

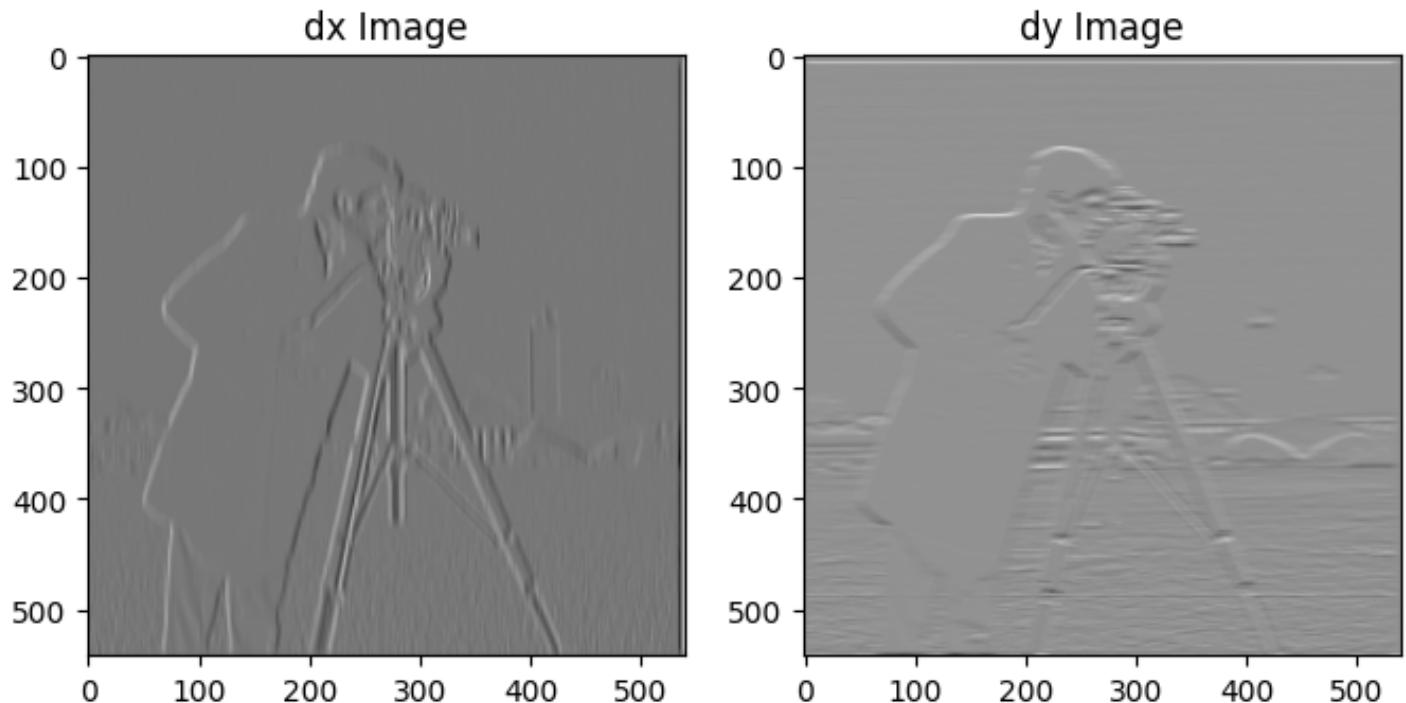
Fun with Filters and Frequencies

Project2 By Fan Du

Highpass and lowpass filter could be used for edge detection, sharpen image, hybrid images and blend images.

Part1 Edge Detection

To detect the edge of a cameraman image, it is first convolve with finite difference operators $\mathbf{D_x}$ and $\mathbf{D_y}$.

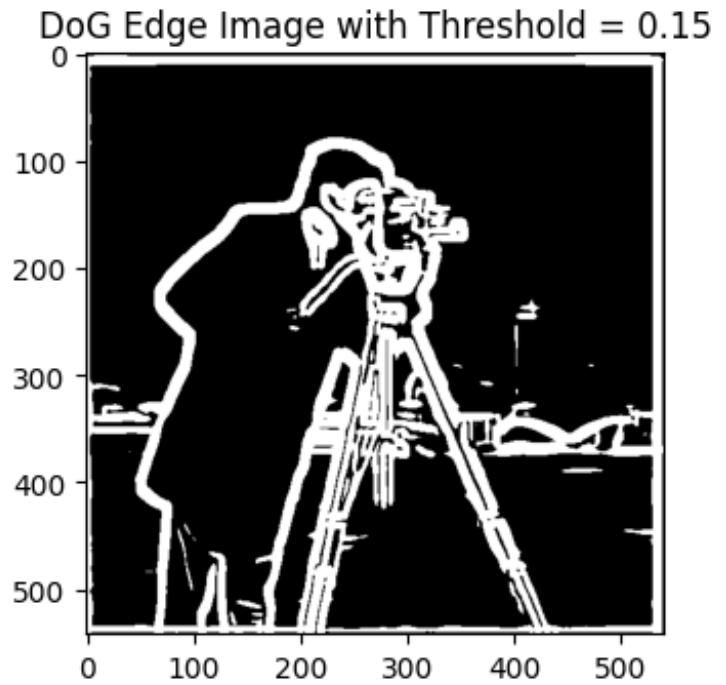
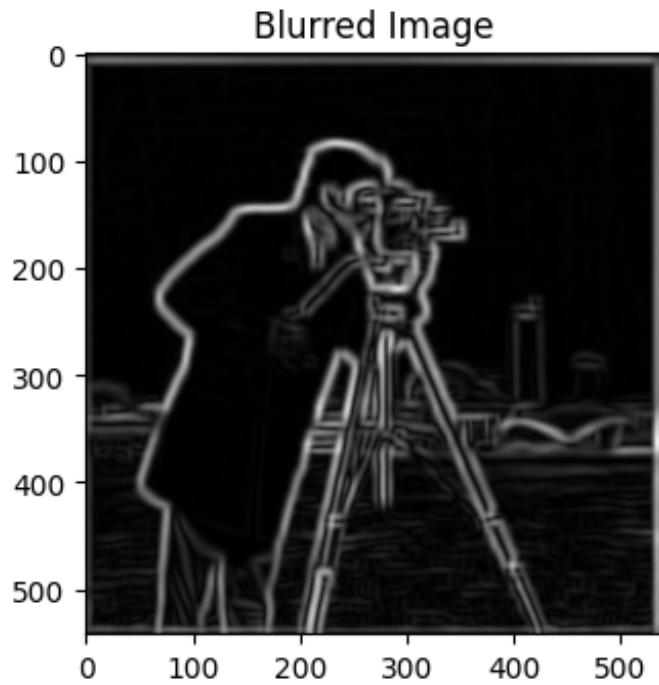


Then, we use below formula to compute **gradient magnitude image**. And set threshold=0.14 to change it into edge image.

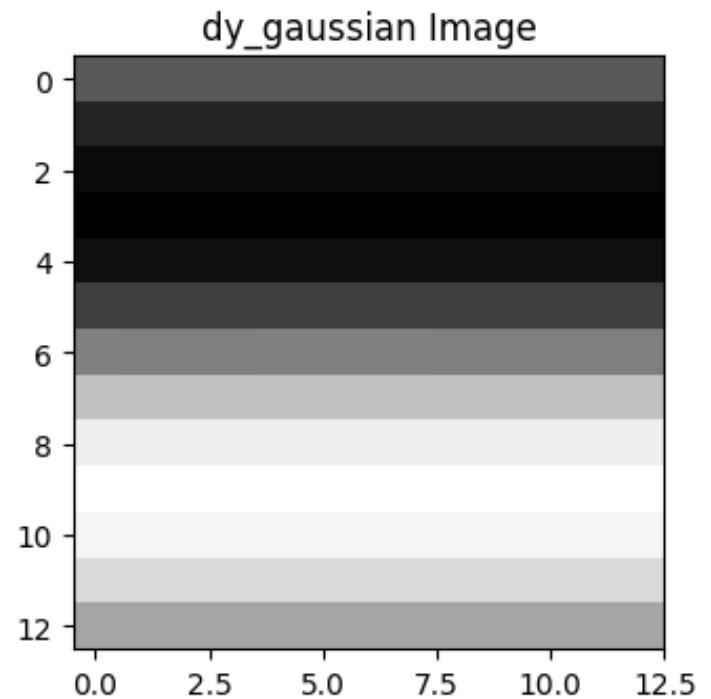
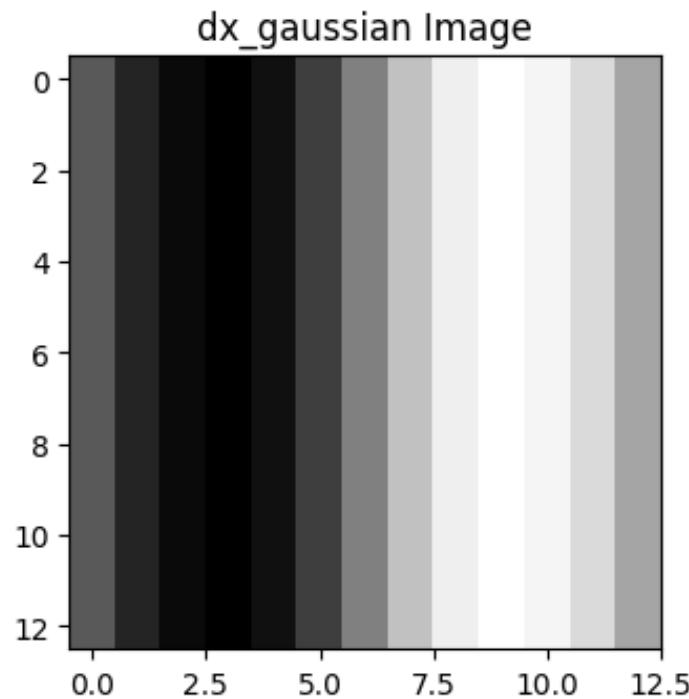
$$\text{image_gradient} = \sqrt{\text{image_dx}^2 + \text{image_dy}^2} \quad (1)$$

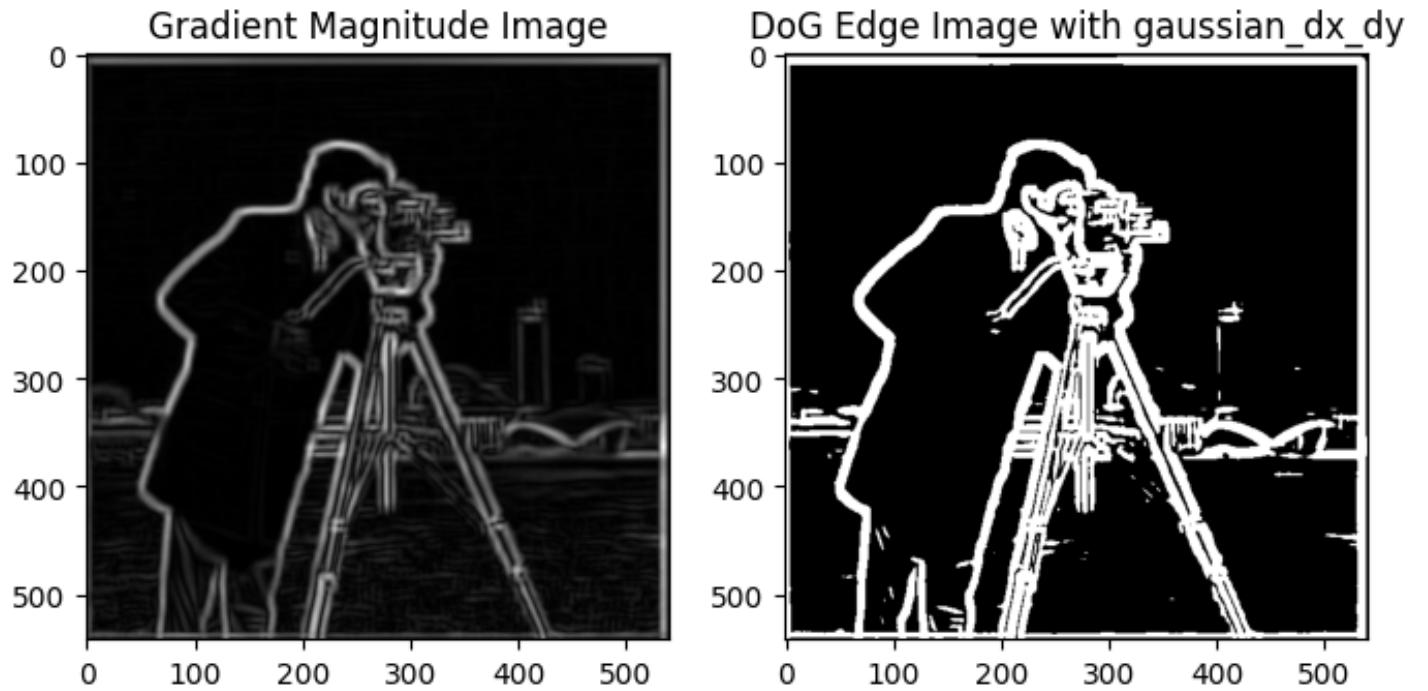
21

However, we could see that the edge image is rather noisy. Using Gaussian filter to blur the image first is an effective way to make it better, because it filters the high frequency noise. The edge of DoG is more distinct and thicker than previous one.



Except blur the image first, we could convolve gaussian filter with D_x and D_y first, and use it to filter the image. The result is same.



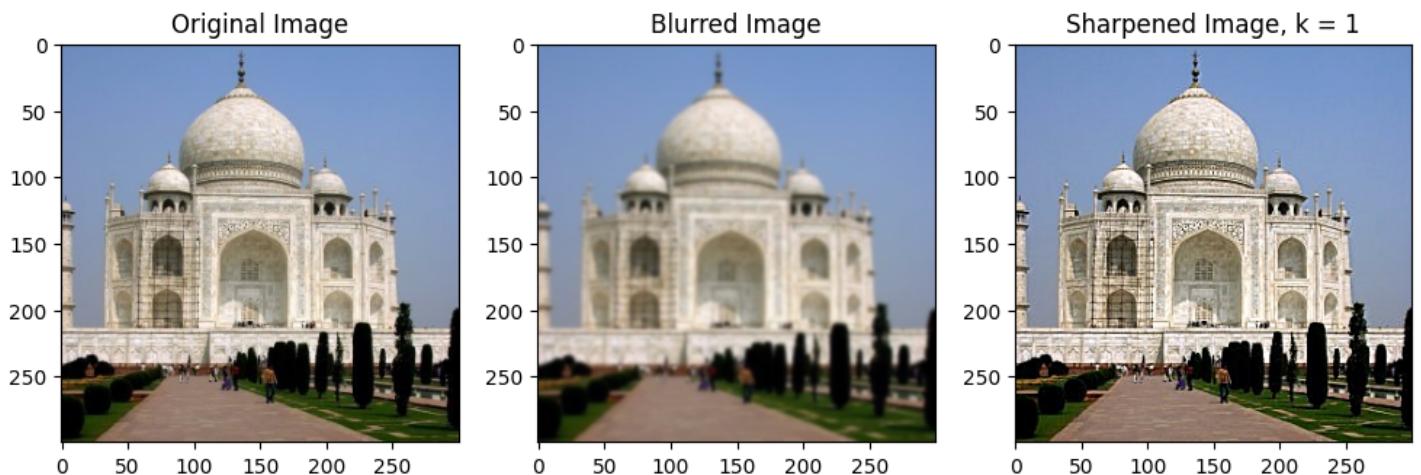


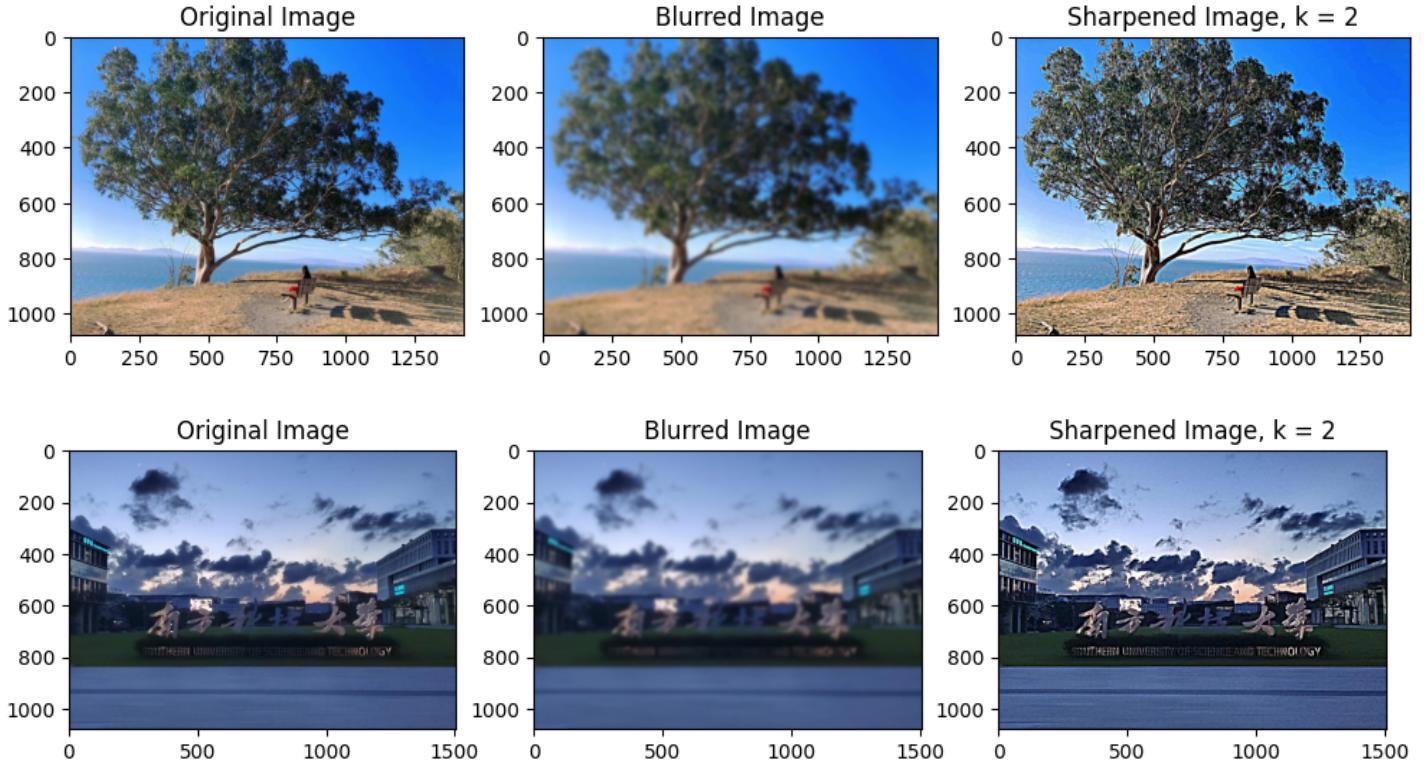
Part2

2.2 Sharpen Images

Based on the formula below, we can create a sharpen core. f is the original image, e is an unit impulse, g is a gaussian core.

$$f + \alpha(f - f * g) = f * ((1 + \alpha)e - \alpha g) \quad (2)$$





2.3 Hybrid Images

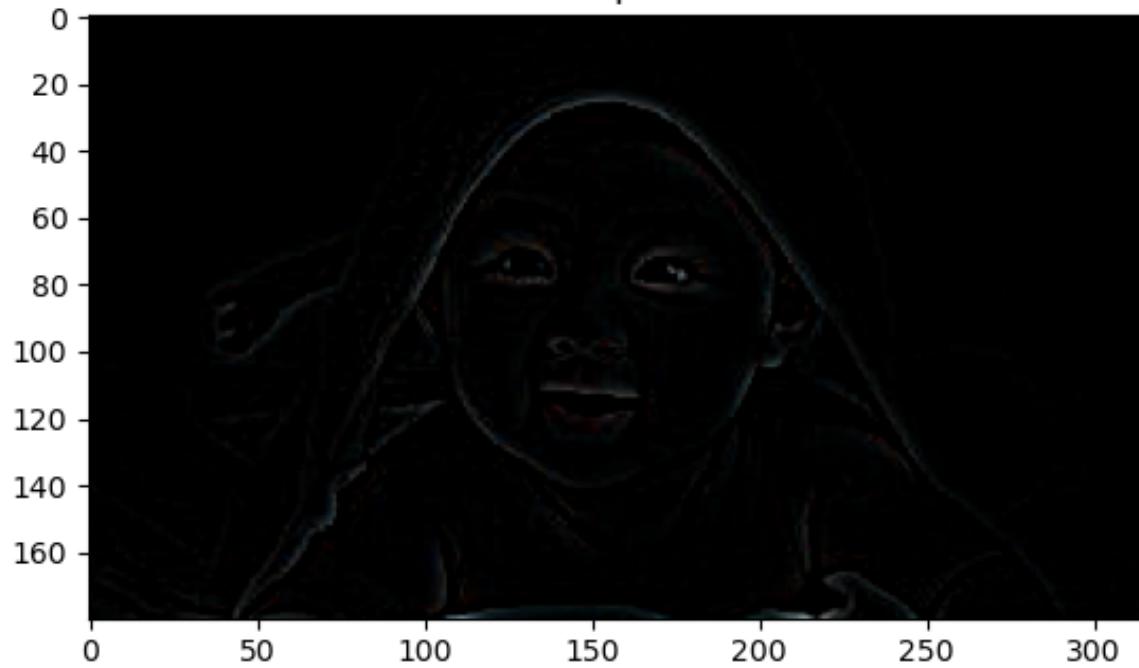
To hybrid images, we use low-pass filter to one image, high-pass filter the second image, and add the two images.

1. Baby vs elder

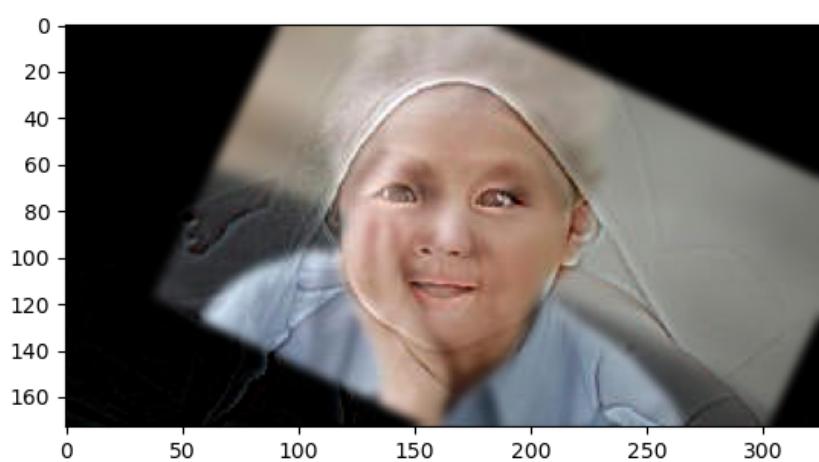
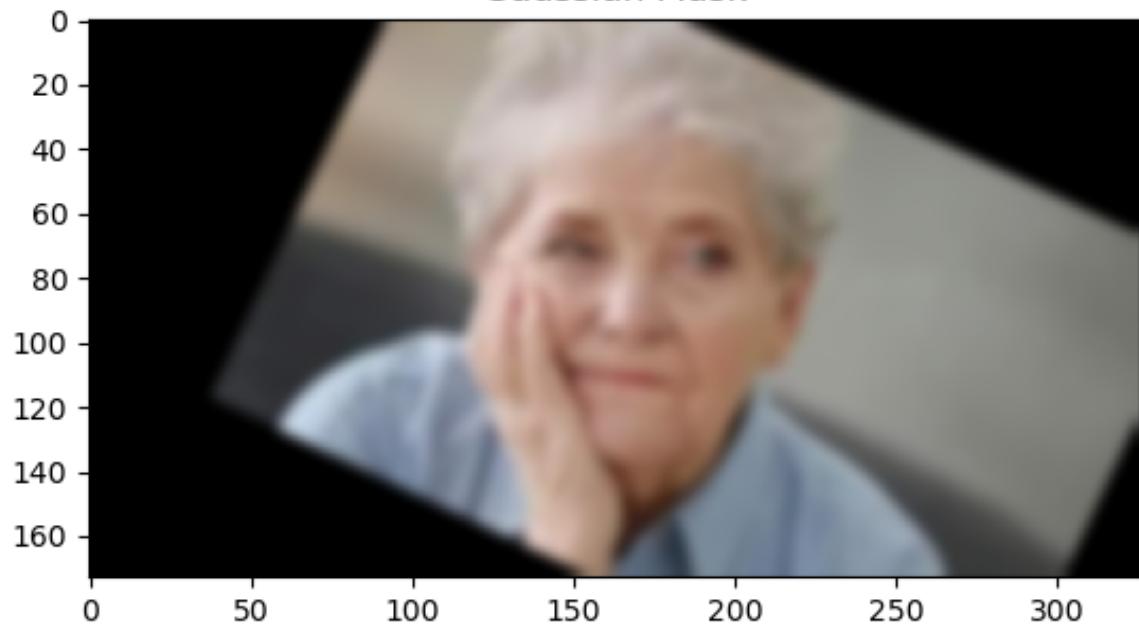




Unsharp Mask



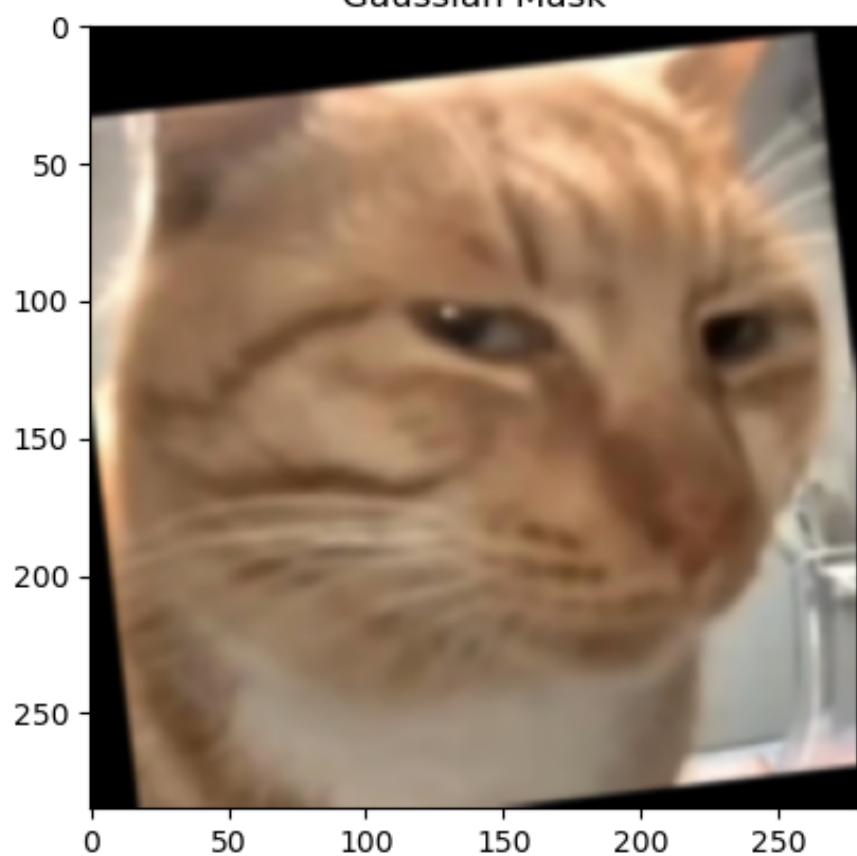
Gaussian Mask



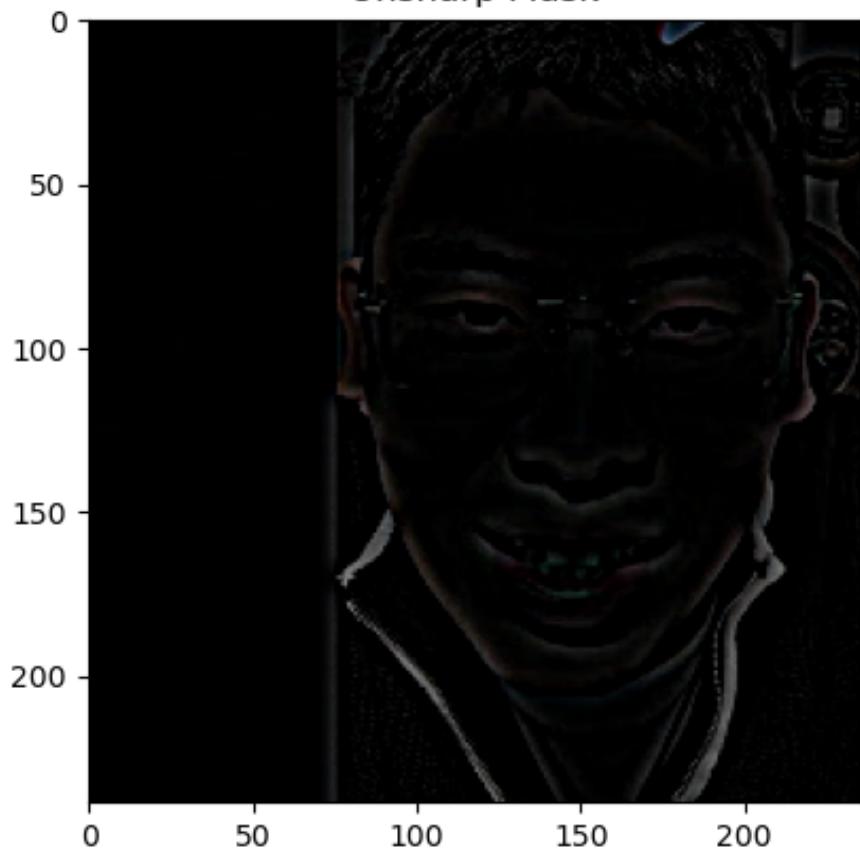
2. man vs cat



Gaussian Mask



Unsharp Mask



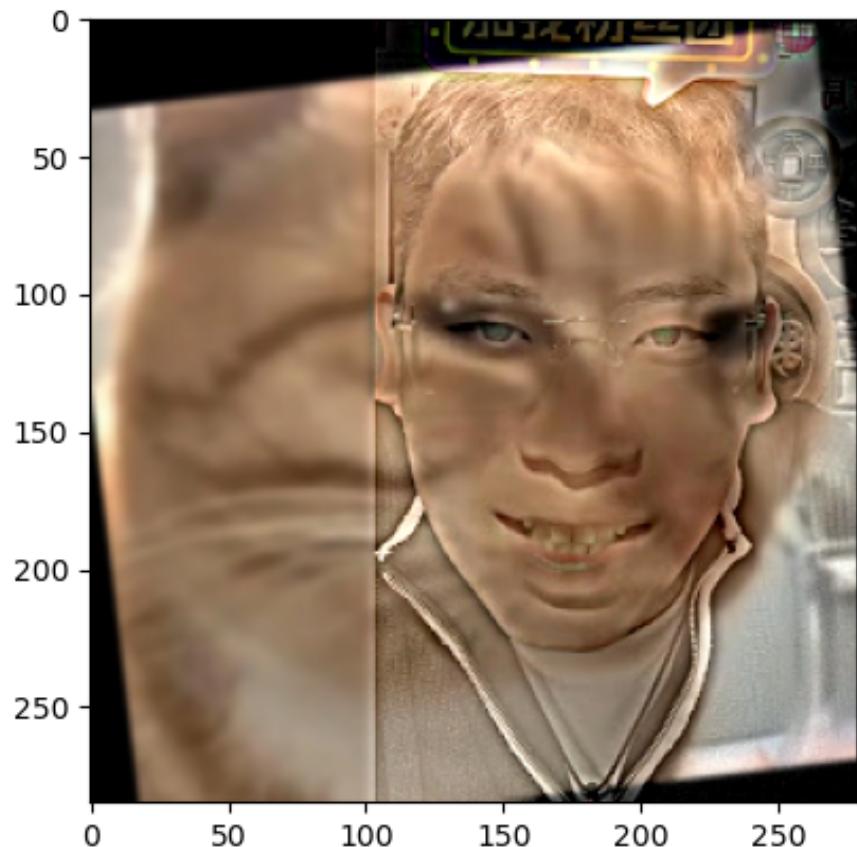


Image to be blurred

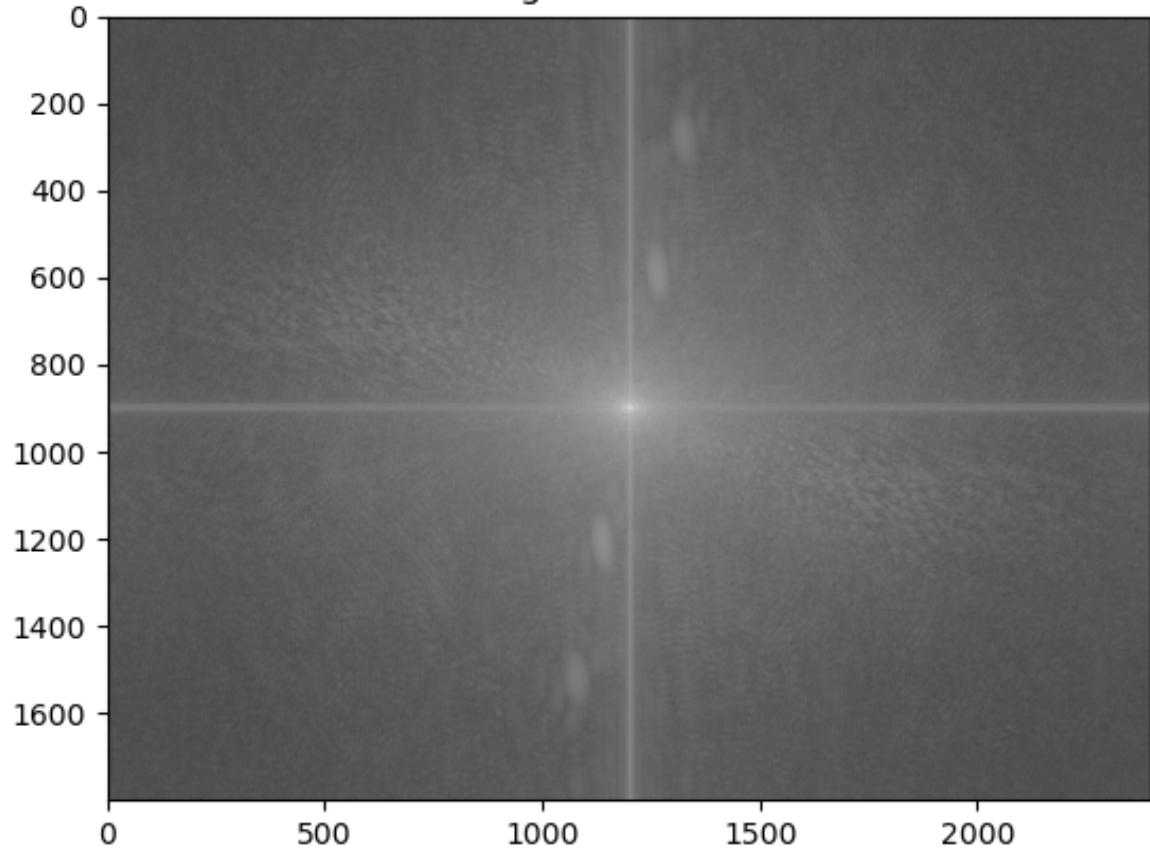
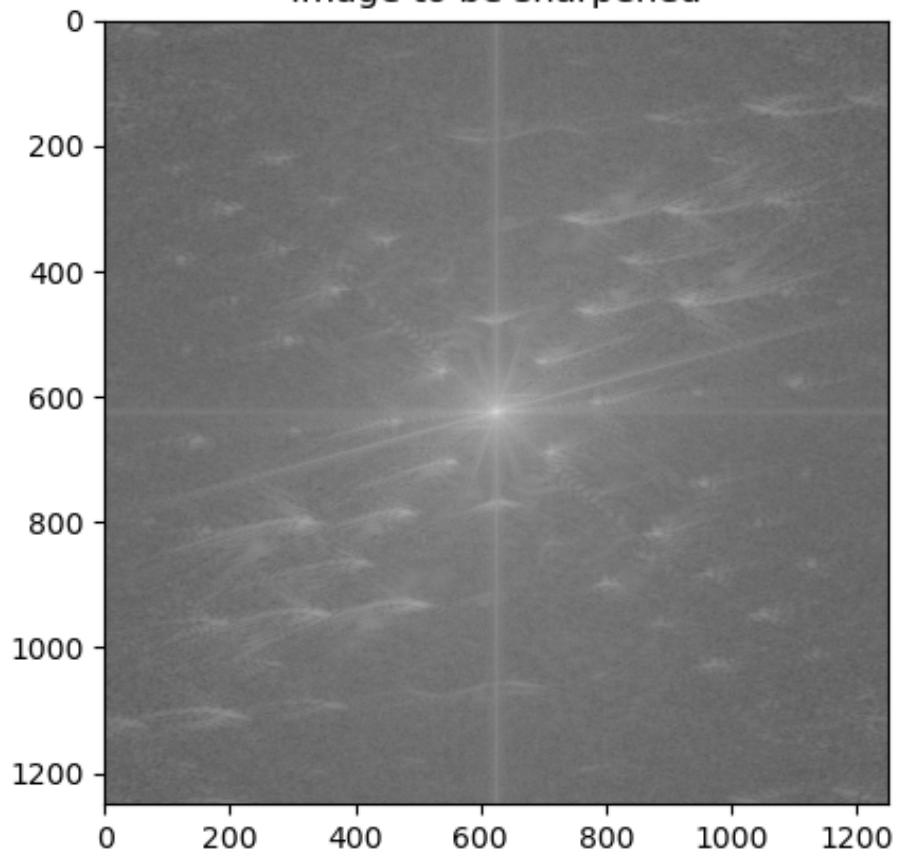
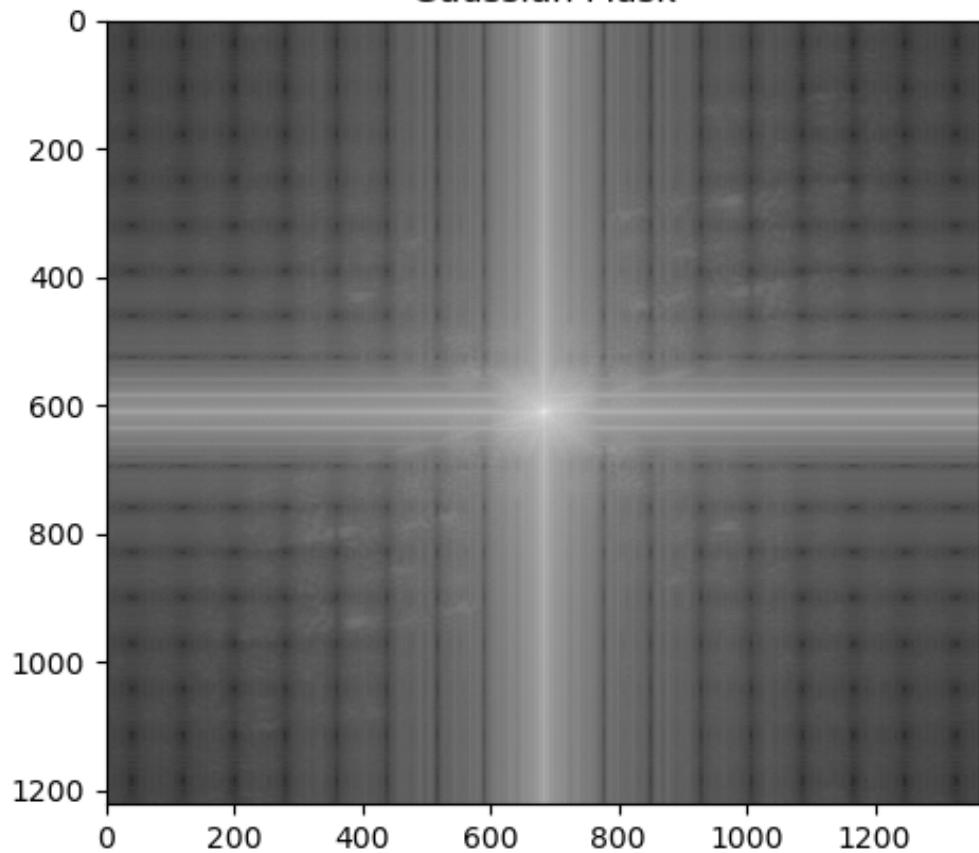
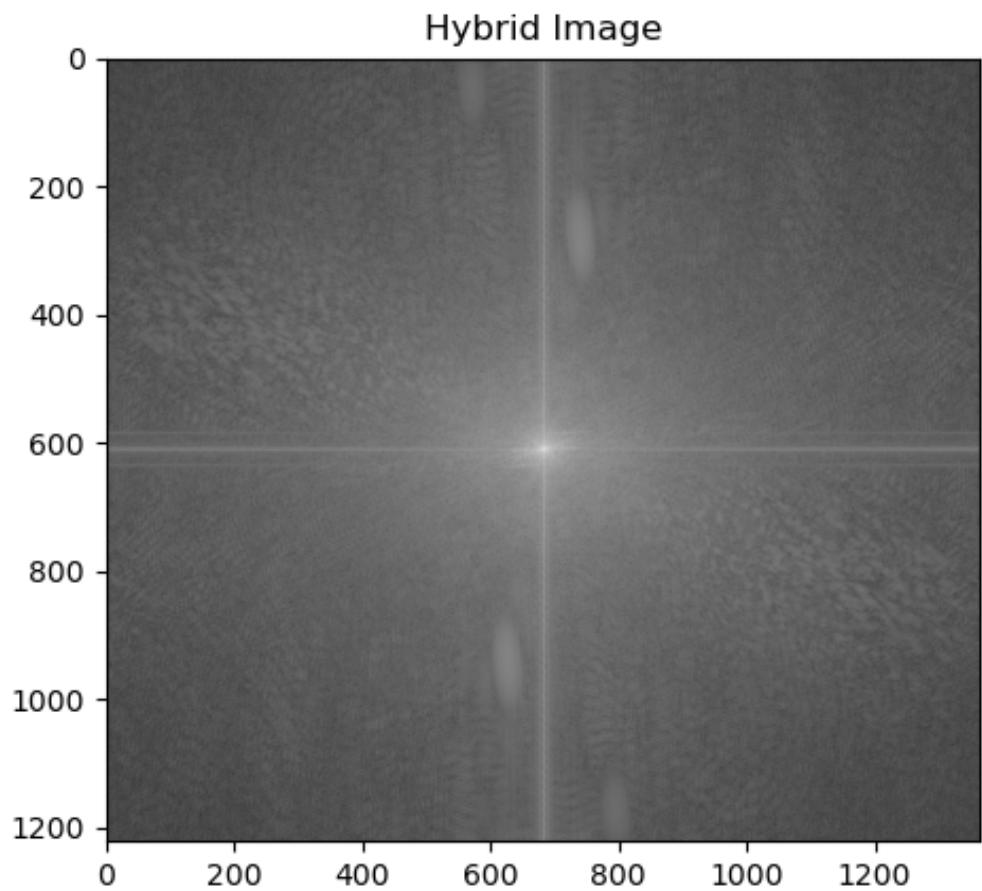


Image to be sharpened



Gaussian Mask

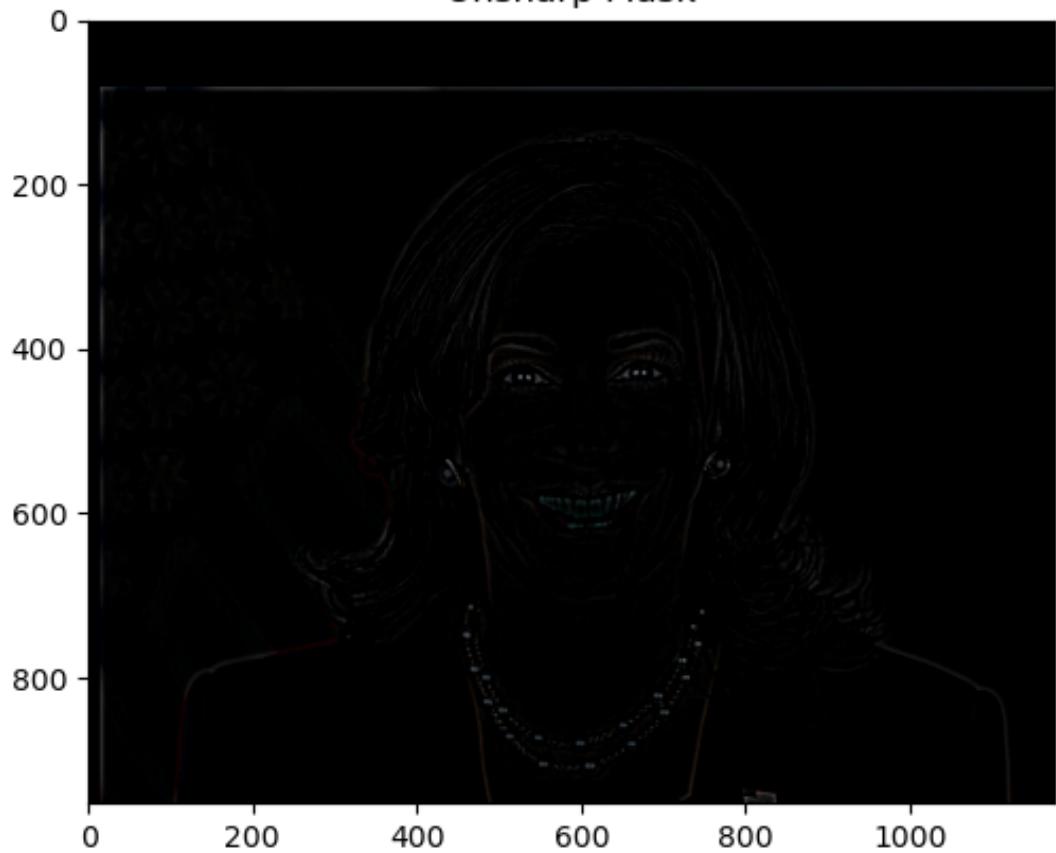




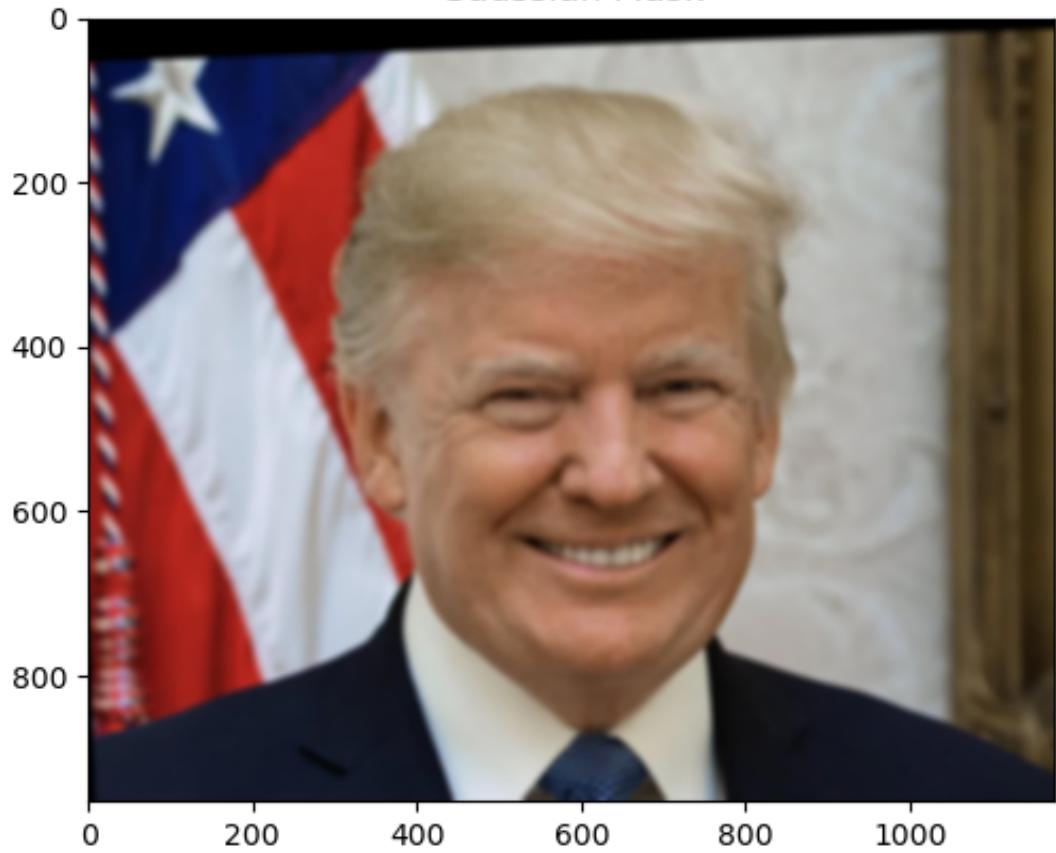
3. Harris vs Trump

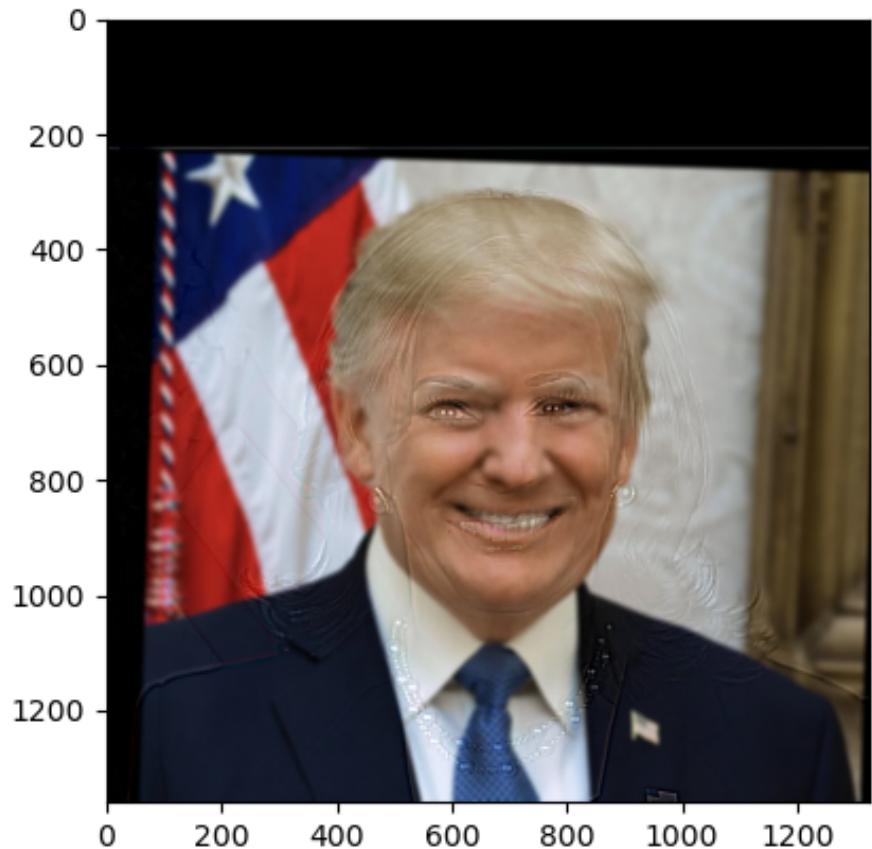


Unsharp Mask



Gaussian Mask

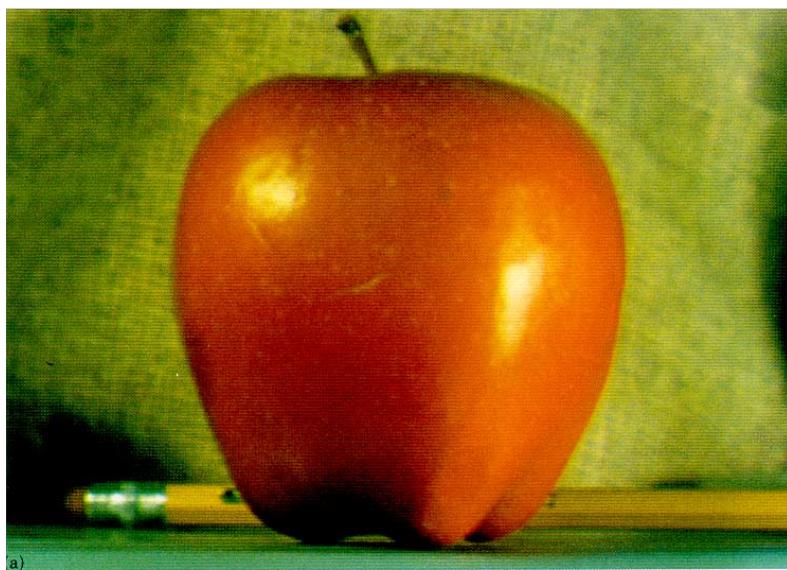




2.3 & 2.4 Blend images

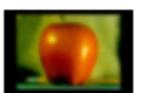
Multiresolution blending is a technique used to seamlessly blend two images by utilizing Gaussian and Laplacian pyramids. The method allows for smooth transitions between images by blending them at multiple frequency bands.

1. apple vs orange



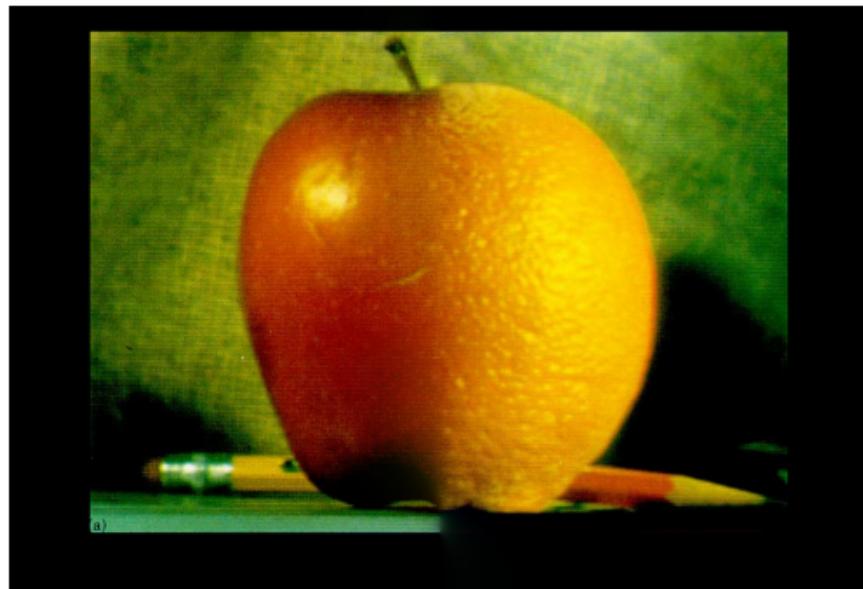
a)

Level 0 Level 1 Level 2 Level 3 Level 4 Level 5 Level 6

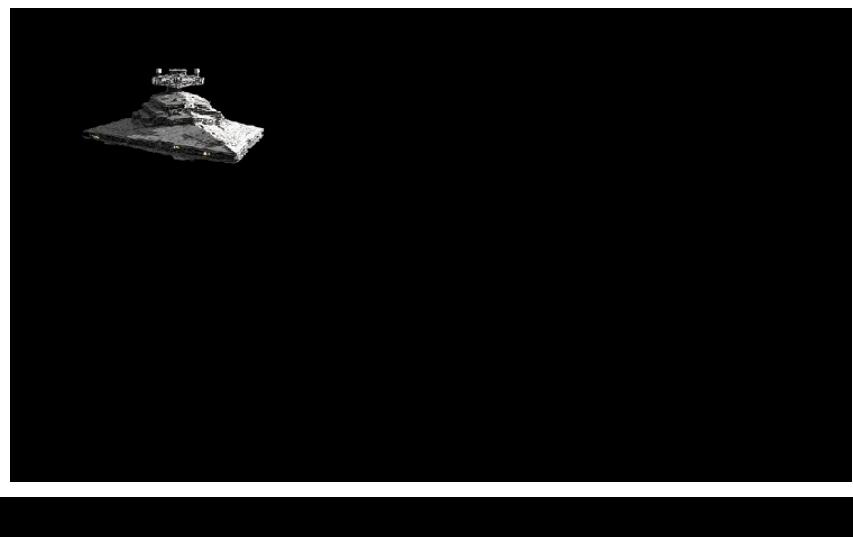


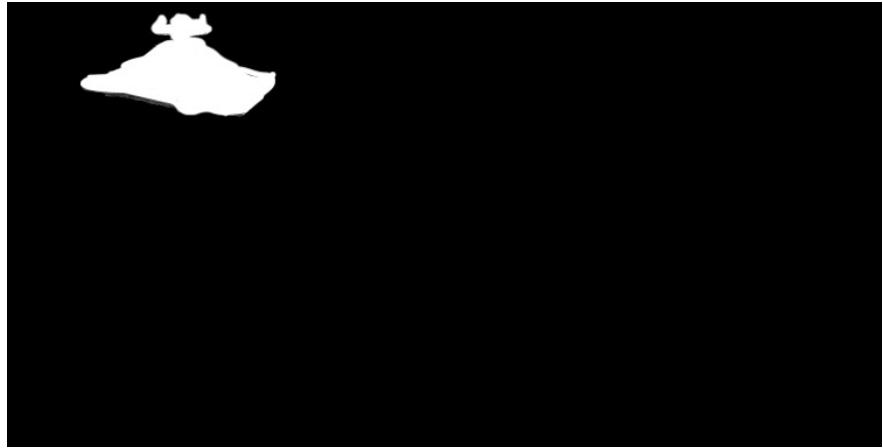
Level 0 Level 1 Level 2 Level 3 Level 4 Level 5 Level 6





2. Sky vs Ship





3. UCB vs Stanford



