier, neither of the text nor the ghost can be recognized within the new picture. Nothing is readable compare to the original

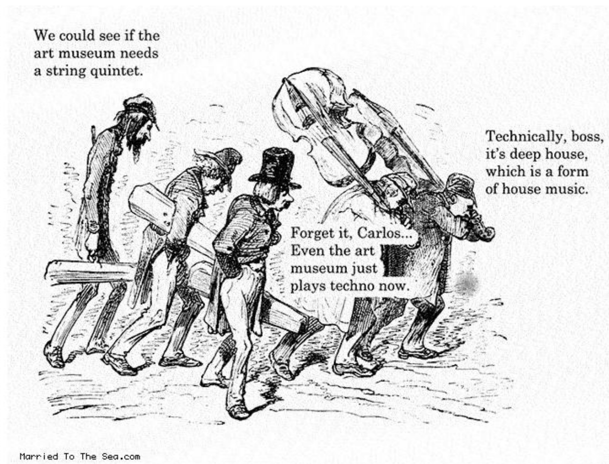
Main Function

```
%% 2b
museum = imread('museum-blur.png');
museum1 = deconvwnr(museum,PSF);
imshow(museum1);
%% 2b
museum = imread('museum-blur.png');
museum1 = deconvwnr(museum,PSF,0.00001);
imshow(museum1);
```

Matlab Result



Remove PSF



Remove RSF with nts 0.00001

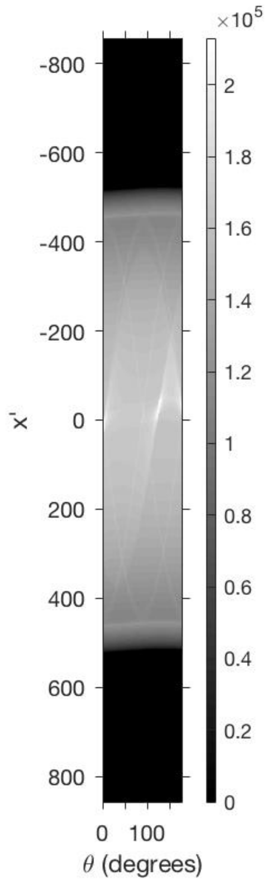
The ideally removed PSF with nts (Noise to Signal) ratio = 0 is shown in the above left, which significantly increased the clarity of the picture. The only downside would be the grainy noise background caused by the deconvwnr. Then we applied the same procedure but with a 0.00001 noise to signal ratio. Now neither the noise nor the blurriest exist anymore compare to the ideal inverse filtered image.

```
%% ===================================8.3====================================
```

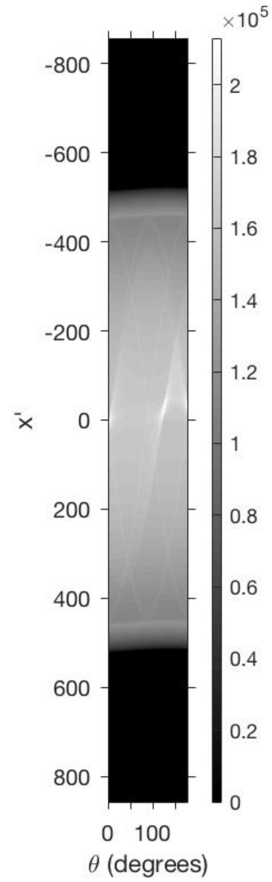
Main Function

```
%% 3a
iptsetpref('ImshowAxesVisible','on')
clock2 = double(imread('clock2.png'));
theta = 0:2:179;
[R,xp] = radon(clock2,theta);
imshow(R,[ ],'Xdata',theta,'Ydata',xp,'InitialMagnification','fit')
xlabel('\theta (degrees)')
ylabel('x''')
colormap('gray'), colorbar
iptsetpref('ImshowAxesVisible','off')
```

Matlab Result



delta theta = 2-degree



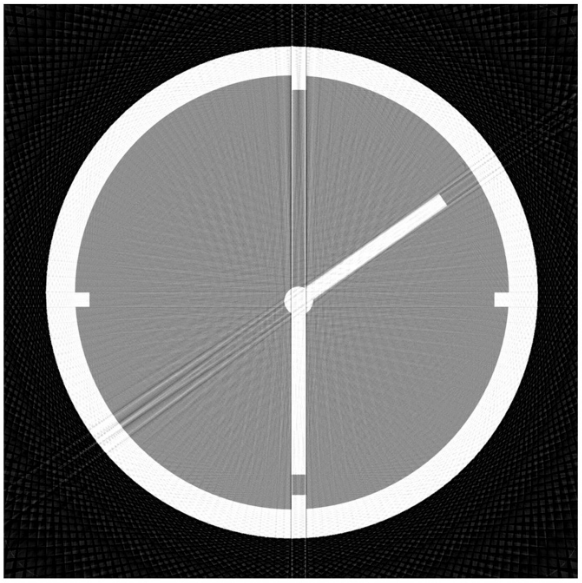
delta theta = 1-degree

Resulting image using Radon transform are shown above with two different delta thetas. First, the diagonal length of the image corresponds to the height of the transform. The bright spots appeared at when theta equals to 90 degree and 135 degree. These are the angles where the short and long hands on the clock were. The image is black on top and on bottom due to the original clock's black background. The transformed none zero region is rectangular since the clock image is confined to a circle and a circle is equidistant in width from any angle.

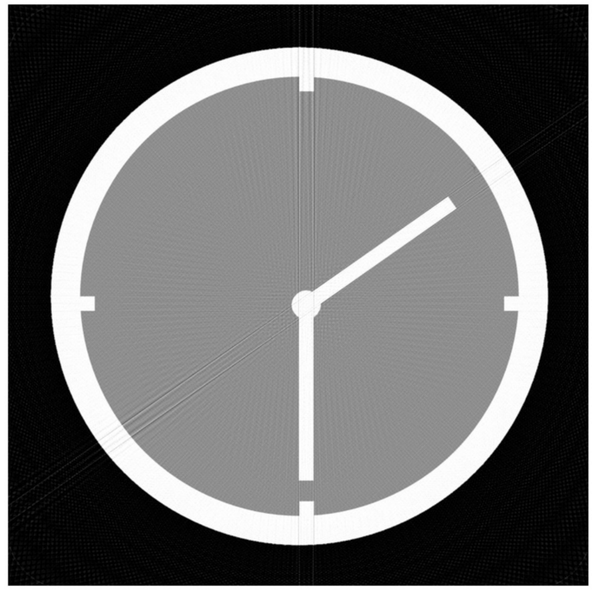
Main Function

```
%% 3b
I1 = uint8(iradon(R,0:179));
imshow(I1,[]);
```

Matlab Result



delta theta = 2-degree



delta theta = 1-degree

The reconstructed images with two different delta theta are shown above. Though both images are recognizable, for delta theta = 2 degrees, we can see the wave pattern. It seems like every other angle there's an empty signal. This makes sense due to the granularity of the theta vector. For delta theta = 1 degree, the reconstructed result improved significantly, the wave pattern mostly disappeared, and the contrast became a lot better.

```
%% ===================================8.4=====================================
```

Main Function

```
%% 4a
guys = double(imread('guys.png'));
imshow(guys>128);
```

Matlab Result

Threshold at 128

First, we've threshold the image at value of 128, this created a binary image with white at anywhere greater than 128 and black at anywhere less than 128. This resulted in a plain picture with no detailed background, tress and the clothing have been ignored.

Main Function

```
%% 4b
noise = (rand(size(guys))-0.5)*100;
imshow((guys+noise)>128);
```

Matlab Result

Random noise then threshold at 128

Next, we applied a uniform dithering by adding random noise in the range of [-50, 50] before thresholding. Some details are added from the tree and the clothing and became distinguishable. However, this also caused the picture being displeasing, especially around the faces due to the random variable noise.

Main Function

```
%% 4c
bmask = [1 9 3 11; 13 5 15 7; 4 12 2 10; 16 8 14 6]*16;
[m,n] = size(guys);
m1 = floor(m/4);
n1 = floor(n)/4;
hmask = repmat(bmask,[m1,n1]);
guys1 = guys(1:(m1*4),1:(n1*4));
guys2 = double(guys1) + hmask;
imshow(guys2>256);
```

Matlab Result

Bayer Mask Halftone

Third, a halftone image made from tiling Bayer mask was applied, this procedure retained lots of details, we can clearly see the tress and the clothing in the background, even to their facial expressions, the only downside would be the blocky shape throughout the picture.

Main Function

```
%% 4d
imshow(dither(uint8(guys)));
```

Matlab Result

Matlab dither

Finally, use Matlab's default Floyd-Steinberg dithering, we can see none of the problems from the previous three problems occurred. All details were retained from this operation.