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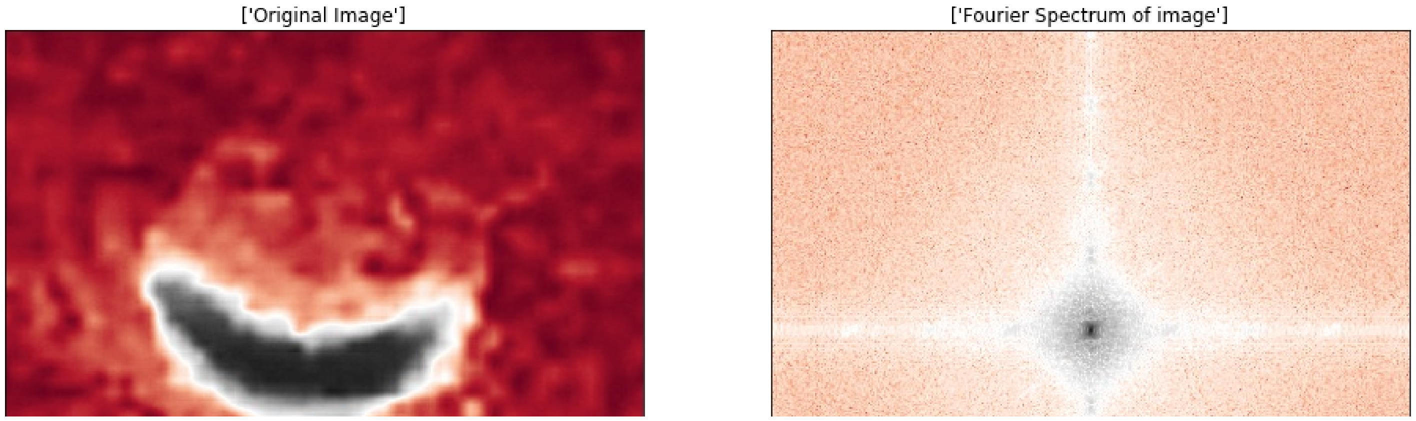
Assignment 2 - Image Filtering

Computer Vision

1. Implement image low pass filtering with FFT using CV2 and Numpy (in python notebook please) as shown in the following figures (You may use your own images).

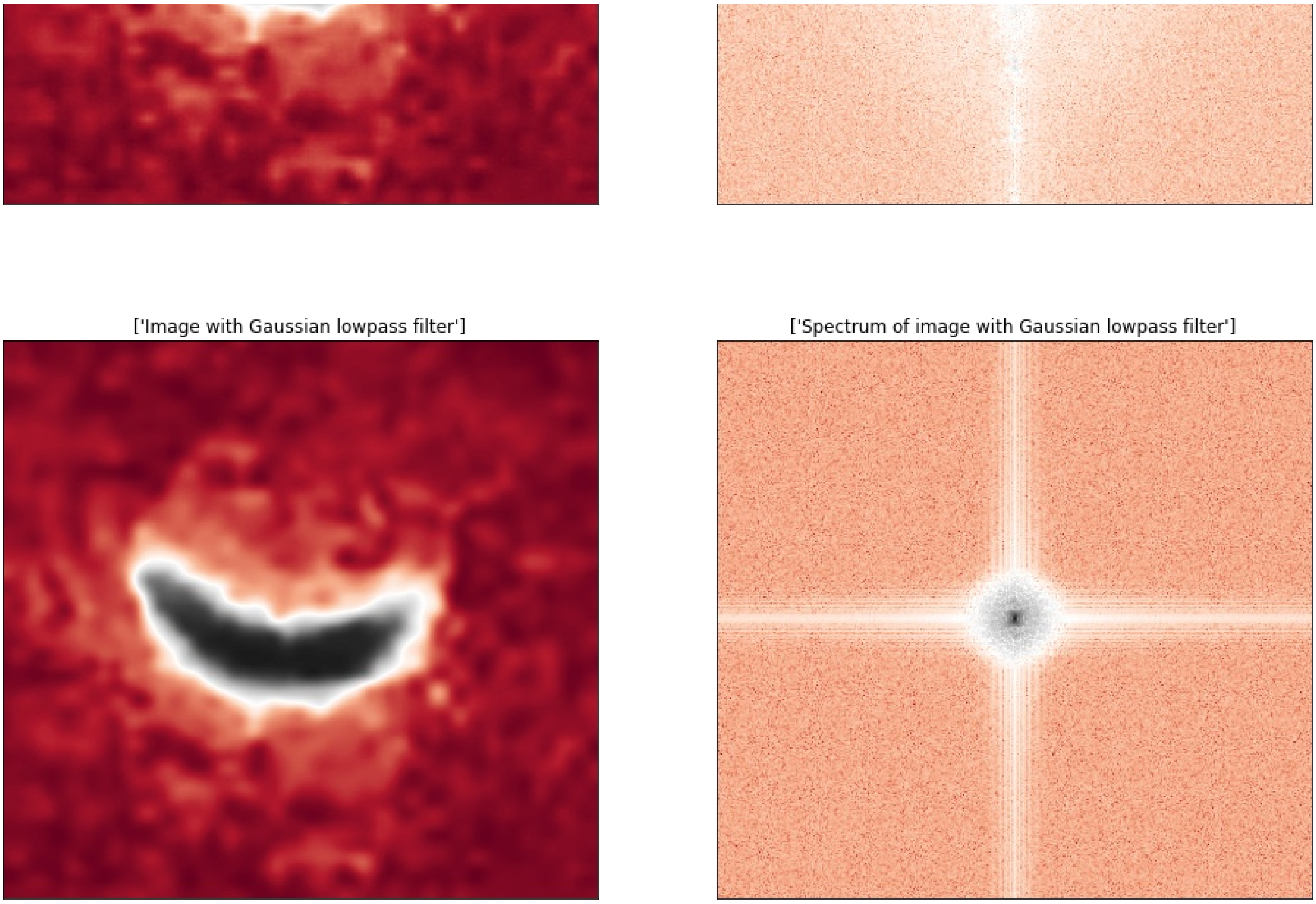
In [1]:

```
import numpy as np
import cv2
import matplotlib.pyplot as plt

img = cv2.imread('set.jpeg',0)

def dft(img, axes):
    dft = np.fft.fft2(img, axes=axes) # do fft as complex output
    dft_shift = np.fft.fftshift(dft) # apply shift of origin to the center of image
    mag = np.abs(dft_shift) # generate spectrum from magnitude image (usually for viewing only)
    spec = np.log(mag) / 20
    return spec

def gauss_blur(img,xy):
    blur_img = cv2.GaussianBlur(img, xy, cv2.BORDER_DEFAULT)
    return blur_img

spec = dft(img,(0,1))
gauss_img = gauss_blur(img,(11,11))
gauss_spec = dft(gauss_img,(0,1))

img_list = [img,spec,gauss_img, gauss_spec]
title = ['Original Image','Fourier Spectrum of image',
         'Image with Gaussian lowpass filter','Spectrum of image with Gaussian lowpass filter']

plt.figure(figsize = (16,16))
for i in range(len(img_list)):
    plt.subplot(2,2,i+1)
    plt.title([title[i]])
    plt.imshow(img_list[i],cmap="RdGy")
    plt.yticks([]),plt.xticks([])
```



['Original Image']

['Fourier Spectrum of image']



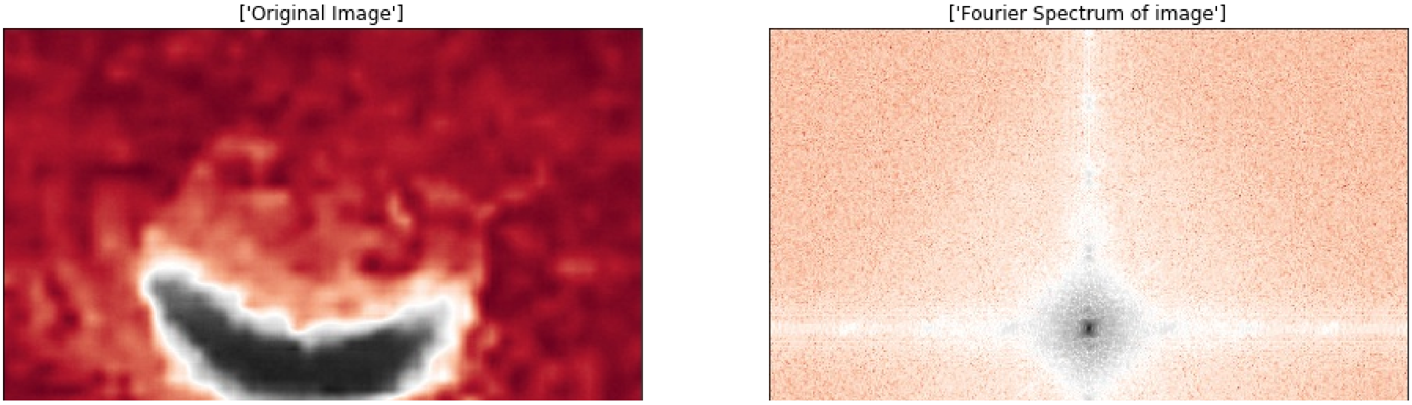
['Image with Gaussian lowpass filter']

['Spectrum of image with Gaussian lowpass filter']

2. Similar like task #1, but now try to implement image high pass filtering.

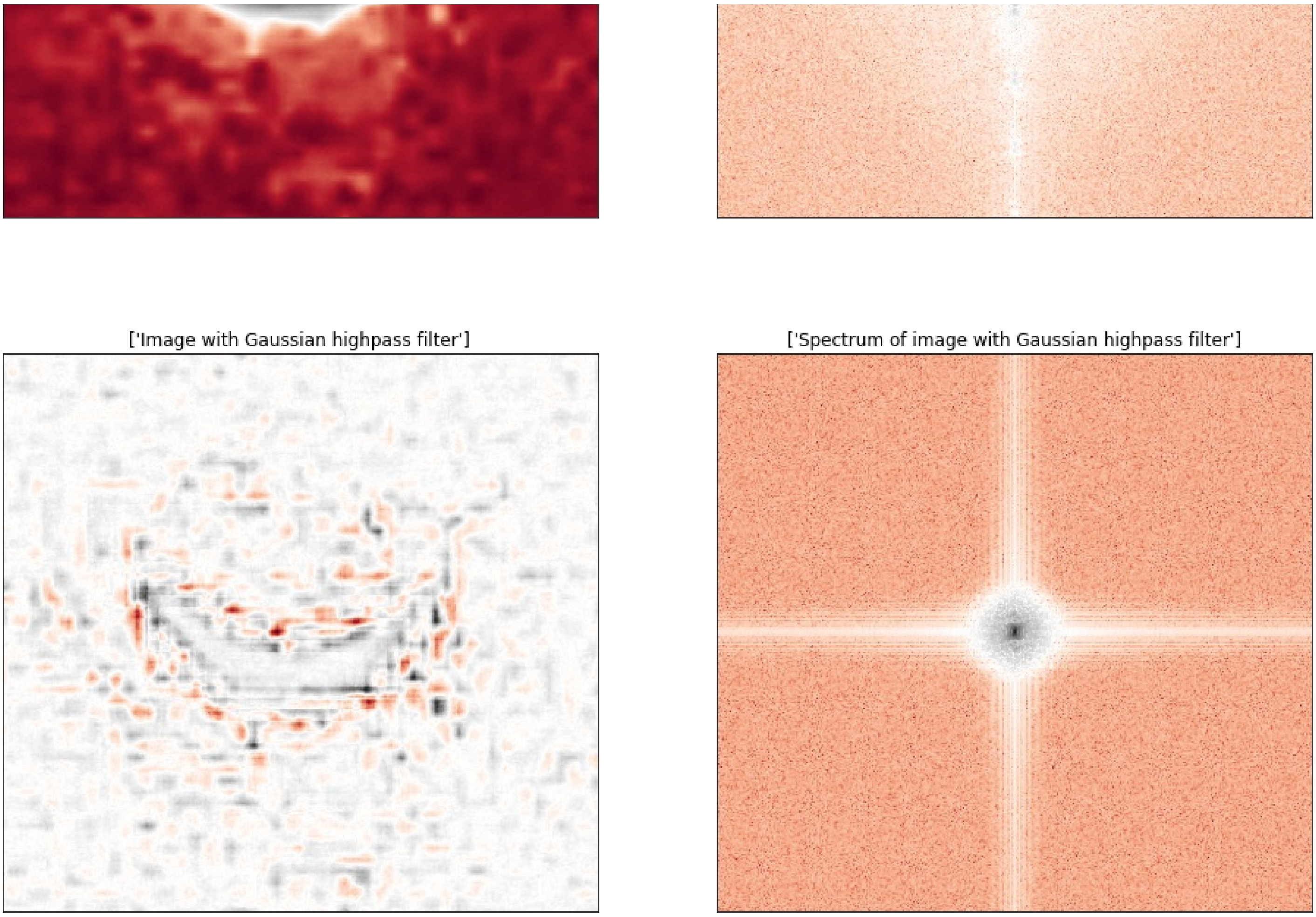
In [2]:

```
def new_gauss_blur(img,xy):
    blur_img = cv2.GaussianBlur(img, xy, cv2.BORDER_DEFAULT) + 127
    hp = img - blur_img
    return hp

gauss_img_2 = new_gauss_blur(img,(105,105))
gauss_spec_2 = dft(gauss_img,(0,1))

img_list = [img,spec,gauss_img_2, gauss_spec_2]
title = ['Original Image','Fourier Spectrum of image',
         'Image with Gaussian highpass filter','Spectrum of image with Gaussian highpass filter']

plt.figure(figsize = (16,16))
for i in range(len(img_list)):
    plt.subplot(2,2,i+1)
    plt.title([title[i]])
    plt.imshow(img_list[i],cmap="RdGy")
    plt.yticks([]),plt.xticks([])
```



['Original Image']

['Fourier Spectrum of image']



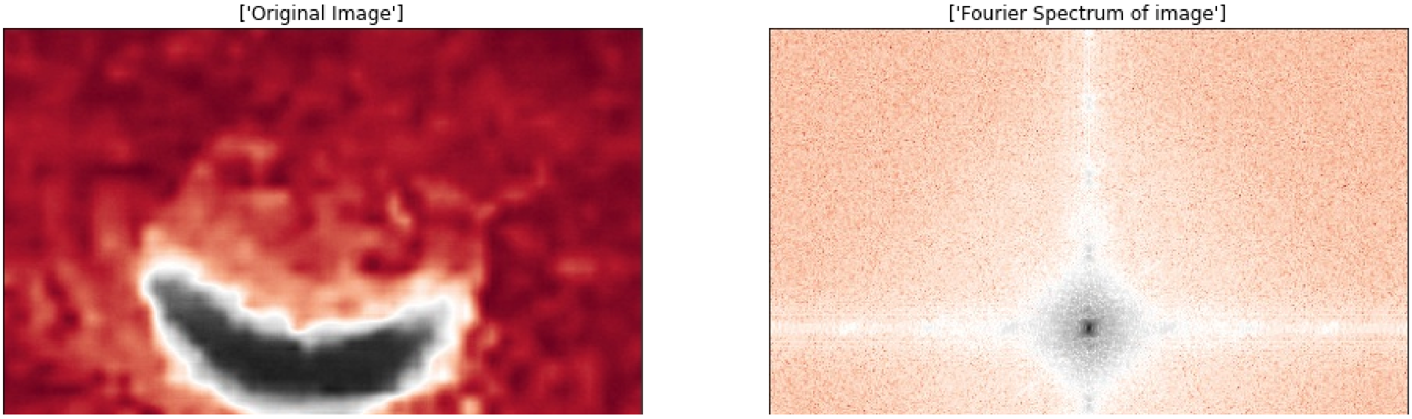
['Image with Gaussian highpass filter']

['Spectrum of image with Gaussian highpass filter']

3. This time is somewhat difficult. You are asked to design Butterworth Notch Filter to remove repetitive noise in the input image

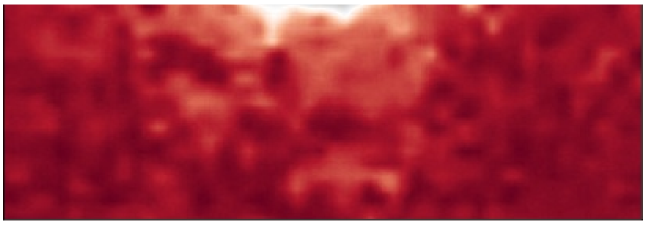
In [3]:

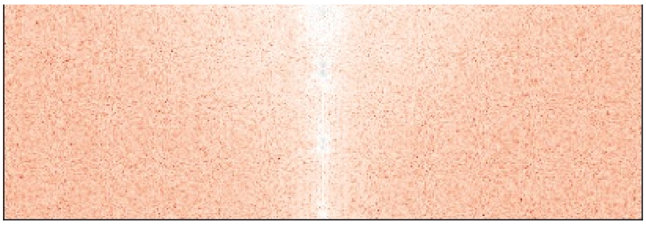
```
from scipy.signal import lfilter, iirnotch

x, y = iirnotch(100, Q=0.01, fs=255)
butter_notch = lfilter(x, y, img)
butter_notch_spec = dft(butter_notch,(0,1))

img_list = [img,spec,butter_notch,butter_notch_spec]
title = ['Original Image','Fourier Spectrum of image',
         'Image with Butterworth Notch Filter','Spectrum of Image with Butterworth Notch
Filter']

plt.figure(figsize = (16,16))
for i in range(len(img_list)):
    plt.subplot(2,2,i+1)
    plt.title([title[i]])
    plt.imshow(img_list[i],cmap="RdGy")
    plt.yticks([]),plt.xticks([])
```



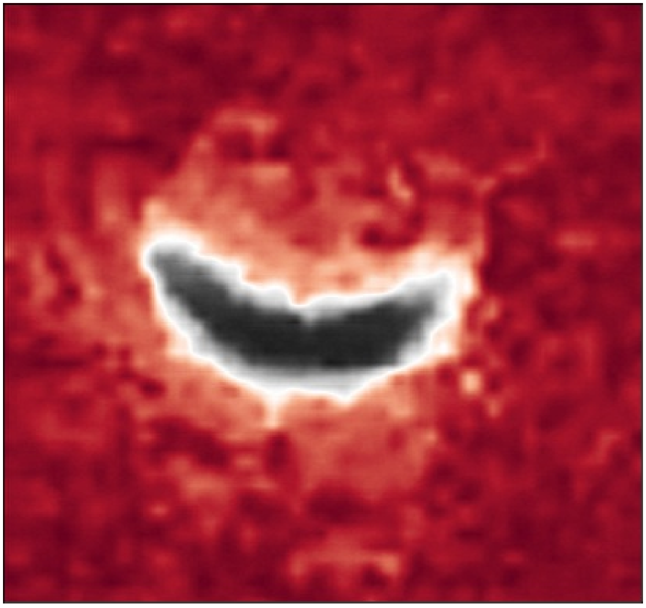
['Original Image']

['Fourier Spectrum of image']





['Image with Butterworth Notch Filter']



['Spectrum of Image with Butterworth Notch Filter']