lab2

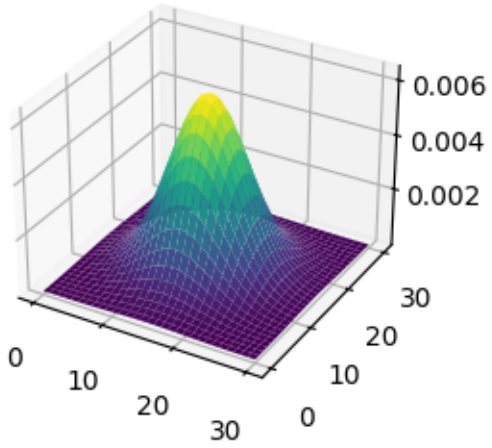
January 24, 2024

Part 1:

[26]:
```
import numpy as np
import cv2 as cv
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import axes3d, Axes3D
import random
```

[27]:
```
#Import the image and display in a window
img = cv.imread('saphira.jpg')


#Create a kernle with a square matrix of 31x31
#divide the matrix by (31^2) = 961 to average it
kernelmean = np.ones((31,31),np.float32)/ 961

#Apply averaging kernel into image to filter
avgfilter = cv.filter2D(img,-1,kernelmean)
```

[28]:
```
#Get Gaussian filter
gauss = cv.getGaussianKernel(31, 5)
gaus = np.outer(gauss,gauss)

#Surface plot of Gaussian Filter
n = 31
fig = plt.figure()
ax = fig.add_subplot(1,2,1, projection='3d')
x = np.arange(0, n, 1)
y = np.arange(0, n, 1)
X, Y = np.meshgrid(x, y)
Z = gaus.flatten()
ax.plot_surface(X, Y, gaus, cmap='viridis')
plt.show()
```



[29]:
```
#Apply the Gaussian blur on the image
blur = cv.GaussianBlur(img,(31,31),5)

#Concatenate the images in the same window
window2 = cv.hconcat([img,avgfilter, blur])
# cv.imshow('Original + Average Filter + Gaussian Blur Filter', window2)
plt.imshow(window2)
plt.title('Original + Average Filter + Gaussian Blur Filter'), plt.xticks([]),␣
 ↪plt.yticks([])
plt.show()
```

[30]:
```
def add_noise(img):

    # Getting the dimensions of the image
    row , col, c = img.shape

    # Randomly pick some pixels in the
    # image for coloring them white
```

```
    # Pick a random number between 300 and 10000
    number_of_pixels = random.randint(300, 10000)
    for i in range(number_of_pixels):

        # Pick a random y coordinate
        y_coord=random.randint(0, row - 1)

        # Pick a random x coordinate
        x_coord=random.randint(0, col - 1)

        # Color that pixel to white
        img[y_coord][x_coord] = 255

        # Randomly pick some pixels in
        # the image for coloring them black
        # Pick a random number between 300 and 10000
    number_of_pixels = random.randint(300 , 10000)
    for i in range(number_of_pixels):

        # Pick a random y coordinate
        y_coord=random.randint(0, row - 1)

        # Pick a random x coordinate
        x_coord=random.randint(0, col - 1)

        # Color that pixel to black
        img[y_coord][x_coord] = 0


    return img
```

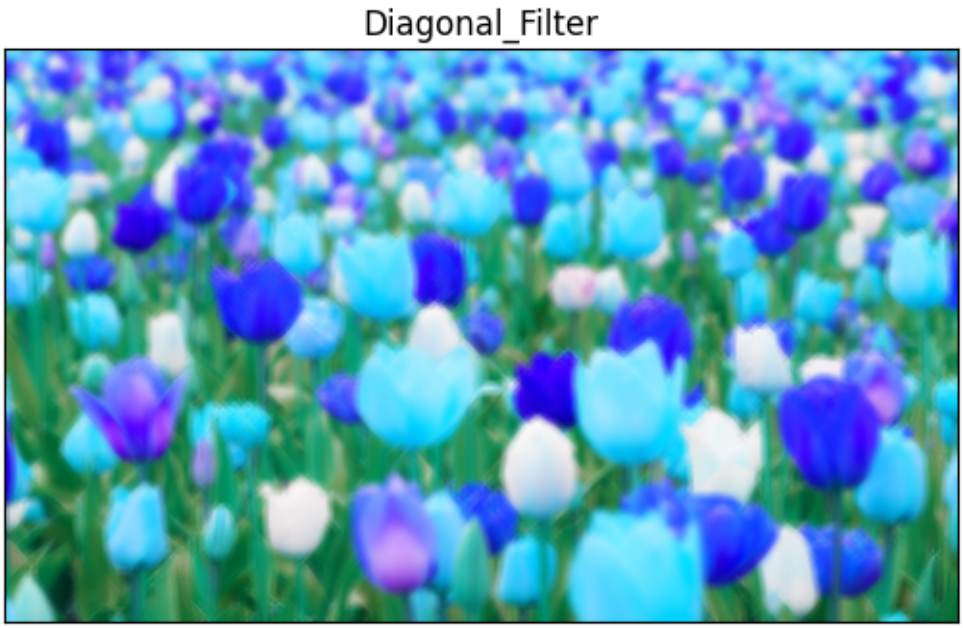
[31]:
```
#Convert the image to Grayscale to be used to add noise
#Save the image to the directory
#gray = cv.imread('saphira.jpg',cv.IMREAD_GRAYSCALE)
cv.imwrite('salt-n-pepper.jpg',add_noise(img))
salt_n_peppa = cv.imread('salt-n-pepper.jpg')
```

[32]:
```

#Create a kernle with a square matrix of 3x3
#divide the matrix by 3^2 = 9 to average
kernelmean2 = np.ones((3,3),np.float32)/ 9

#Apply averaging kernel into image to filter
avgfilter2 = cv.filter2D(salt_n_peppa,-1,kernelmean2)


#Apply the Gaussian blur on the image
```

```
blur2 = cv.GaussianBlur(salt_n_peppa,(3,3),0.5)


#Add Median Blur
med = cv.medianBlur(salt_n_peppa,3)

#Concatenate the images in the same window
window3 = cv.hconcat([salt_n_peppa,avgfilter2, blur2, med])
# cv.imshow('Salt N Pepper Picture + Averaging Filter + Gausiann Filter +␣
 ↪Median Blur', window3)
plt.imshow(window3)
plt.title('Salt N Pepper Picture + Averaging Filter + Gausiann Filter + Median␣
 ↪Blur'), plt.xticks([]), plt.yticks([])
plt.show()

# cv.waitKey(0)
# cv.destroyAllWindows()
```

Part 2:

[33]:
```
#Import image tulips.jpg
tulips = cv.imread('tulips.jpg')
tulips = cv.resize(tulips,(500,300))

#Create kernel with 1's on the diagonals, then divide by 9 for average
img_kernel = np.array([[1,0,0,0,1],[0,1,0,1,0], [0,0,1,0,0],␣
 ↪[0,1,0,1,0],[1,0,0,0,1]])
img_kernel = img_kernel/9

flt_img = cv.filter2D(tulips,-1,img_kernel)

# cv.imshow('Diagonal_Filter', flt_img)
plt.imshow(flt_img)
plt.title('Diagonal_Filter'), plt.xticks([]), plt.yticks([])
plt.show()
```



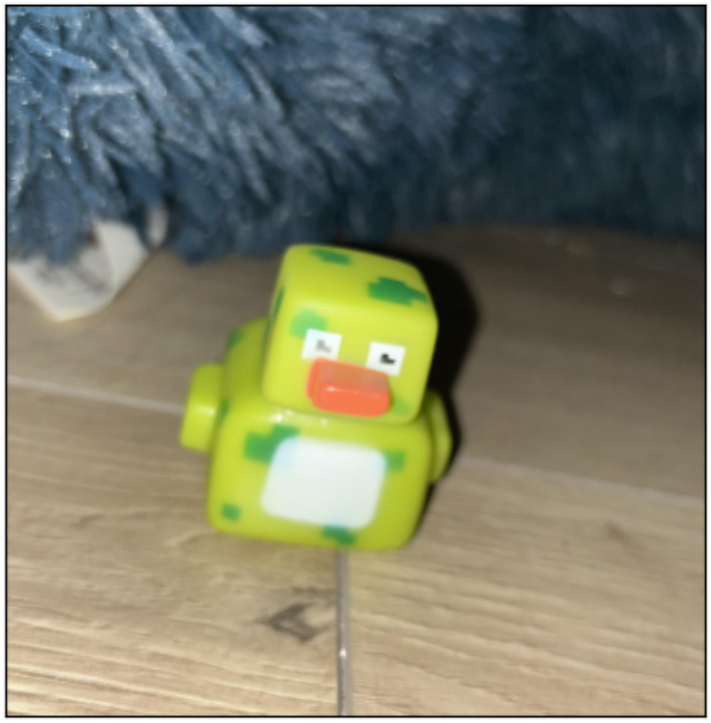
Part 3:

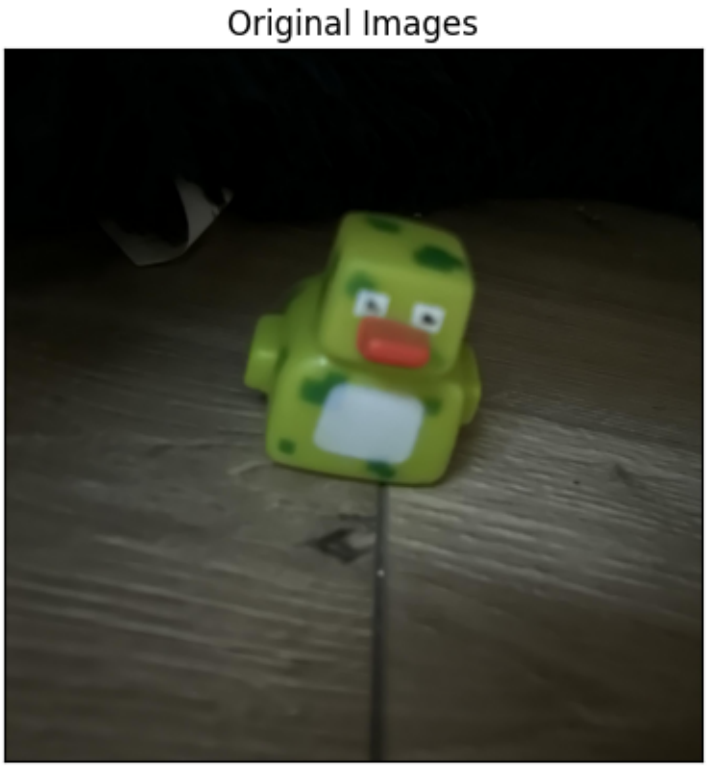
[52]:
```
image_list = ['image1.jpg', 'image2.jpg', 'image3.jpg', 'image4.jpg']
test_images = [cv.imread(image_list[0]), cv.imread(image_list[1]), cv.
 ↪imread(image_list[2]), cv.imread(image_list[3])]


for image in range(len(test_images)):
    test_images[image] = cv.cvtColor(test_images[image], cv.COLOR_BGR2RGB)
    plt.imshow(test_images[image])
    plt.title('Original Images'), plt.xticks([]), plt.yticks([])
    plt.show()
```

Original Images

Original Images

Original Images

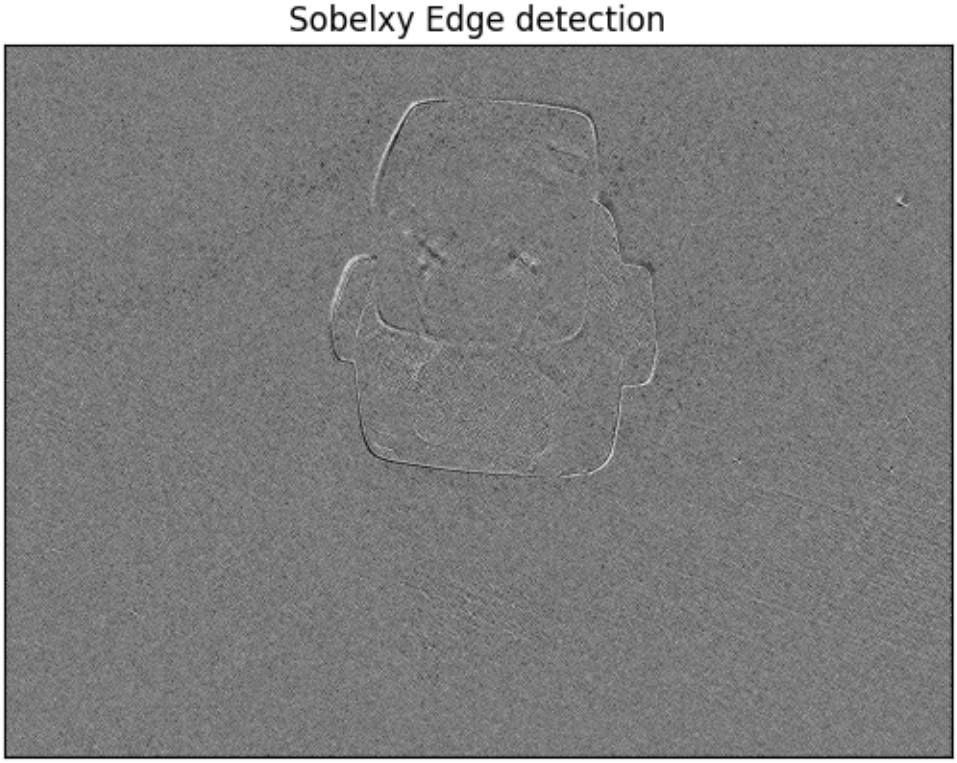




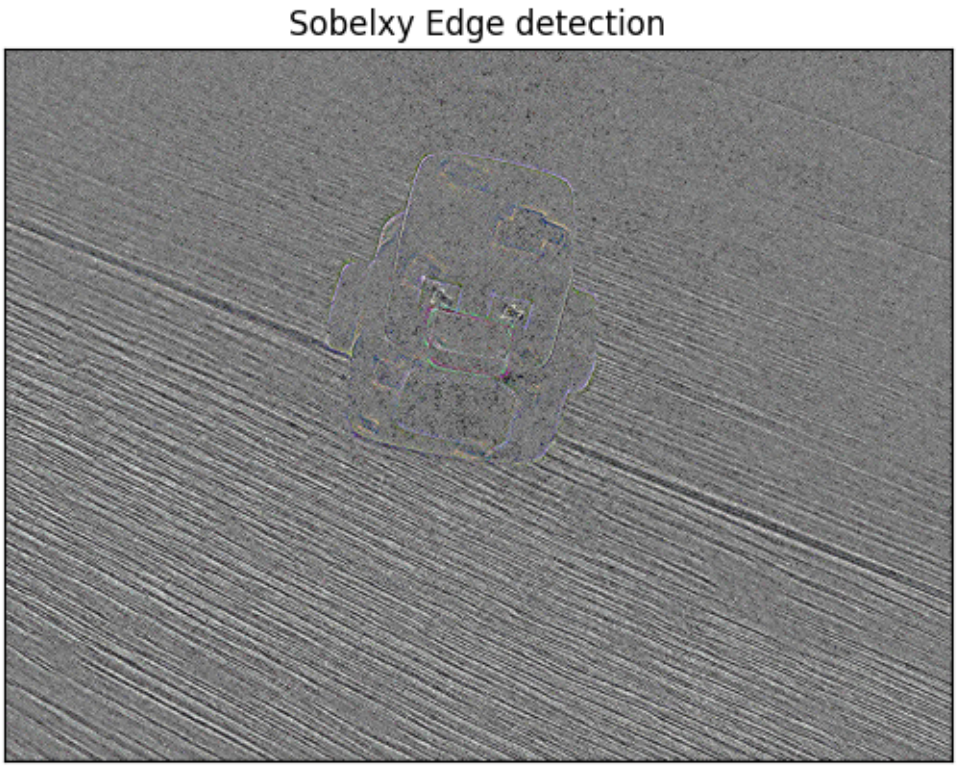
Testing the Sobel edge detection algorithm:

[73]:
```
gray_images = []
sobelxy_images = []
for image in range(len(test_images)):
    # Convert to graycsale
    test_images[image] = cv.cvtColor(test_images[image], cv.COLOR_RGB2BGR)
    gray_images.append(cv.cvtColor(test_images[image], cv.COLOR_BGR2GRAY))
    # Blur the image for better edge detection
    gray_images[image] = cv.GaussianBlur(test_images[image], (3,3), 0)

    sobelxy_images.append(cv.Sobel(src=gray_images[image], ddepth=cv.CV_64F,␣
 ↪dx=1, dy=1, ksize=5))
    plt.imshow(sobelxy_images[image], cmap='gray')
    plt.title('Sobelxy Edge detection'), plt.xticks([]), plt.yticks([])
    plt.show()
```

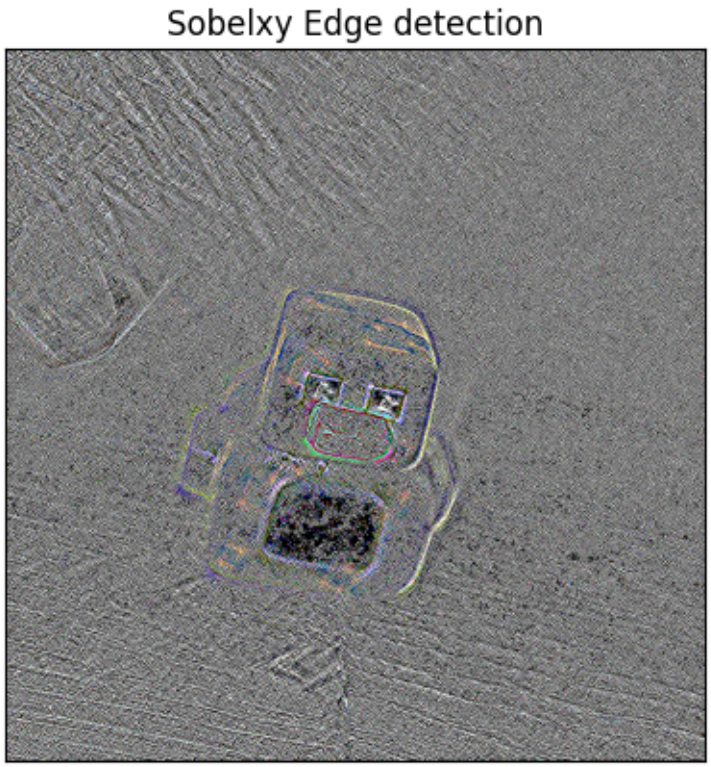
```
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers).
```



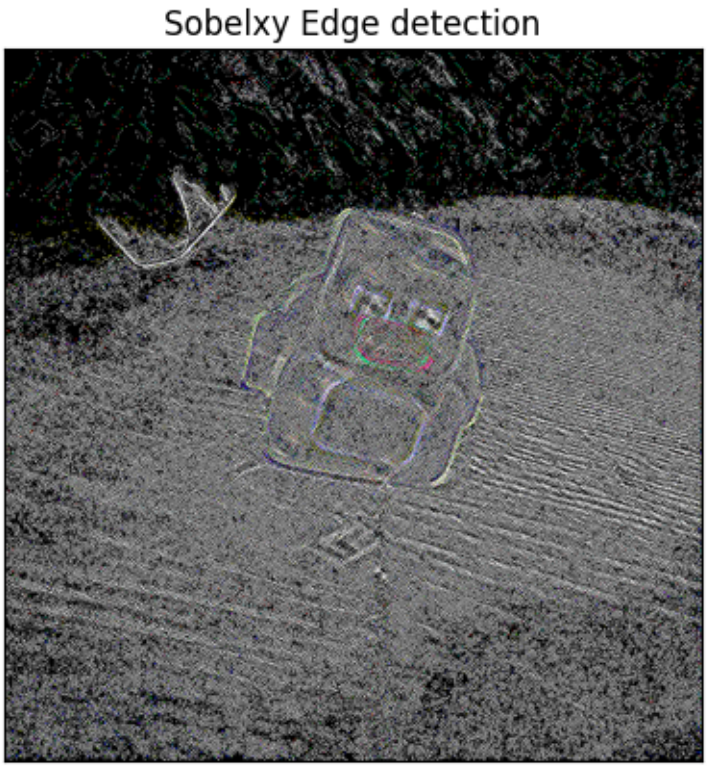

```
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers).
```




```
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers).
```



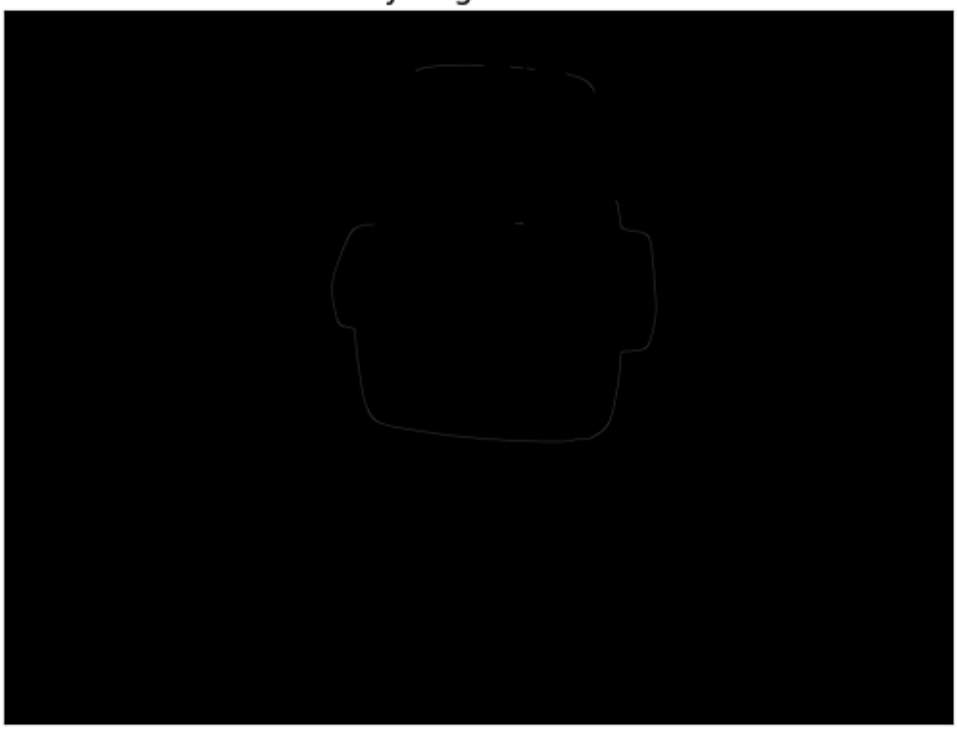

```
Clipping input data to the valid range for imshow with RGB data ([0..1] for
floats or [0..255] for integers).
```



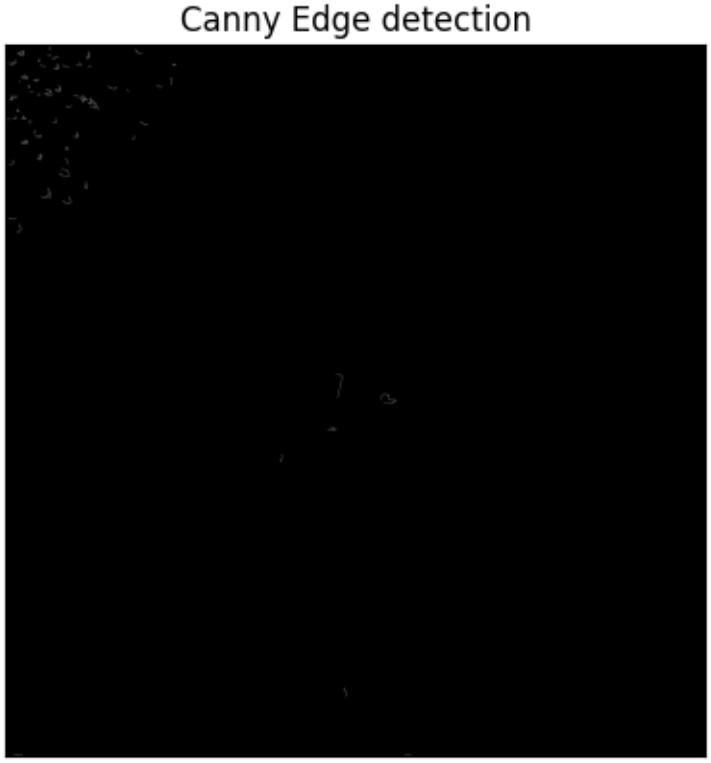
The sobel algorithm seemed to have a lot of spurious edge detection. Now let's try the canny edge detection algorithm:

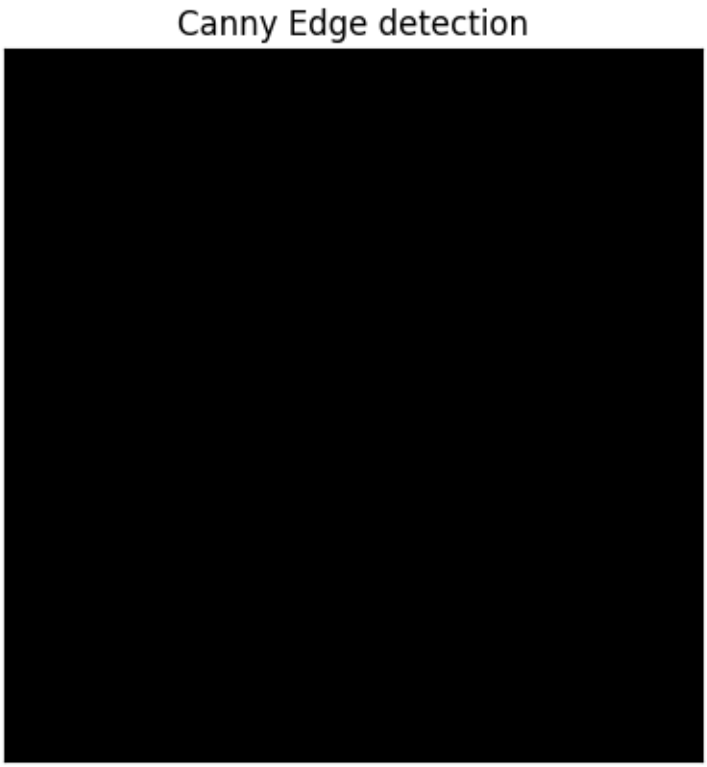
[74]:
```
canny_images = []
for image in range(len(test_images)):

    canny_images.append(cv.Canny(image=gray_images[image], threshold1=100,␣
 ↪threshold2=200))
    plt.imshow(canny_images[image], cmap='gray')
    plt.title('Canny Edge detection'), plt.xticks([]), plt.yticks([])
    plt.show()
```

Canny Edge detection



Canny Edge detection

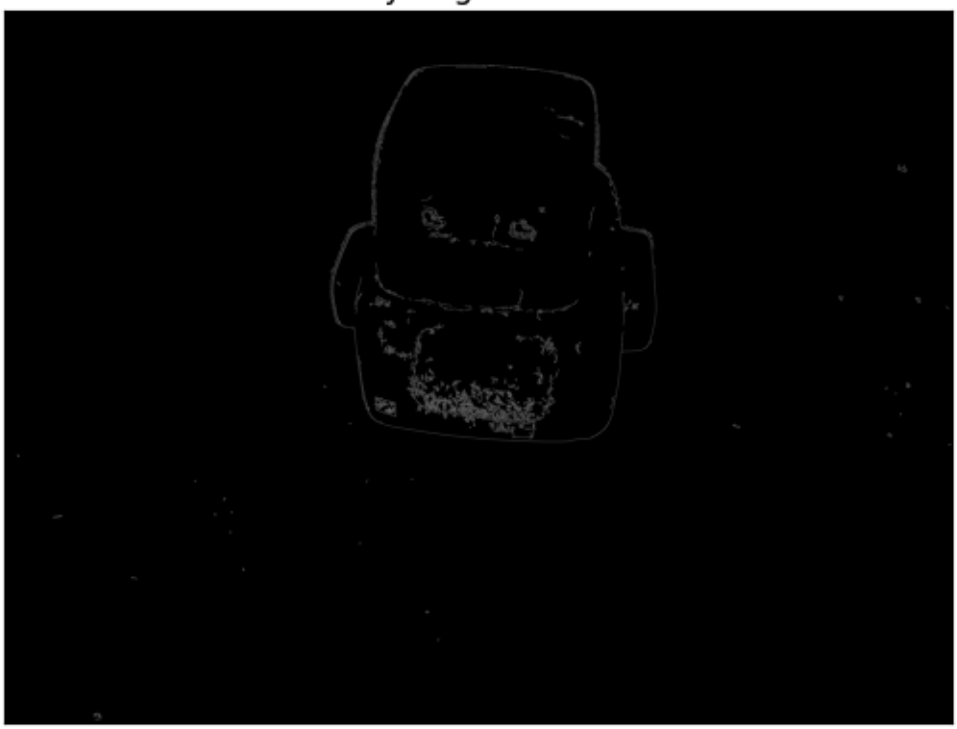

Canny Edge detection



The results of the first attempt at using the Canny edge detection algorithm look unimpressive. Now let's try tuning the threshold values.

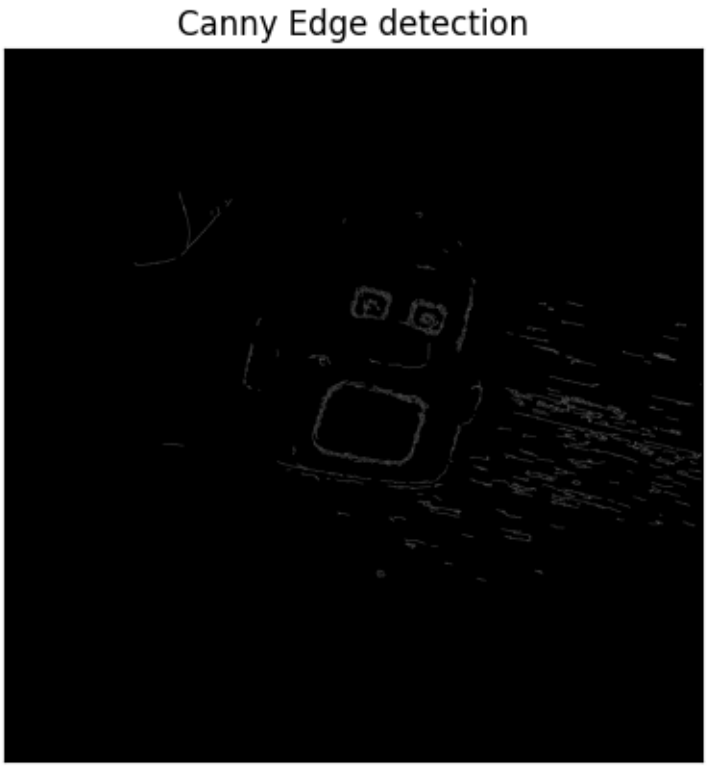
[75]:
```
canny_images = []
for image in range(len(test_images)):

    canny_images.append(cv.Canny(image=gray_images[image], threshold1=10,␣
 ↪threshold2=50))
    plt.imshow(canny_images[image], cmap='gray')
    plt.title('Canny Edge detection'), plt.xticks([]), plt.yticks([])
    plt.show()
```

Canny Edge detection



Canny Edge detection

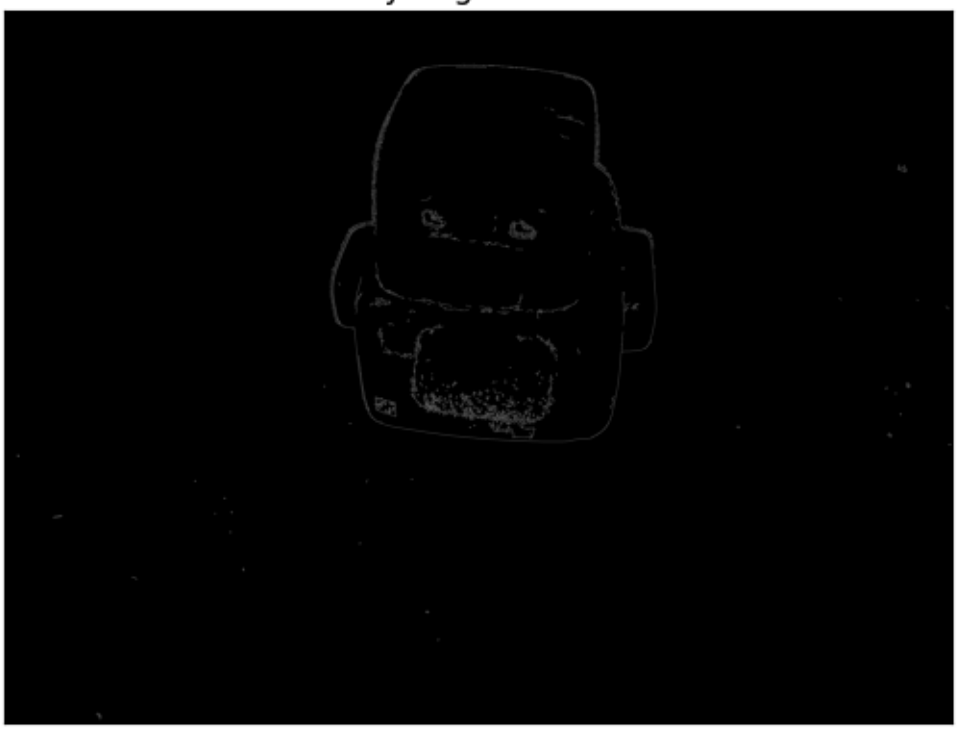
Canny Edge detection



These results are much more impressive. Let's see if we can tune the threshold values further to improve the robustness of this edge detection algorithm.

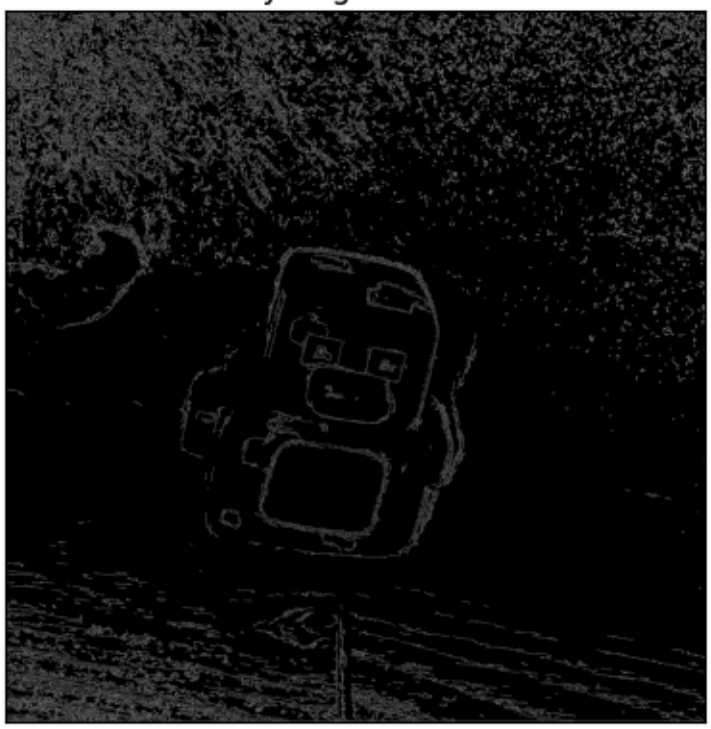
[76]:
```
canny_images = []
for image in range(len(test_images)):

    canny_images.append(cv.Canny(image=gray_images[image], threshold1=20,␣
 ↪threshold2=50))
    plt.imshow(canny_images[image], cmap='gray')
    plt.title('Canny Edge detection'), plt.xticks([]), plt.yticks([])
    plt.show()
```

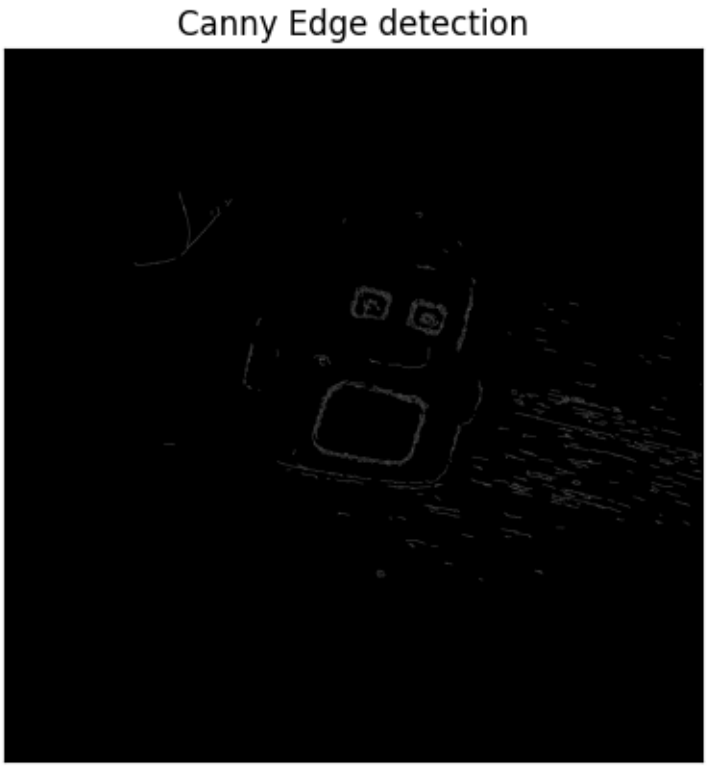
Canny Edge detection



Canny Edge detection

Canny Edge detection





These results prove the Canny edge detection algorithm with the tuned values found through iterative experimentation is a robust edge detecting algorithm.