

Assignment 3

CS 455/555

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Purpose:

To understand and implement different ways to enhance an image given the following concepts:

- RGB to HSI
- Discrete Cosine Transformations (DCT)
 - 8 point
 - 8 point inverse
- Region of Interest
 - Sobel

To Run:

On command line type: make (This will make the executable file assign3)

Next type: ./assign3 (All the images presented in this file will then be displayed)

To Remove Executable File:

On command line type: make clean

Notes:

Methods to obtaining Images

Method for Calculating XGradient and YGradient:

Create mask 3x3 that consists of:

$$\begin{matrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{matrix}$$

Apply matrix to the given image by multiplying according coordinates and summing all

Method for Sobel Operator:

Create a new Image, and initialize all pixels to 0

For each pixel of original image, calculate the horizontal and vertical gradient.

Add these two gradients together to find the total gradient

If total gradient > 255, then total gradient = 255

If total gradient < 0, then total gradient = 0

Replace each pixel in new image with the total gradient

Method for RGB to HSI:

Used following formulas:

$$\text{Hue: } \cos^{-1} \left\{ \frac{\frac{1}{2}[(R-G)+(R-B)]}{[(R-G)^2+(R-B)(G-B)]^{1/2}} \right\}$$

$$\text{Saturation: } 1 - [\min(R, G, B) / I]$$

$$\text{Intensity (I): } (1/3)(R+G+B)$$

Method for DCT:

Used formula:

$$F(u,v) = a(u)a(v) \sum_{x=0}^{N-1} \sum_{y=0}^{N-1} f(x,y) \cos\left[\frac{(2x+1)u\pi}{2N}\right] \cos\left[\frac{(2y+1)v\pi}{2N}\right]$$

For both $a(u)$ and $a(v)$

$$a(u) = \begin{cases} \sqrt{\frac{1}{N}} & \text{for } u = 0 \\ \sqrt{\frac{2}{N}} & \text{for other} \end{cases}$$

Method for IDCT:

Used formula:

$$f(x, y) = \sum_{u=0}^{N-1} \sum_{v=0}^{N-1} a(u)a(v)F(u, v)\cos\left[\frac{(2x+1)u\pi}{2N}\right]\cos\left[\frac{(2y+1)v\pi}{2N}\right]$$

For both $a(u)$ and $a(v)$:

$$a(u) = \begin{cases} \sqrt{\frac{1}{N}} & \text{for } u = 0 \\ \sqrt{\frac{2}{N}} & \text{for other } u \end{cases}$$

Methods for DCT_DC:

In DCT image, keep first element of each 8x8 matrix, and change rest to 0

Methods for DCT_9:

In DCT image, keep upper left 9 elements of each 8x8 matrix, and change rest to 0

Methods for ROI:

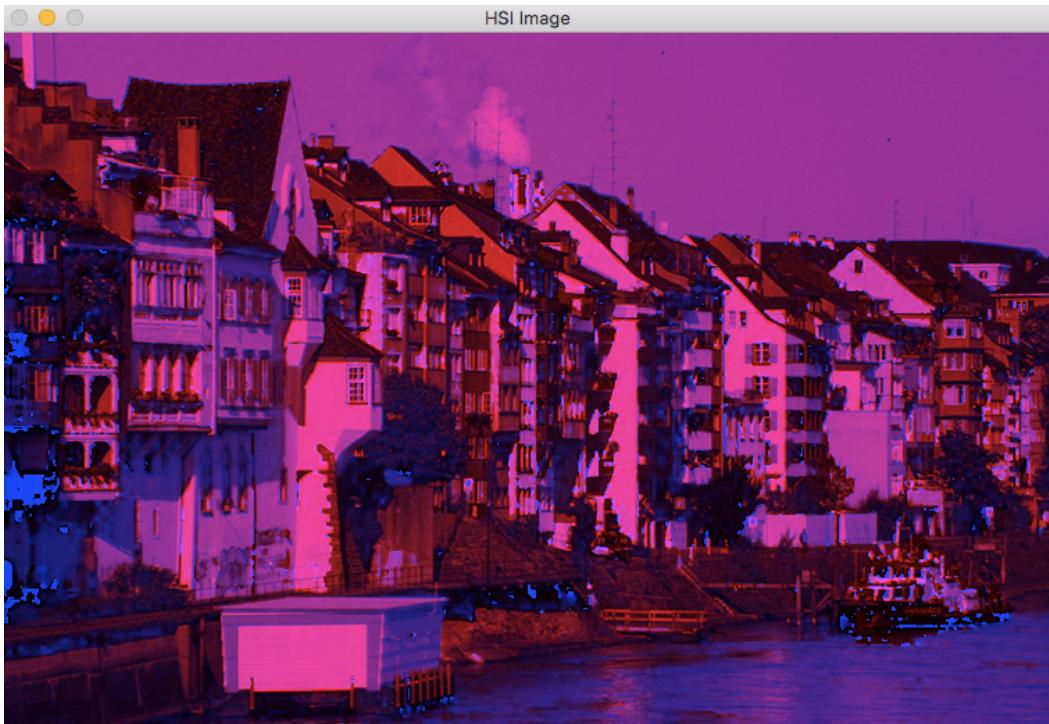
Sobel operator on RGB Image

Results:

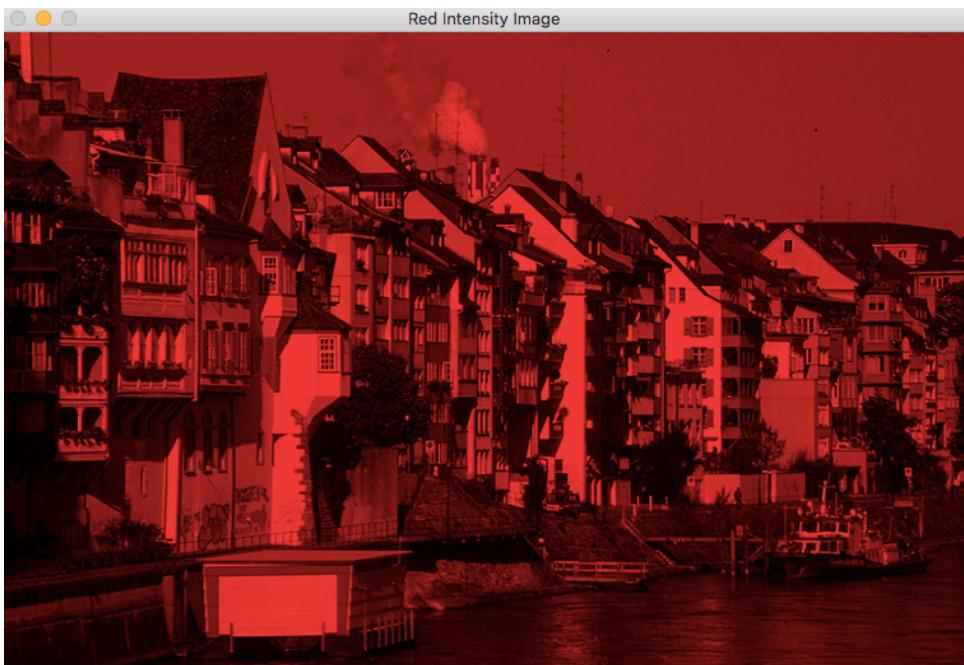
Original Image:



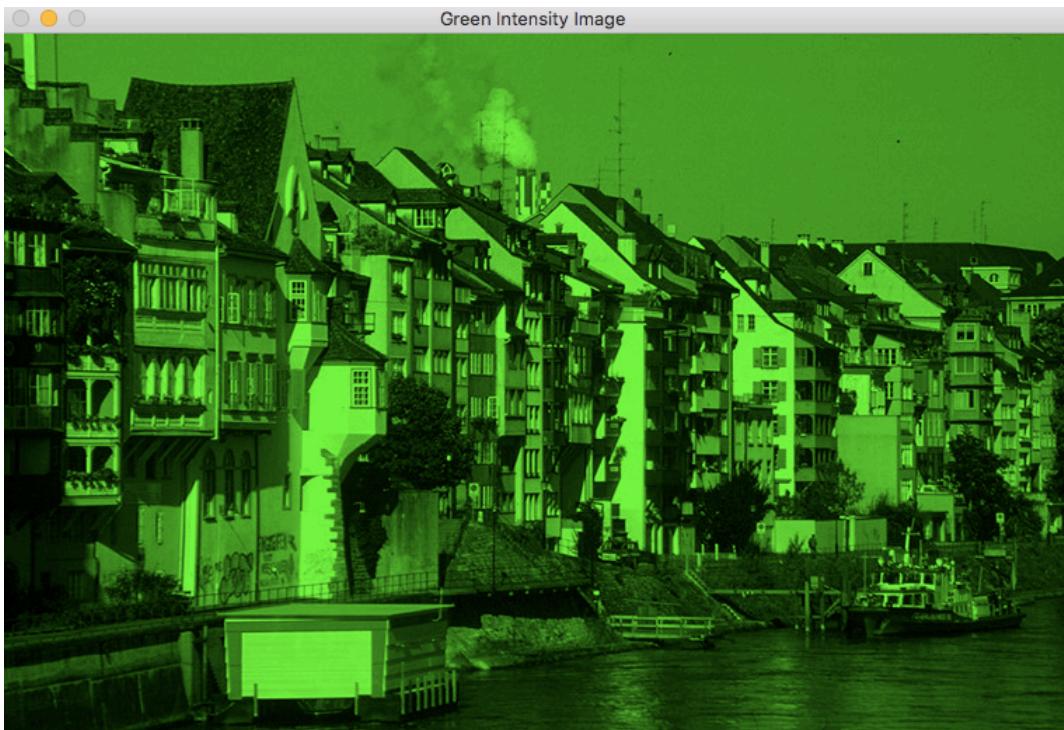
HSI Image:



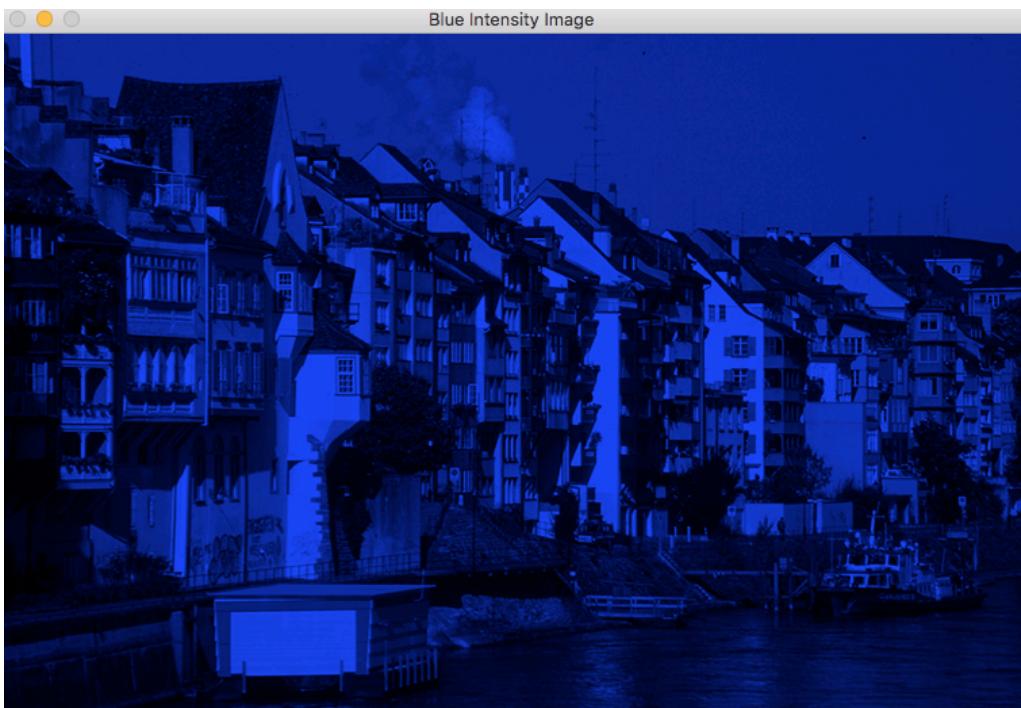
Red Intensity:



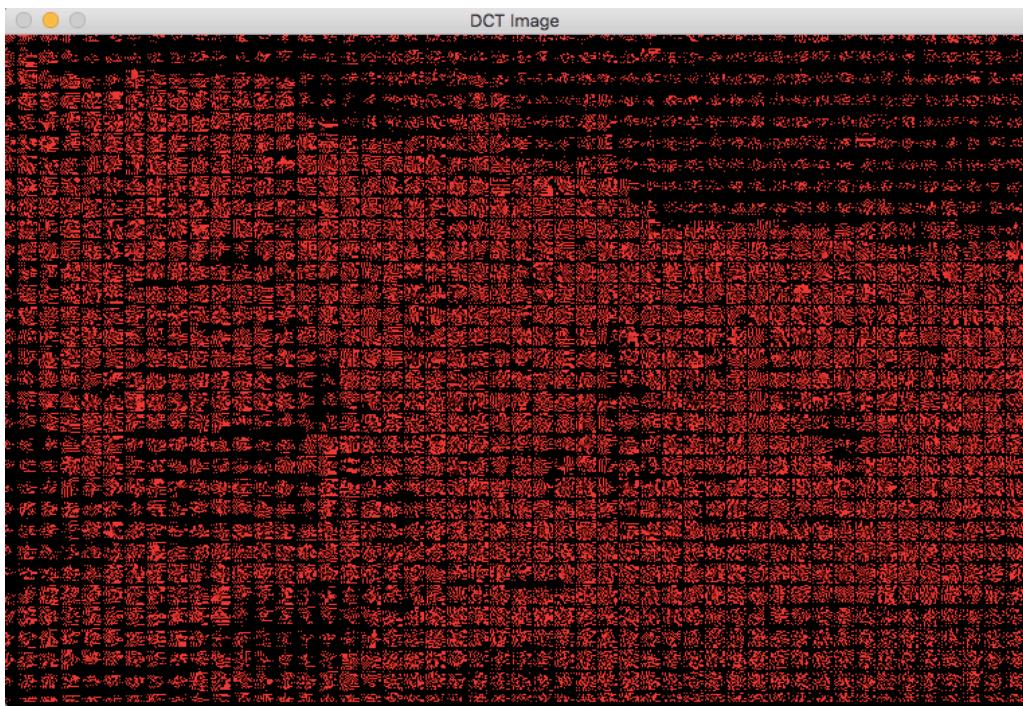
Green Intensity:



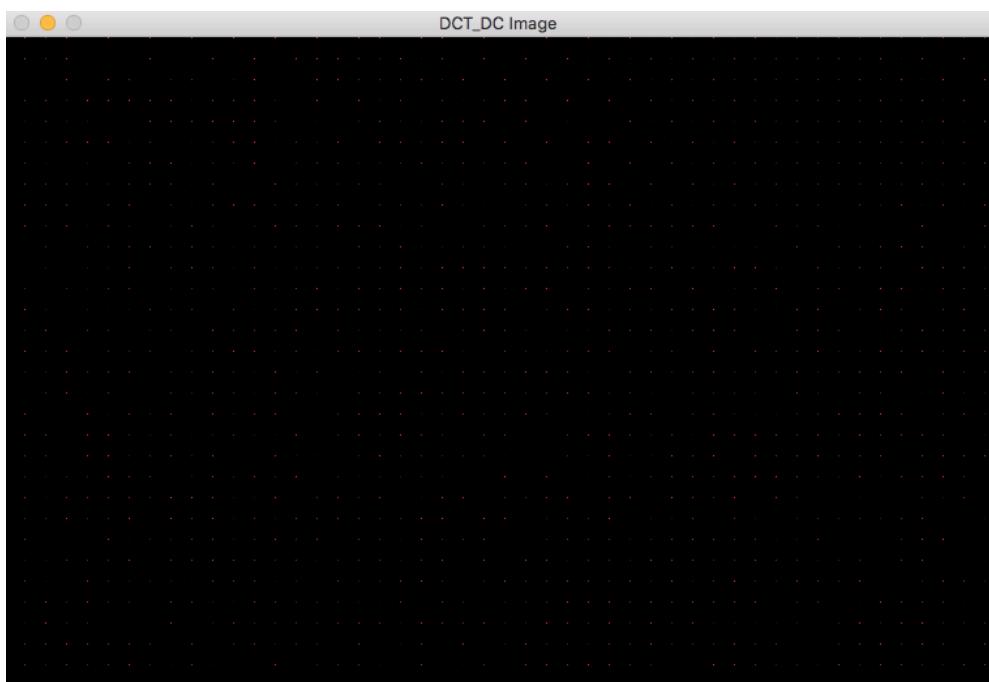
Blue Intensity:



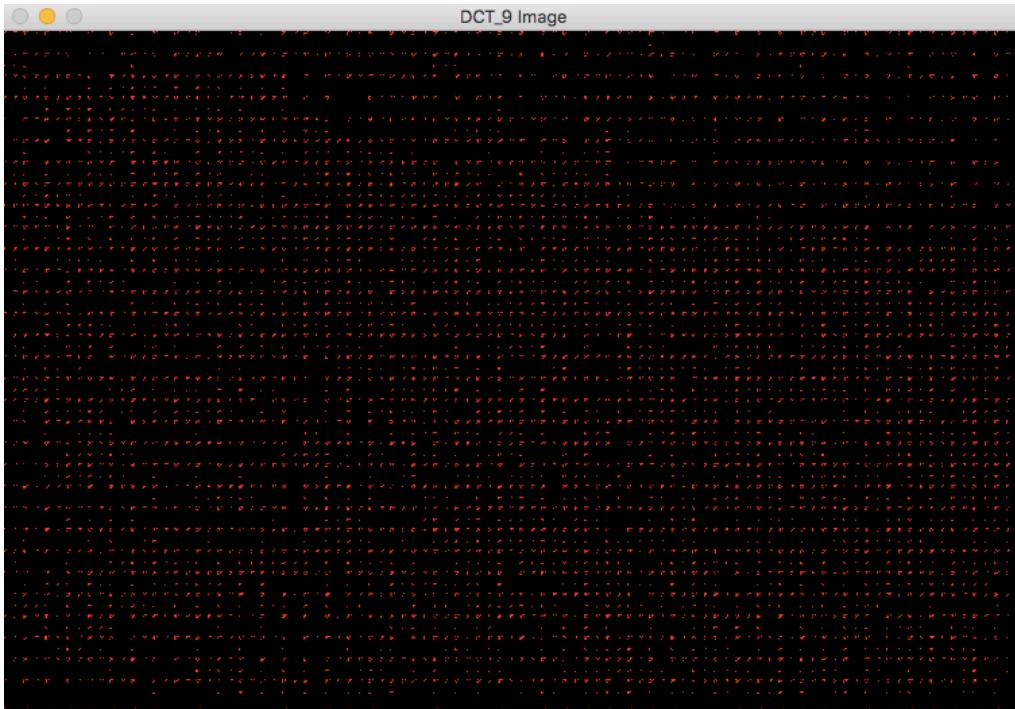
DCT Image:



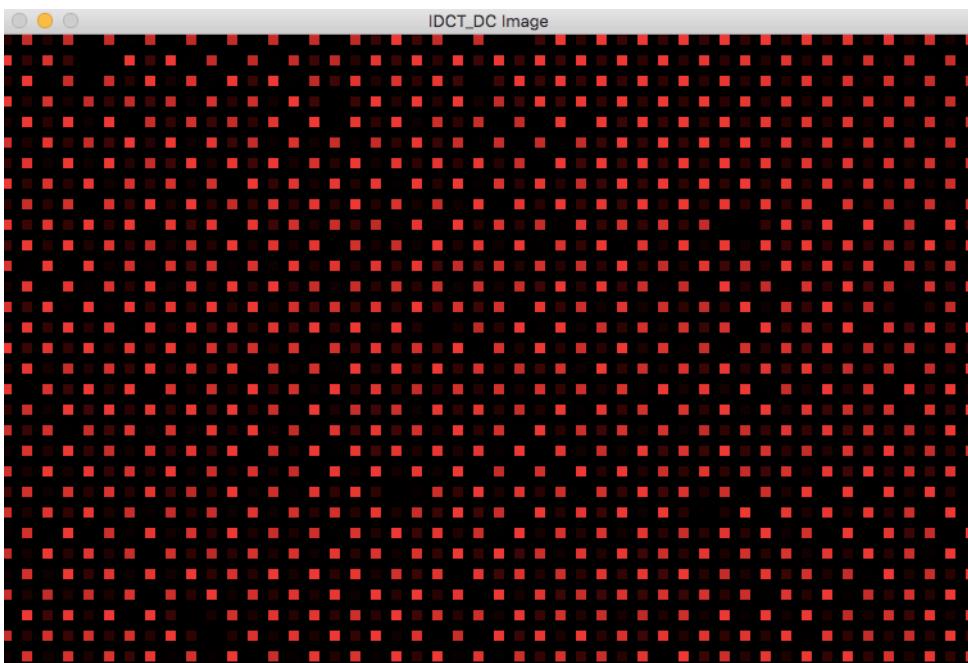
DCT_DC Image:



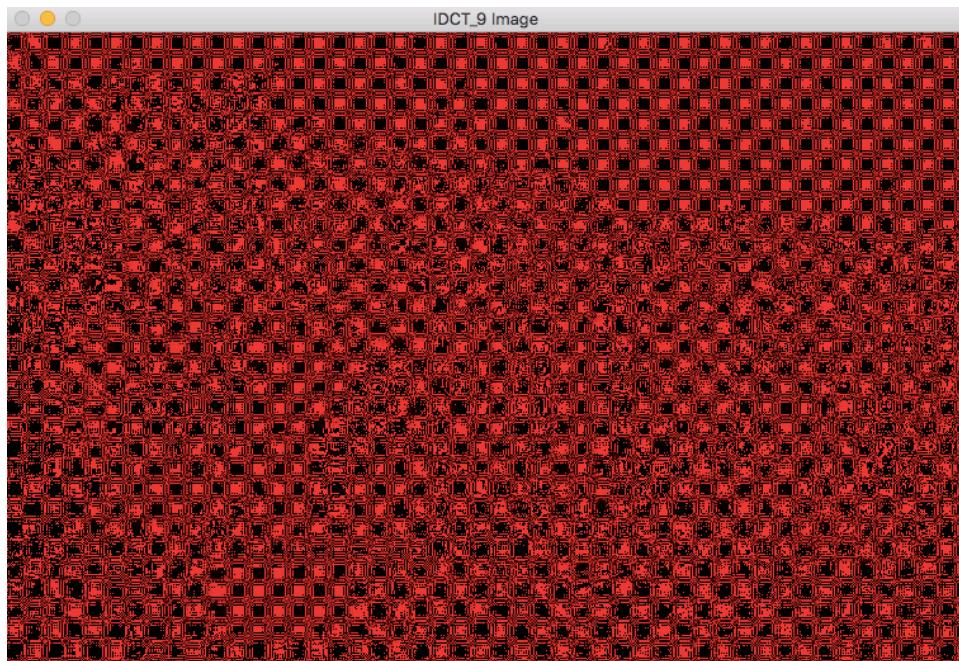
DCT_9 Image:



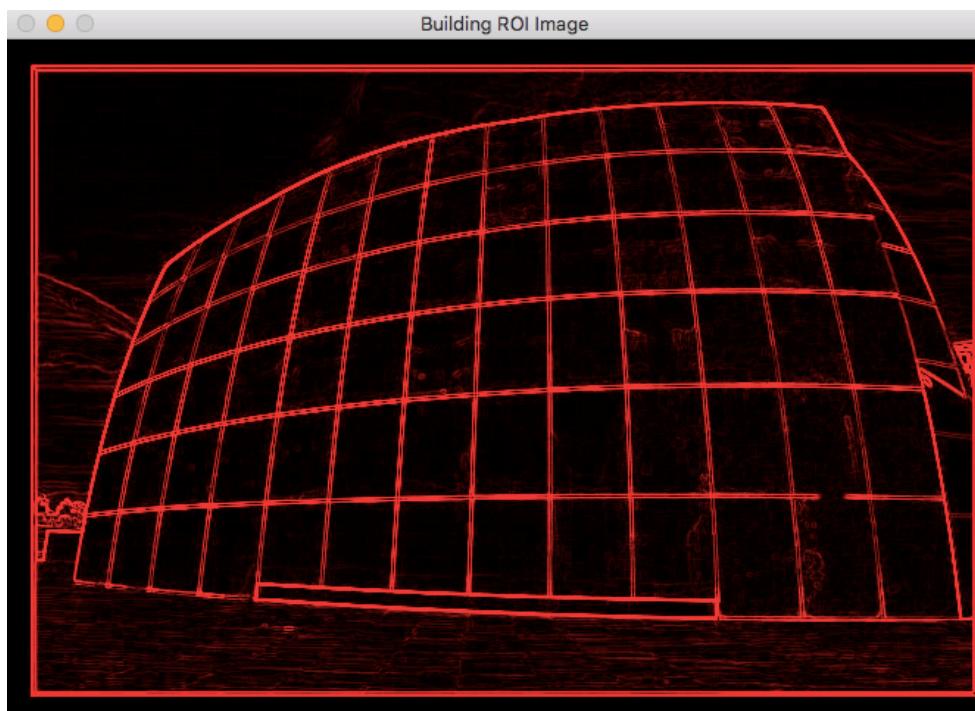
IDCT_DC Image:



IDCT_9 Image:



Building ROI Image:



Disk ROI Image:

