Non-linear Spatial Filter

March 12, 2024

[4]:
```
import numpy as np
import cv2
import matplotlib.pyplot as plt
```

[2]:
```
image= cv2.imread('img5.jpg', 0)
```

[2]:
```
array([[ 74, 107,  98, …,  92, 113, 108],
       [ 64,  84,  98, …, 102, 106, 113],
       [120,  93,  70, …, 110,  96,  80],
       …,
       [ 14,  17,   8, …,   3,   3,   3],
       [ 12,  13,  11, …,   3,   4,   4],
       [ 15,  14,  20, …,   4,   5,   6]], dtype=uint8)
```

[6]:
```
image_rgb = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)  # for display
```

[7]:
```
plt.imshow(image_rgb)
plt.title('Original Image')
plt.axis('off')
```

[7]:
```
(-0.5, 639.5, 967.5, -0.5)
```

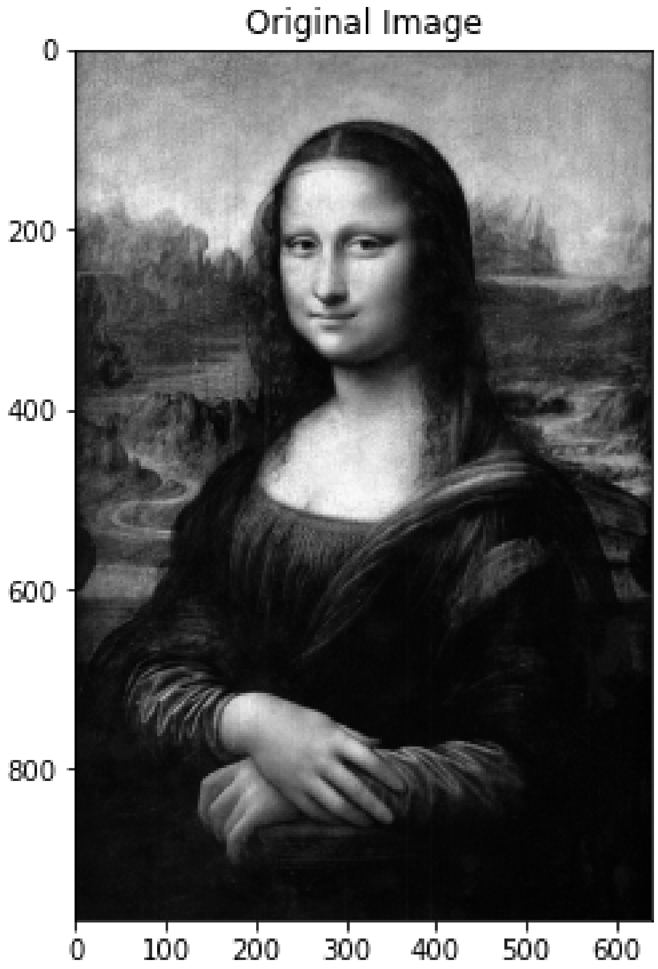
Original Image

[8]:
```
# Median Filter
filtered_image = cv2.medianBlur(image, 5)
```

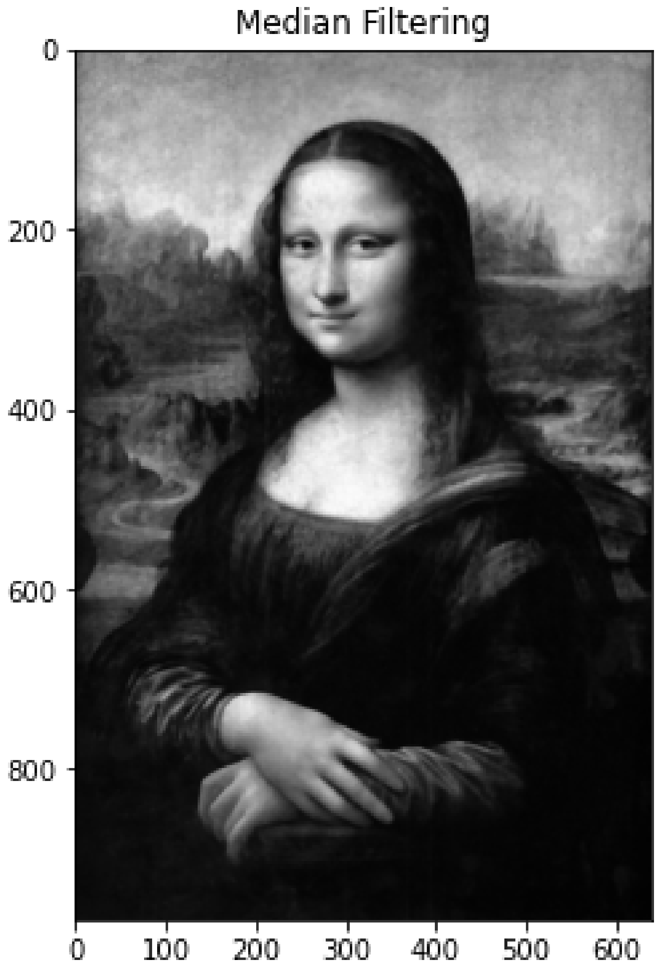
[9]:
```
plt.figure(figsize=(8, 6))
plt.imshow(cv2.cvtColor(image, cv2.COLOR_BGR2RGB))
plt.title('Original Image')

plt.figure(figsize=(8, 6))
plt.imshow(cv2.cvtColor(filtered_image, cv2.COLOR_BGR2RGB))
plt.title('Median Filtering')
```

```
[9]: Text(0.5, 1.0, 'Median Filtering')
```



Original Image



[10]:
```
# Define a kernel for max and min filtering
kernel = np.ones((5, 5), np.uint8)
```

[11]:
```
# Perform Max filter (Dilation)
max_filtered_image = cv2.dilate(image, kernel)
```

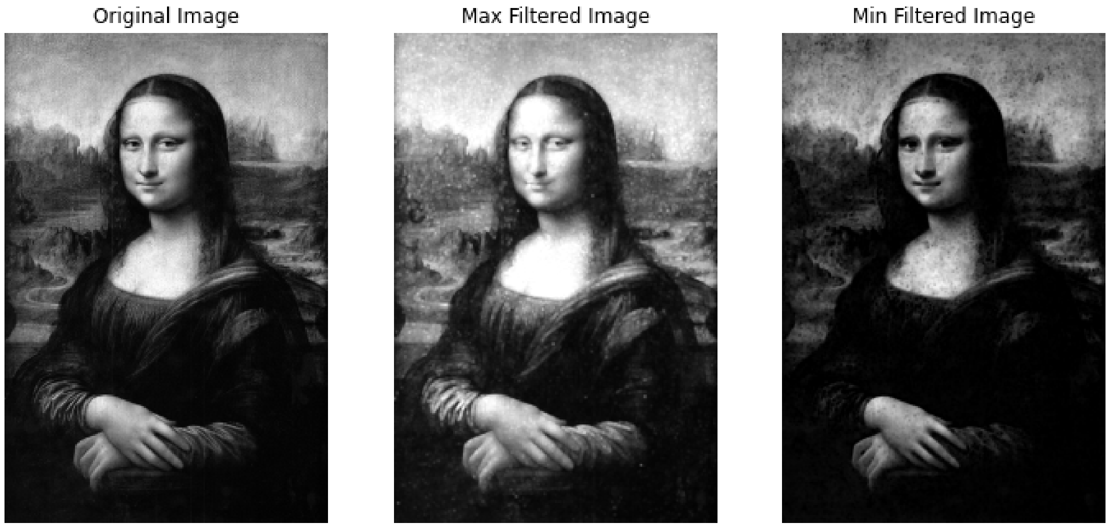
[12]:
```
# Perform Min filter (Erosion)
min_filtered_image = cv2.erode(image, kernel)
```

[13]:
```
# Display the original, max filtered, and min filtered images using matplotlib
plt.figure(figsize=(12, 6))

plt.subplot(1, 3, 1)
plt.imshow(image, cmap='gray')
plt.title('Original Image')
plt.axis('off')
plt.subplot(1, 3, 2)
plt.imshow(max_filtered_image, cmap='gray')
plt.title('Max Filtered Image')
plt.axis('off')

plt.subplot(1, 3, 3)
plt.imshow(min_filtered_image, cmap='gray')
plt.title('Min Filtered Image')
plt.axis('off')

plt.show()
```



[14]:

```
# Mid-point Filtering
# Define the kernel size for the neighborhood
kernel_size = 3
padding_size = kernel_size // 2
```

[15]:

```
# Pad the image to handle border pixels
padded_image = cv2.copyMakeBorder(image, padding_size, padding_size,␣
 ↪padding_size, padding_size, cv2.BORDER_REFLECT)
```

[16]:

```
# Create an empty output image
output_image = np.zeros_like(image)
```

[17]:

```
# Apply midpoint filtering
for i in range(padding_size, padded_image.shape[0] - padding_size):
    for j in range(padding_size, padded_image.shape[1] - padding_size):
            neighborhood = padded_image[i-padding_size:i+padding_size+1,␣
↪j-padding_size:j+padding_size+1]
            min_val = np.min(neighborhood)
            max_val = np.max(neighborhood)
            output_image[i-padding_size, j-padding_size] = (min_val + max_val) // 2
```

```
<ipython-input-17-43c5986a26a6>:7: RuntimeWarning: overflow encountered in
ubyte_scalars
  output_image[i-padding_size, j-padding_size] = (min_val + max_val) // 2
```

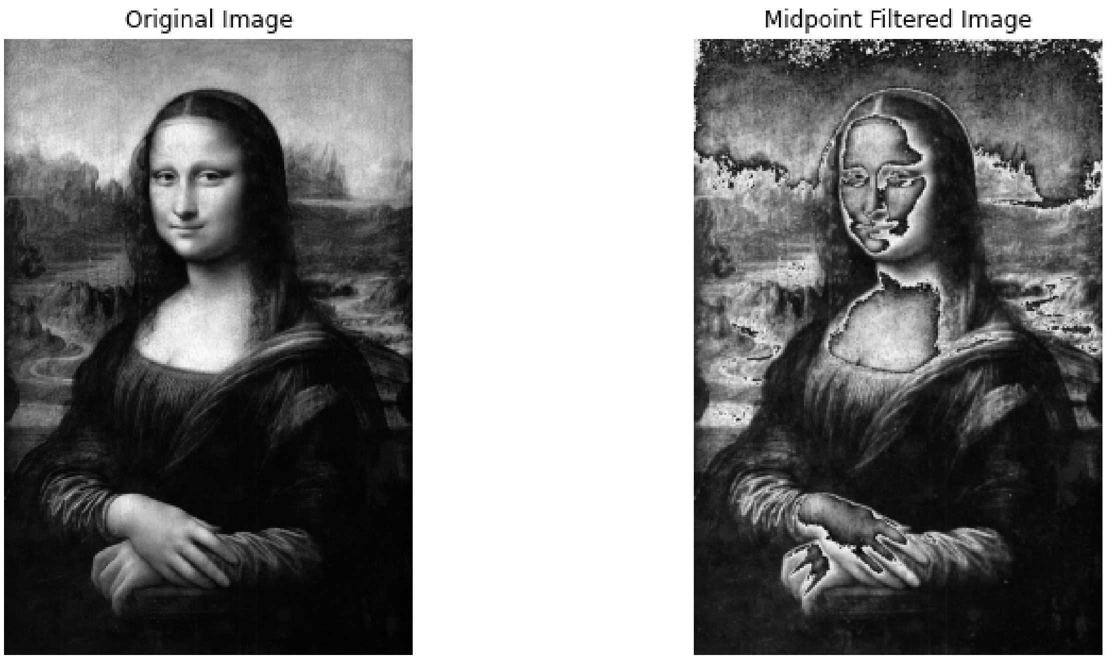
[18]:

```
# Display the original and midpoint filtered images using matplotlib
plt.figure(figsize=(12, 6))

plt.subplot(1, 2, 1)
plt.imshow(image, cmap='gray')
plt.title('Original Image')
plt.axis('off')

plt.subplot(1, 2, 2)
plt.imshow(output_image, cmap='gray')
plt.title('Midpoint Filtered Image')
plt.axis('off')

plt.show()
```



[ ]: