# ip-mini-project

February 29, 2024

[9]:
```
import warnings
warnings.filterwarnings('ignore')
```

[10]:
```
# importing libraries
import cv2
import numpy as np
import matplotlib.pyplot as plt
from scipy import signal
```

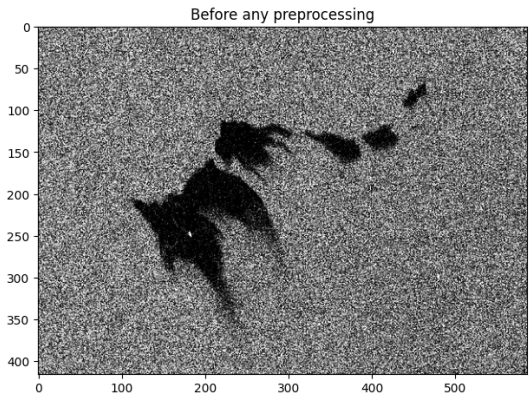
[11]:
```
# importing images
sar1 = cv2.imread(r'C:
 ↪\Users\sejit\Downloads\Oil-Spill-Classification-main\images\SAR#1.png', 0)
sar2 = cv2.imread(r'C:
 ↪\Users\sejit\Downloads\Oil-Spill-Classification-main\images\SAR#2.png', 0)
sar3 = cv2.imread(r'C:
 ↪\Users\sejit\Downloads\Oil-Spill-Classification-main\images\SAR#3.png', 0)
```

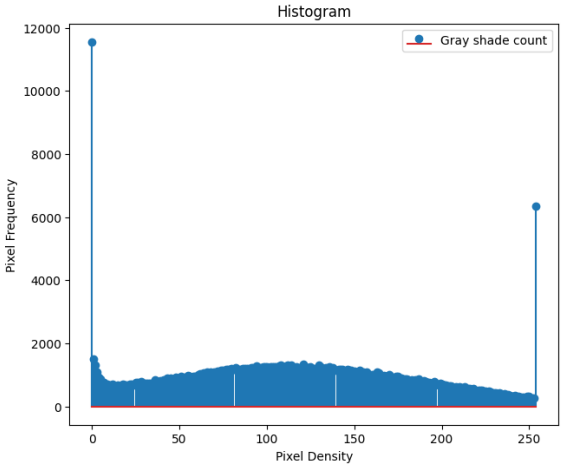
### 0.0.1 Utility Functions

[12]:
```
def plotHistogram(original, img, name):
  count, value = np.histogram(img, 255, [0, 255])
  plt.figure(figsize = (16, 6))
  plt.subplot(1, 2, 1)
  plt.imshow(img, cmap="gray")
  plt.title(name)
  plt.subplot(1, 2, 2)
  plt.stem(count)
  plt.legend(["Gray shade count"])
  plt.xlabel("Pixel Density")
  plt.ylabel("Pixel Frequency")
  plt.title("Histogram")
```

## 0.1 Processing the first SAR Image

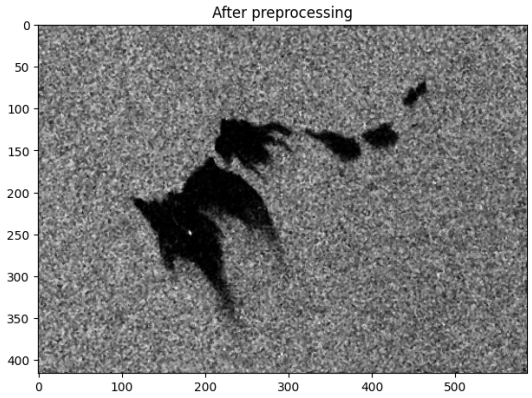
[13]:
```
img = sar1.copy()
imgCopy = sar1.copy()

# image preprocessing first

plotHistogram(img, img, "Before any preprocessing")
plt.show()

# image stats first
r, c = img.shape
print("Image Resolution:", r, "x", c)

# apply median filter to remove noise from the image's background
plt.figure(figsize=(25, 25))
final = cv2.medianBlur(img, 3)

plotHistogram(img, final, "After preprocessing")
plt.show()

img = final.copy()
```

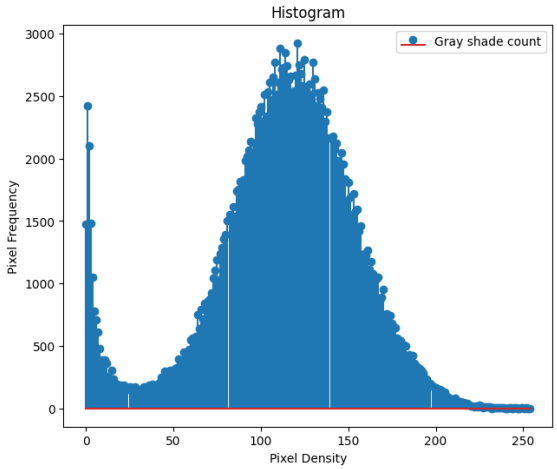



```
Image Resolution: 416 x 586
```

```
<Figure size 2500x2500 with 0 Axes>
```




[14]:
```
plt.figure(figsize=(20, 20))
SE = cv2.getStructuringElement(cv2.MORPH_RECT, (3, 3))

# thresholding with the T from above histogram
for i in range(r):
  for j in range(c):
    img[i, j] = 0 if img[i, j] > 40 else 255
```

```
<Figure size 2000x2000 with 0 Axes>
```

**Performing Opening Morphological Operation to get rid of any noise dots in the background**

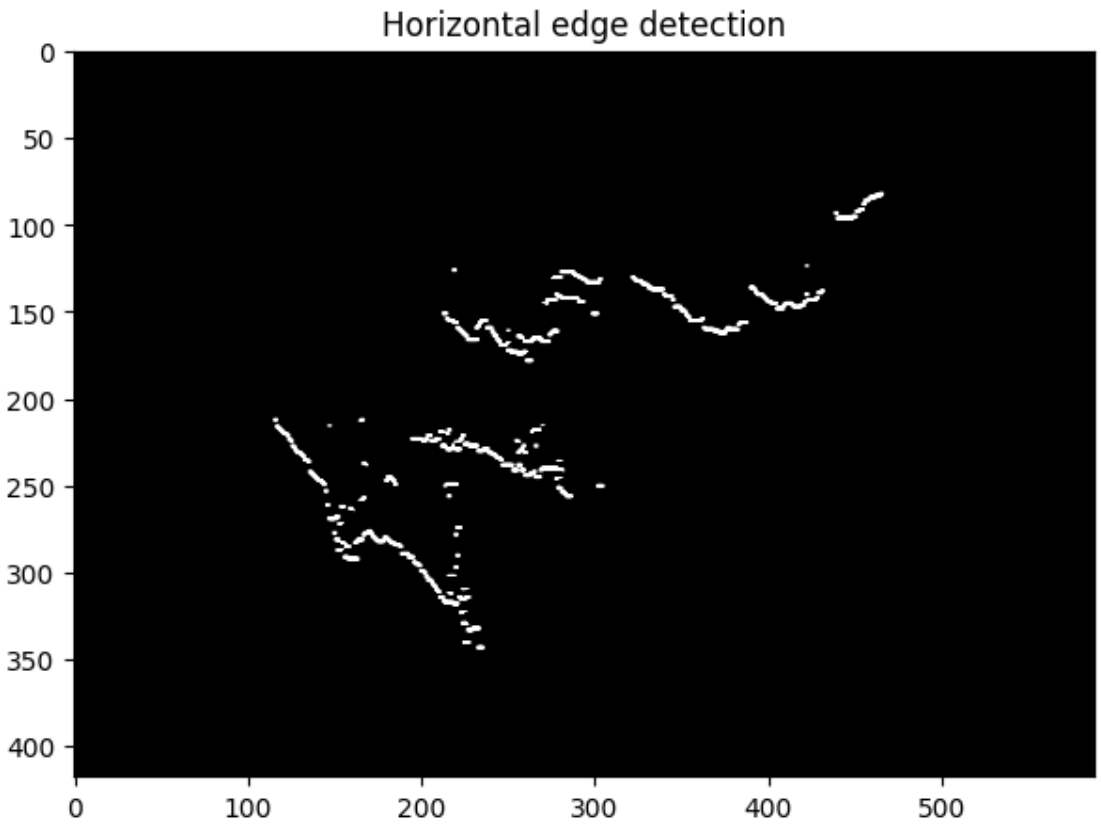
[15]:
```
plt.figure(figsize=(20, 20))

# erording image
erodedImage = cv2.erode(img, SE)

# then dilating image
openImage = cv2.dilate(erodedImage, SE)

plt.subplot(131)
plt.imshow(img, cmap="gray")
plt.title("Pre-processed image")
plt.axis("off")
plt.subplot(132)
plt.imshow(openImage, cmap="gray")
plt.title("Opened Image")
plt.axis("off")
```

[15]:
```
(-0.5, 585.5, 415.5, -0.5)
```


**Identifying the edges of the oil spill to identify the actual spread rather than the region**

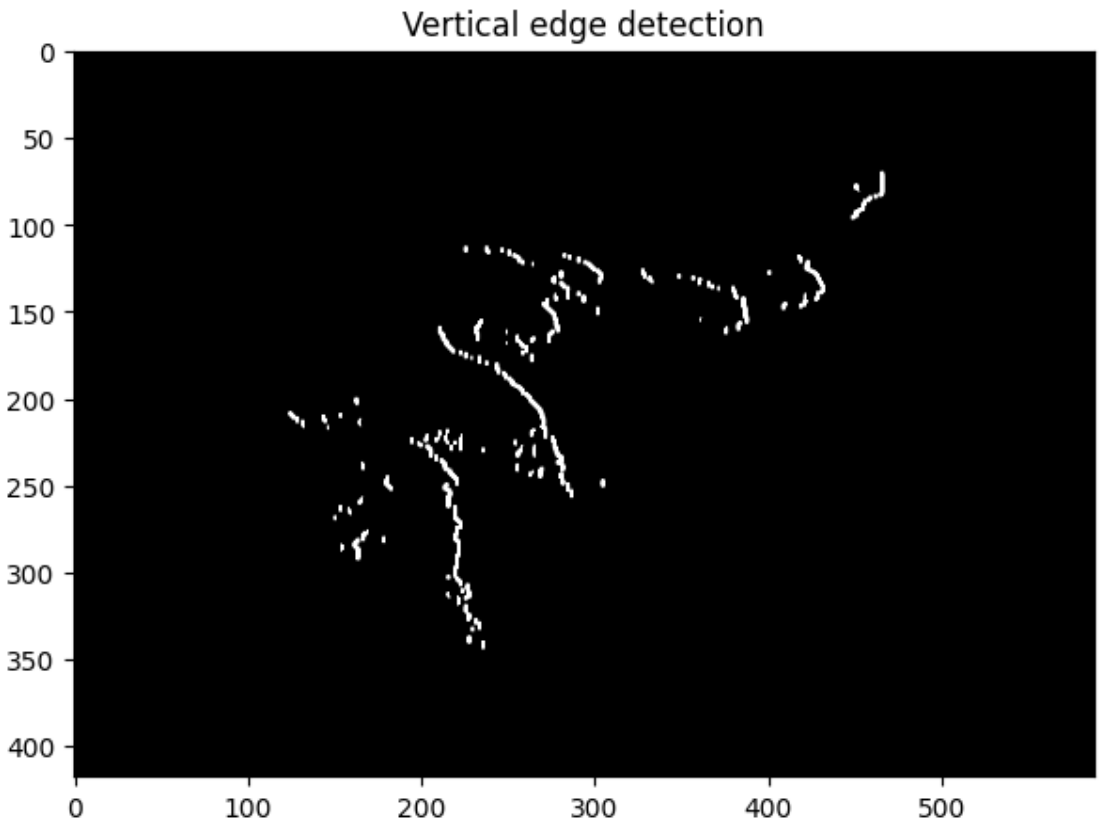
[16]:
```
#Detect horizontal edges using in built convolution function
mask = [
    [-1, -2, -1],
    [0, 0, 0],
    [1, 2, 1],
]

outputHorizontal = signal.convolve2d(openImage, mask)

# showing the output image after convolution
plt.figure(figsize=(7, 7))
plt.imshow(outputHorizontal, cmap="gray", vmin=0, vmax=255)
plt.title("Horizontal edge detection")
```

[16]:
```
Text(0.5, 1.0, 'Horizontal edge detection')
```



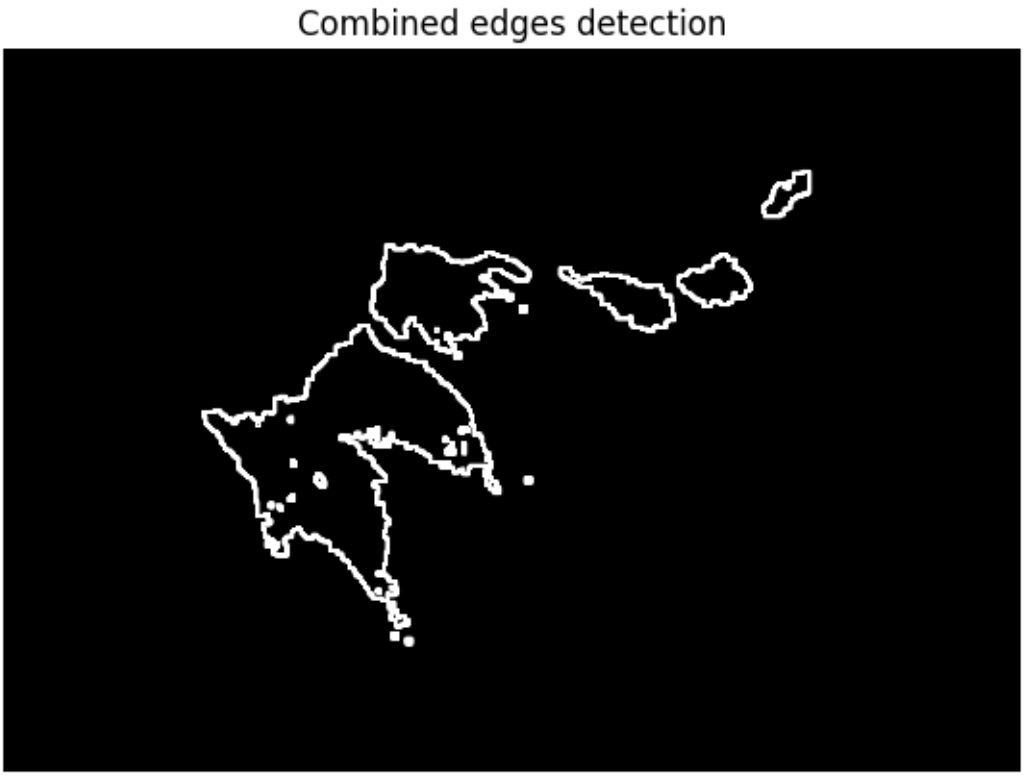

[17]:
```
#Detect vertical edges using inbuilt function for convolution
mask = [
    [-1, 0, 1],
    [-2, 0, 2],
    [-1, 0, 1],
]

outputVertical = signal.convolve2d(openImage, mask)

# showing the output image after convolution
plt.figure(figsize=(7, 7))
plt.imshow(outputVertical, cmap="gray", vmin=0, vmax=255)
plt.title("Vertical edge detection")
```

[17]: Text(0.5, 1.0, 'Vertical edge detection')




[18]:
```
# Detecting vertical and horizontal edges
G = np.absolute(outputVertical) + np.absolute(outputHorizontal)

# showing the output image after adding them
plt.figure(figsize=(15, 15))
plt.subplot(121)
plt.imshow(G, cmap="gray", vmin=0, vmax=255)
plt.title("Combined edges detection")
plt.axis("off")
```

[18]:
```
(-0.5, 587.5, 417.5, -0.5)
```

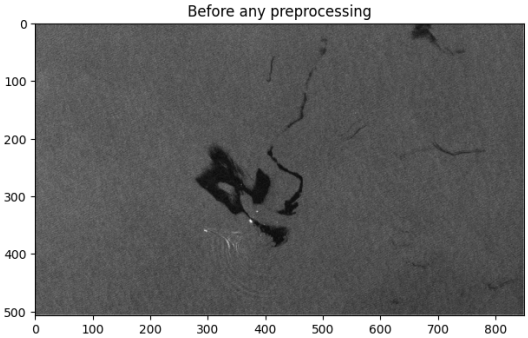


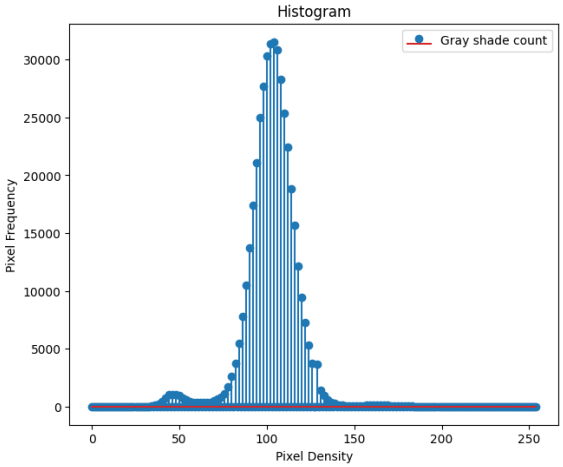

[19]:
```
# final comparison of the original and the gotten images
plt.figure(figsize=(18, 18))
plt.subplot(131)
plt.imshow(imgCopy, cmap="gray")
plt.axis("off")
plt.title("Original Image")
plt.subplot(132)
plt.imshow(openImage, cmap="gray")
plt.axis("off")
plt.title("Opened Image")
plt.subplot(133)
plt.imshow(G, cmap="gray")
plt.axis("off")
plt.title("Detected Oil Spill Edges")
```

[19]:
```
Text(0.5, 1.0, 'Detected Oil Spill Edges')
```


## 0.2 Performing same operations on 2nd SAR Image

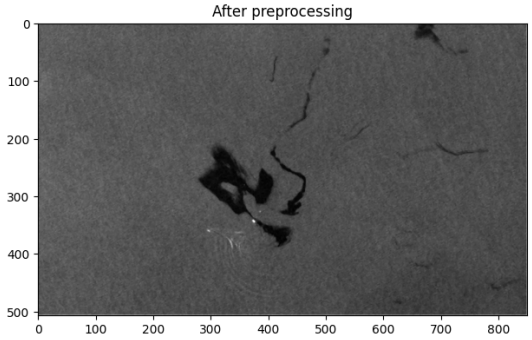
[20]:
```
img = sar2.copy()
imgCopy = sar2.copy()

# image preprocessing first

plotHistogram(img, img, "Before any preprocessing")
plt.show()

# image stats first
r, c = img.shape
print("Image Resolution:", r, "x", c)

# apply median filter to remove noise from the image
plt.figure(figsize=(25, 25))
final = cv2.medianBlur(img, 3)

plotHistogram(img, final, "After preprocessing")
plt.show()

img = final.copy()
```

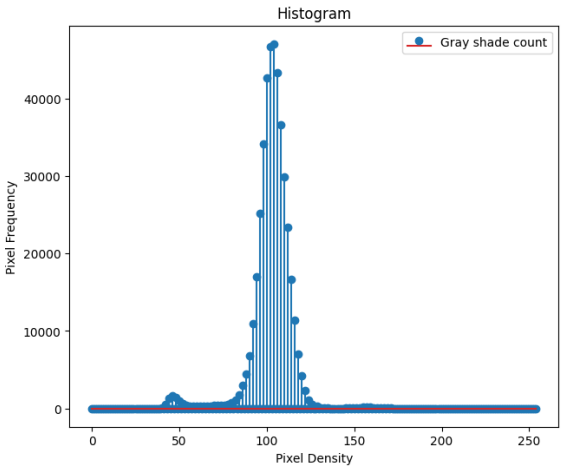


```
Image Resolution: 507 x 850
```

```
<Figure size 2500x2500 with 0 Axes>
```




**Selecting the proper threshold as the histogram shown above as 70**

[21]:
```
plt.figure(figsize=(20, 20))
SE = cv2.getStructuringElement(cv2.MORPH_RECT, (3, 3))

# thresholding
for i in range(r):
  for j in range(c):
    img[i, j] = 0 if img[i, j] > 70 else 255
```

```
<Figure size 2000x2000 with 0 Axes>
```

**Performing Opening Morphological Operation to get rid of any noise dots in the background**

[22]:
```
plt.figure(figsize=(20, 20))

# erording image
erodedImage = cv2.erode(img, SE)

# then dilating image
openImage = cv2.dilate(erodedImage, SE)

plt.subplot(131)
plt.imshow(img, cmap="gray")
plt.title("Pre-processed image")
```

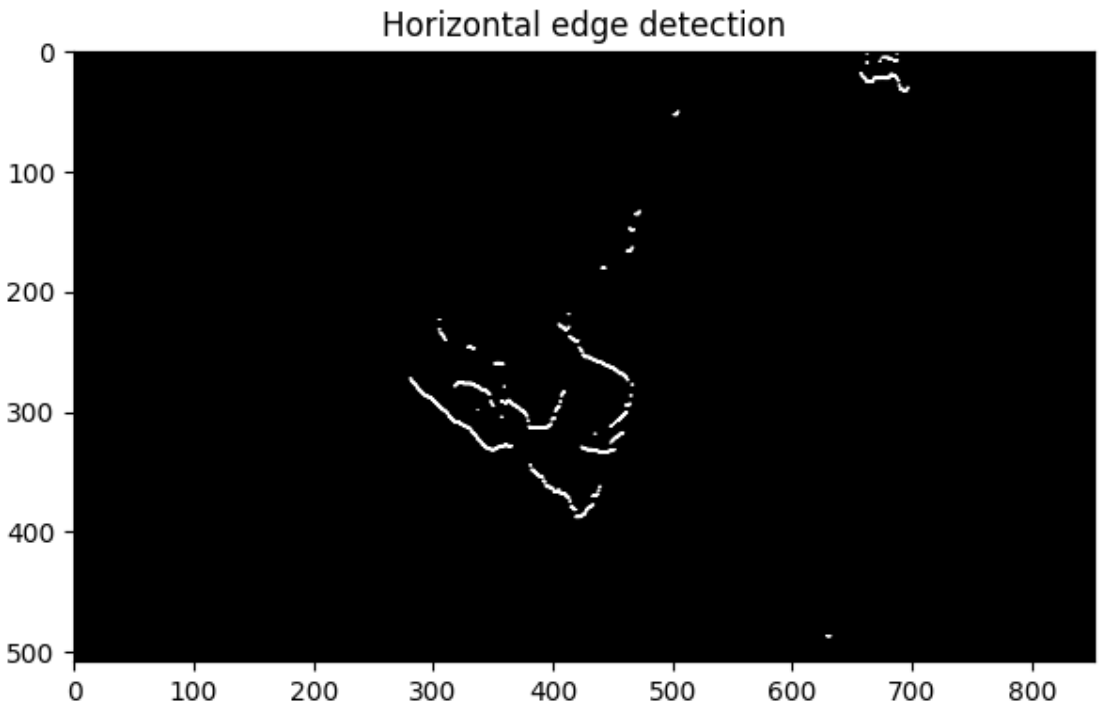
```
plt.axis("off")
plt.subplot(132)
plt.imshow(openImage, cmap="gray")
plt.title("Opened Image")
plt.axis("off")
```

[22]: (-0.5, 849.5, 506.5, -0.5)


**Identifying the edges of the oil spill to identify the actual spread rather than the region**

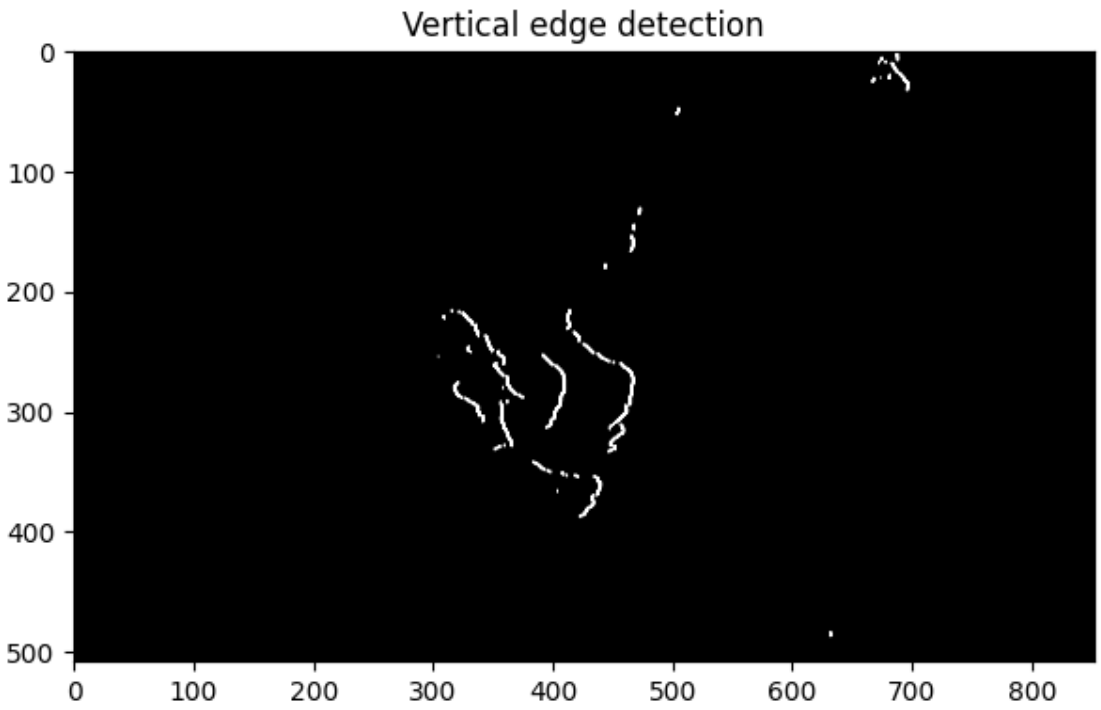
[23]:
```
#Detect horizontal edges using in built convolution function
mask = [
    [-1, -2, -1],
    [0, 0, 0],
    [1, 2, 1],
]

outputHorizontal = signal.convolve2d(openImage, mask)

# showing the output image after convolution
plt.figure(figsize=(7, 7))
plt.imshow(outputHorizontal, cmap="gray", vmin=0, vmax=255)
plt.title("Horizontal edge detection")
```

[23]: Text(0.5, 1.0, 'Horizontal edge detection')



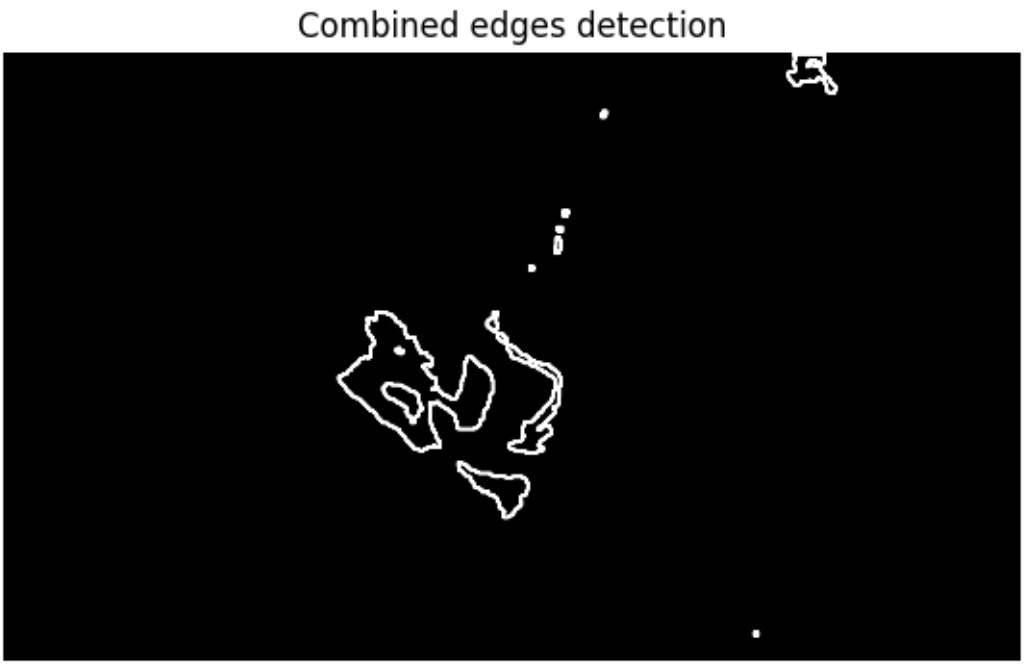

[24]:
```
#Detect vertical edges using inbuilt function for convolution
mask = [
    [-1, 0, 1],
    [-2, 0, 2],
    [-1, 0, 1],
]

outputVertical = signal.convolve2d(openImage, mask)

# showing the output image after convolution
plt.figure(figsize=(7, 7))
plt.imshow(outputVertical, cmap="gray", vmin=0, vmax=255)
plt.title("Vertical edge detection")
```

[24]:
```
Text(0.5, 1.0, 'Vertical edge detection')
```



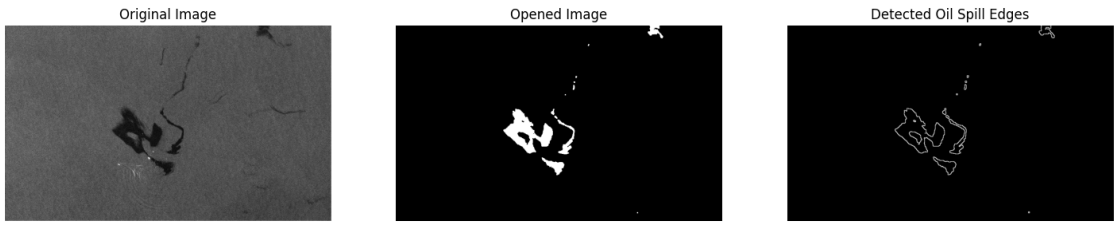

[25]:
```
# Detecting vertical and horizontal edges
G = np.absolute(outputVertical) + np.absolute(outputHorizontal)

# showing the output image after adding them
plt.figure(figsize=(15, 15))
plt.subplot(121)
plt.imshow(G, cmap="gray", vmin=0, vmax=255)
plt.title("Combined edges detection")
plt.axis("off")
```

[25]: (-0.5, 851.5, 508.5, -0.5)



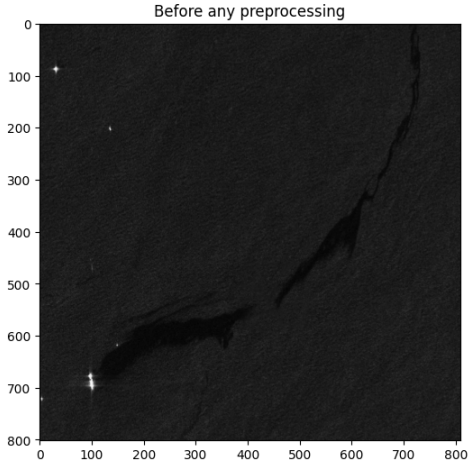

[26]:
```
# final comparison of the original and the gotten images
plt.figure(figsize=(18, 18))
plt.subplot(131)
plt.imshow(imgCopy, cmap="gray")
plt.axis("off")
plt.title("Original Image")
plt.subplot(132)
plt.imshow(openImage, cmap="gray")
plt.axis("off")
plt.title("Opened Image")
plt.subplot(133)
plt.imshow(G, cmap="gray")
plt.axis("off")
plt.title("Detected Oil Spill Edges")
```

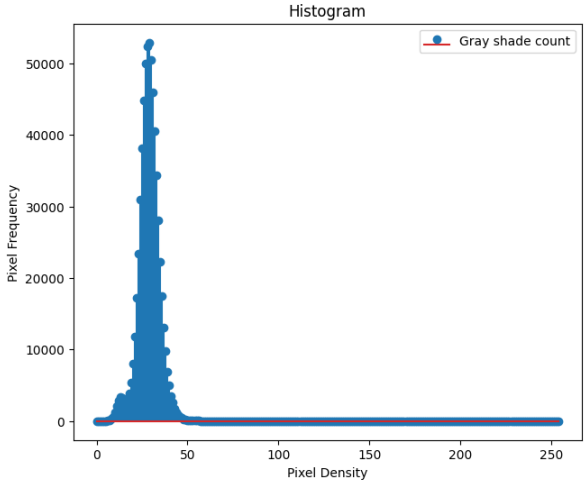
[26]:
```
Text(0.5, 1.0, 'Detected Oil Spill Edges')
```



# 1 Working on SAR Images with low contrast

[27]:
```
img = sar3.copy()
imgCopy = sar3.copy()

# image preprocessing first

plotHistogram(img, img, "Before any preprocessing")
plt.show()

# image stats first
r, c = img.shape
print("Image Resolution:", r, "x", c)
```



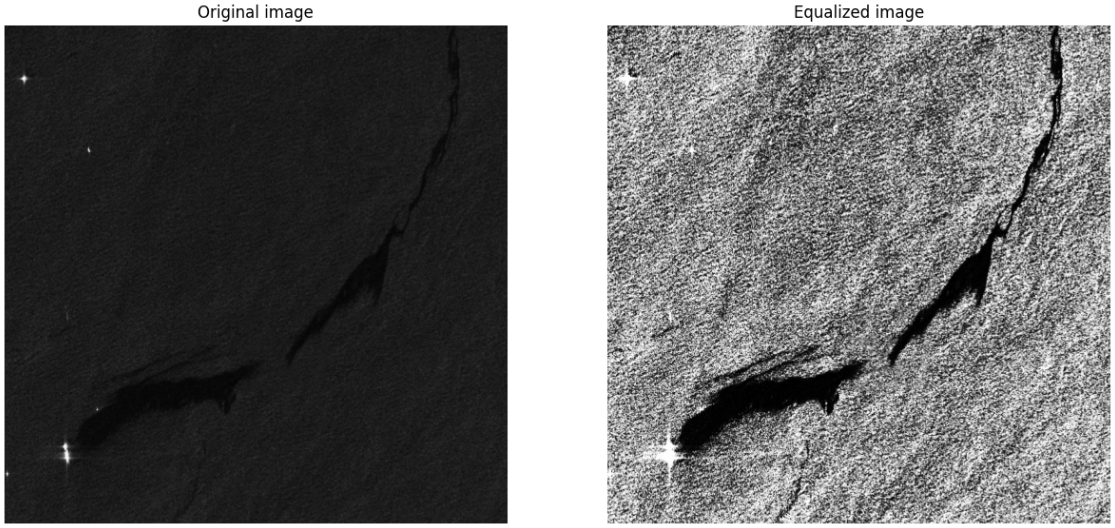

```
Image Resolution: 801 x 809
```

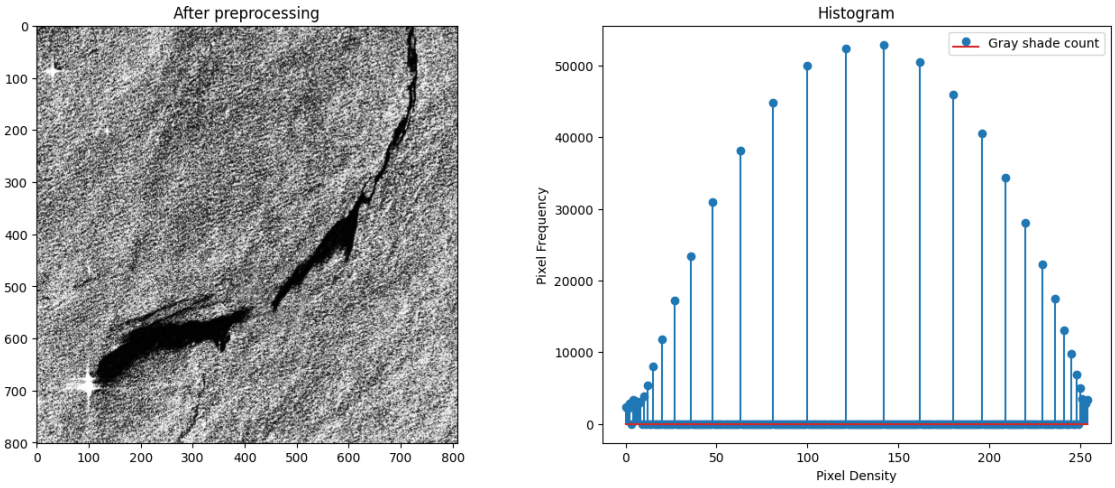
### 1.0.1 After plotting the histogram, we can see due to the low contrast of the image, we can barely see any spots visible (have to strain our eyes)

Solution: Histogram equalization

[28]:
```
count, value = np.histogram(img, 255, [0, 255])
cdf = count.cumsum() / count.sum()
eq = (cdf * 255).astype(int)

for i in range(r):
  for j in range(c):
    img[i, j] = eq[img[i, j]]
```

[29]:
```
plt.figure(figsize = (15, 10))
plt.subplot(1, 2, 1)
plt.imshow(imgCopy, cmap="gray")
plt.title("Original image")
plt.axis("off")
plt.subplot(1, 2, 2)
plt.imshow(img, cmap="gray")
plt.axis("off")
plt.title("Equalized image")
plt.show()

# plotting the new histogram of the equalized image
plotHistogram(img, img, "After preprocessing")
plt.show()
```

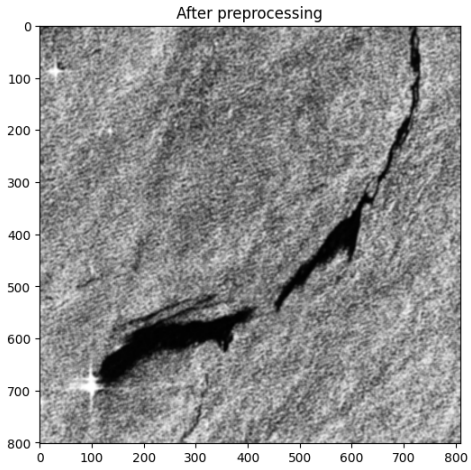


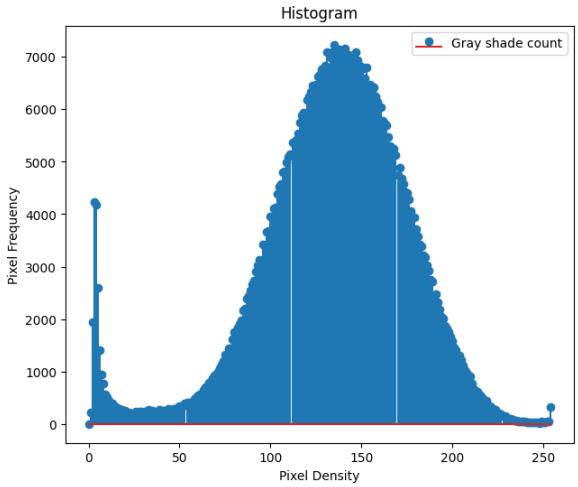



As you can see, our image has too many details visible. Since we don't have so much details in our image we'll try to reduce the background noise.

[30]:
```
# apply median filter to remove noise from the image
plt.figure(figsize=(25, 25))
final = cv2.blur(img, (5, 5))

plotHistogram(img, final, "After preprocessing")
plt.show()

img = final.copy()
```

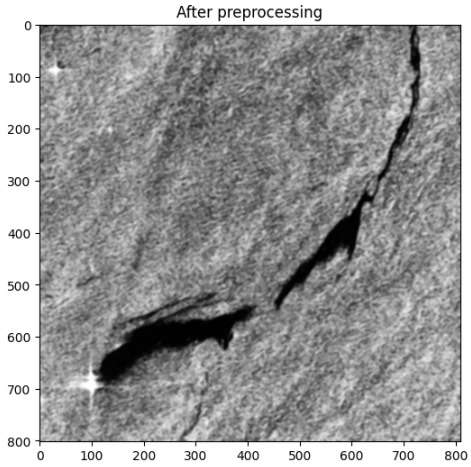
```
<Figure size 2500x2500 with 0 Axes>
```

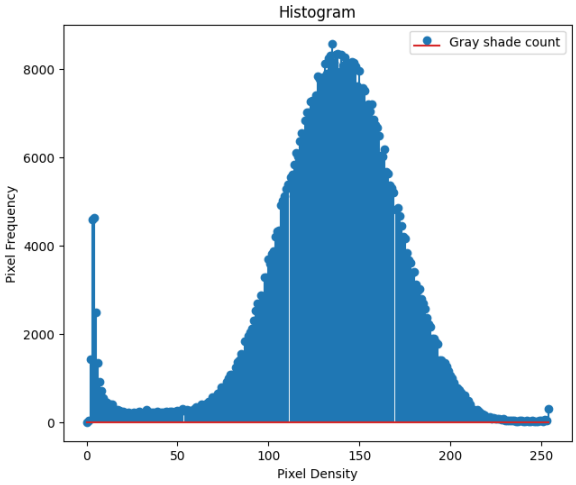



[31]:
```
# apply median filter to remove noise from the image
plt.figure(figsize=(25, 25))
final = cv2.medianBlur(img, 5)

plotHistogram(img, final, "After preprocessing")
plt.show()
```

```
<Figure size 2500x2500 with 0 Axes>
```



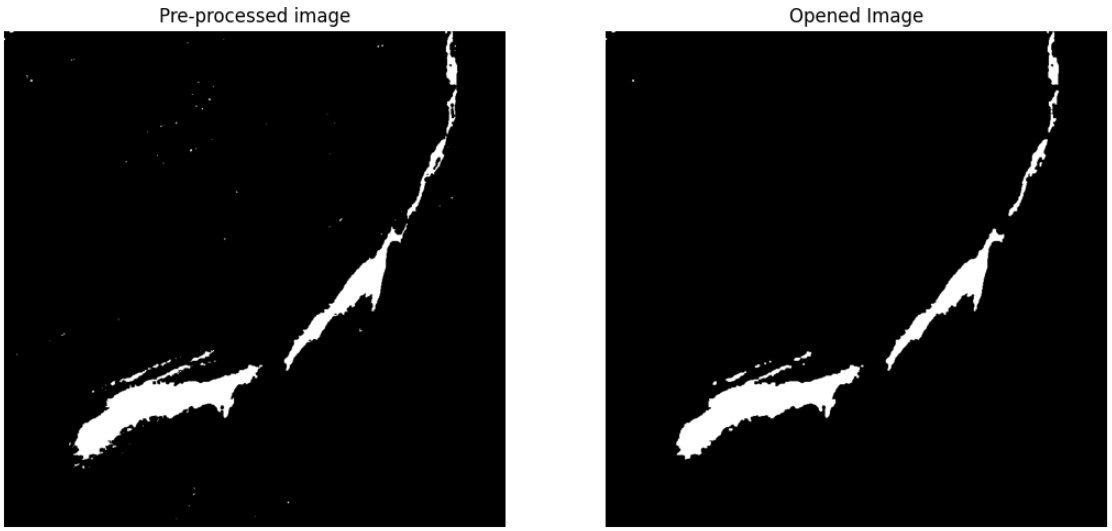

### Selecting threshold as 40

[32]:
```
plt.figure(figsize=(20, 20))
SE = cv2.getStructuringElement(cv2.MORPH_RECT, (3, 3))

# thresholding
for i in range(r):
  for j in range(c):
    img[i, j] = 0 if img[i, j] > 40 else 255
```

```
<Figure size 2000x2000 with 0 Axes>
```

[33]:
```
plt.figure(figsize=(20, 20))

# erording image
erodedImage = cv2.erode(img, SE)

# then dilating image
openImage = cv2.dilate(erodedImage, SE)


plt.subplot(131)
plt.imshow(img, cmap="gray")
plt.title("Pre-processed image")
plt.axis("off")
plt.subplot(132)
plt.imshow(openImage, cmap="gray")
plt.title("Opened Image")
plt.axis("off")
```

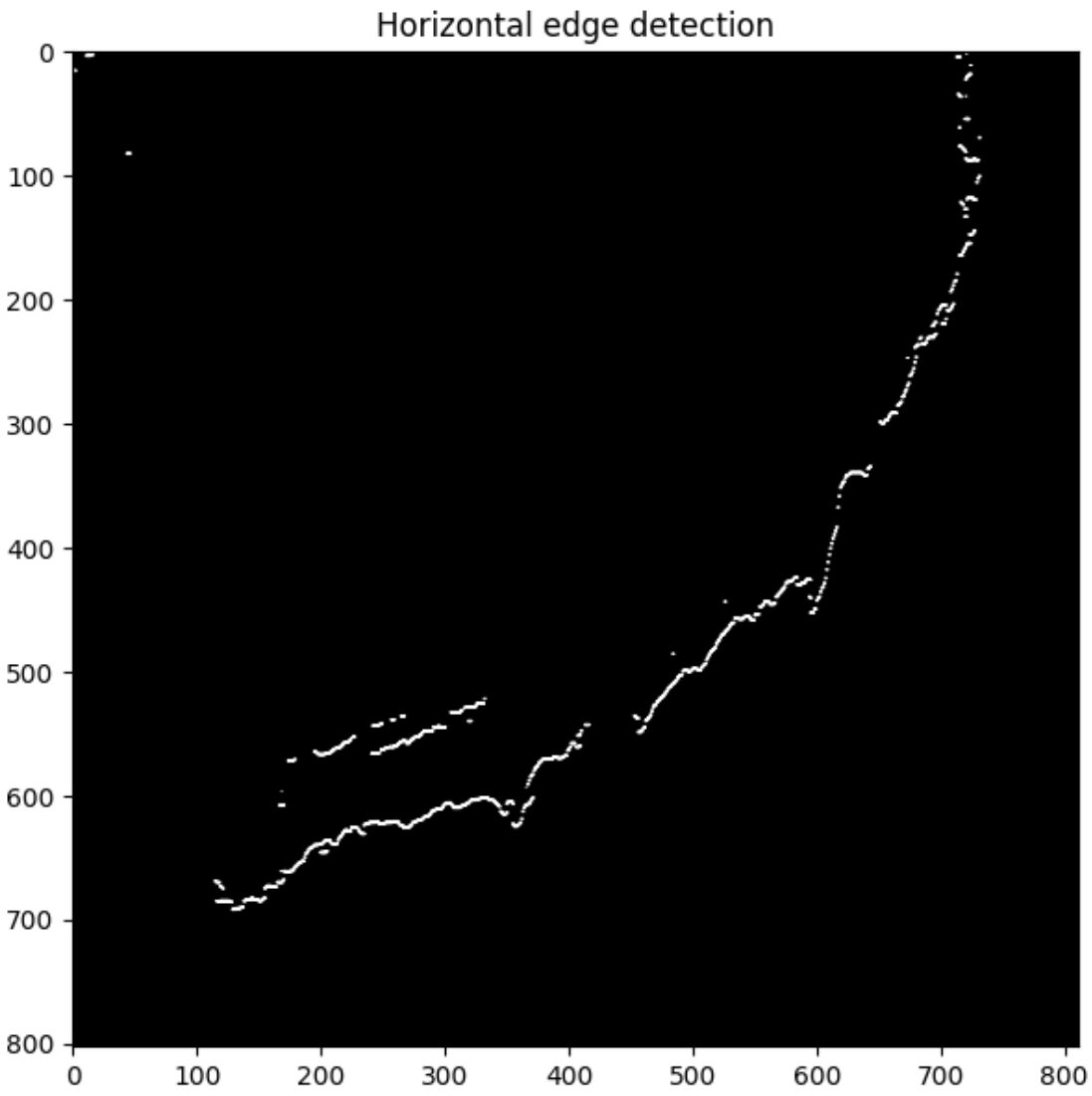
[33]:
```
(-0.5, 808.5, 800.5, -0.5)
```




Detecting the edges and the boundary of the affected region due to Oil Spill

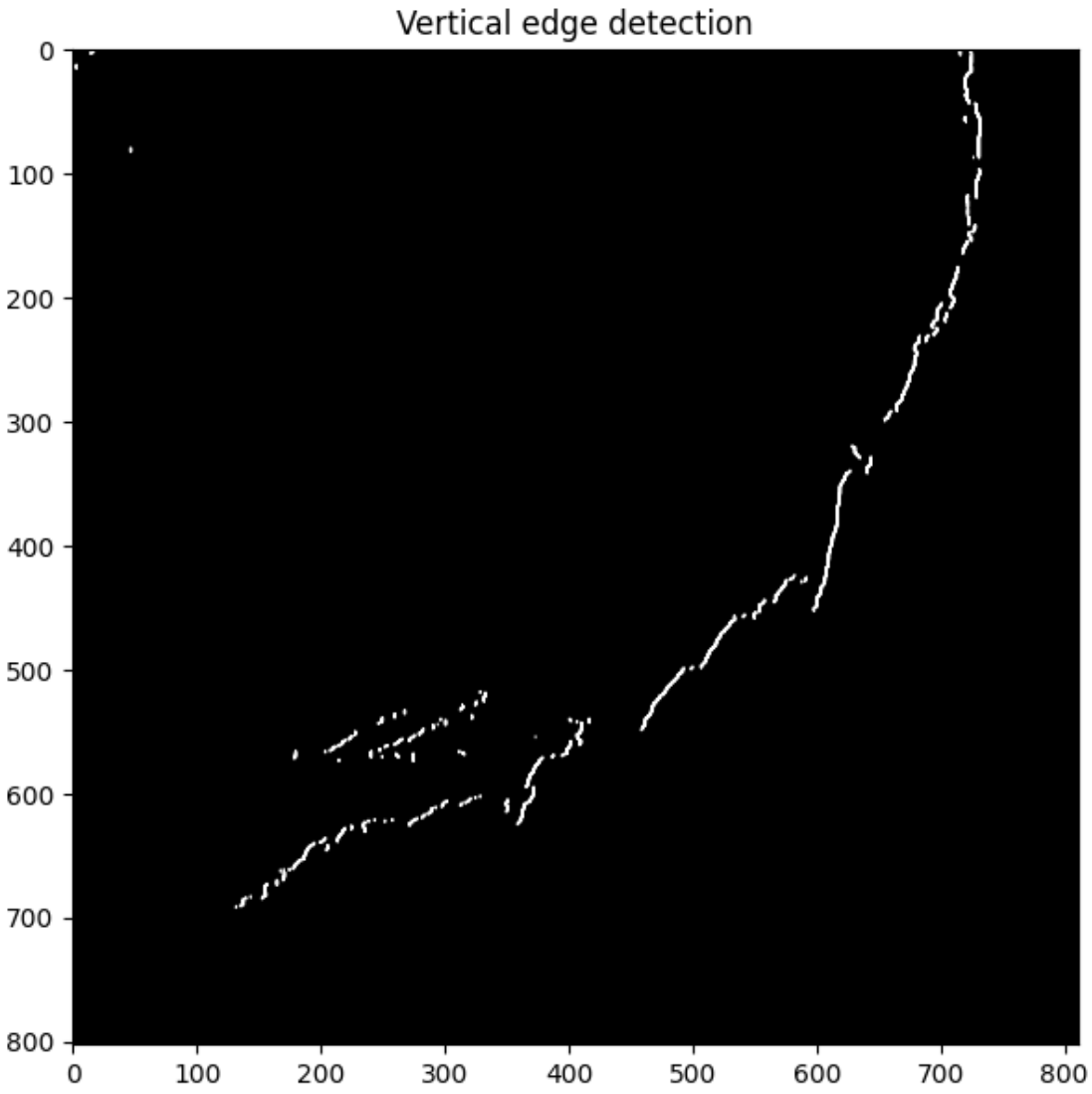
[34]:
```
#Detect horizontal edges using in built convolution function
mask = [
    [-1, -2, -1],
    [0, 0, 0],
    [1, 2, 1],
]

outputHorizontal = signal.convolve2d(openImage, mask)

# showing the output image after convolution
plt.figure(figsize=(7, 7))
plt.imshow(outputHorizontal, cmap="gray", vmin=0, vmax=255)
plt.title("Horizontal edge detection")
```

[34]:
```
Text(0.5, 1.0, 'Horizontal edge detection')
```



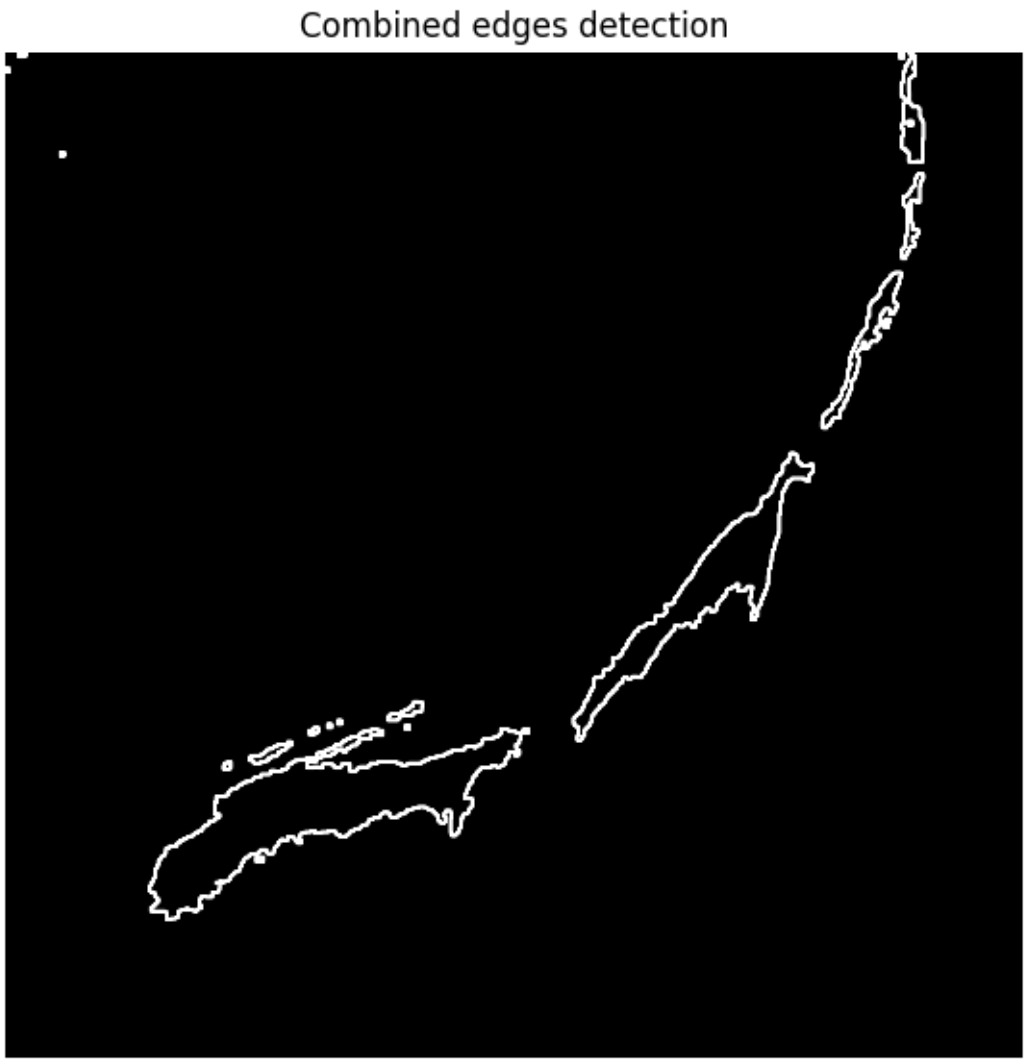

[35]:
```
#Detect vertical edges using inbuilt function for convolution
mask = [
    [-1, 0, 1],
    [-2, 0, 2],
    [-1, 0, 1],
]

outputVertical = signal.convolve2d(openImage, mask)

# showing the output image after convolution
plt.figure(figsize=(7, 7))
plt.imshow(outputVertical, cmap="gray", vmin=0, vmax=255)
plt.title("Vertical edge detection")
```

[35]: Text(0.5, 1.0, 'Vertical edge detection')




[36]:
```
# Detecting vertical and horizontal edges
G = np.absolute(outputVertical) + np.absolute(outputHorizontal)

# showing the output image after adding them
plt.figure(figsize=(15, 15))
plt.subplot(121)
plt.imshow(G, cmap="gray", vmin=0, vmax=255)
plt.title("Combined edges detection")
plt.axis("off")
```

[36]: (-0.5, 810.5, 802.5, -0.5)




[37]:
```
# final comparison of the original and the gotten images
plt.figure(figsize=(18, 18))
plt.subplot(131)
plt.imshow(imgCopy, cmap="gray")
plt.axis("off")
plt.title("Original Image")
plt.subplot(132)
plt.imshow(openImage, cmap="gray")
plt.axis("off")
plt.title("Opened Image")
plt.subplot(133)
plt.imshow(G, cmap="gray")
plt.axis("off")
plt.title("Detected Oil Spill Edges")
```

[37]: Text(0.5, 1.0, 'Detected Oil Spill Edges')