Image Filtering

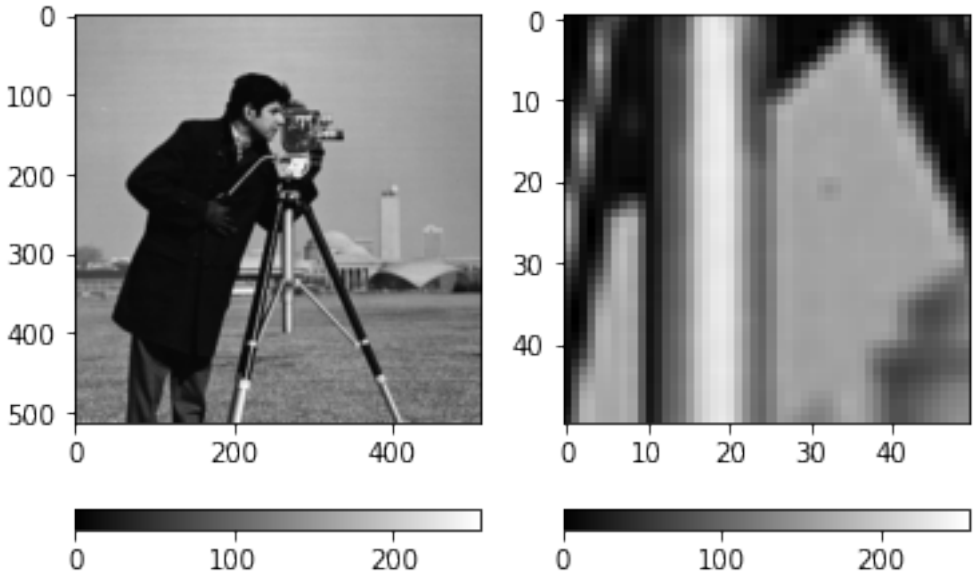
[1]:
```
import numpy as np
import matplotlib.pyplot as plt
from skimage.util import random_noise
from skimage.morphology import square
from skimage import io, data, img_as_ubyte, img_as_float
from skimage.filters import gaussian, laplace, rank
from skimage.restoration import denoise_bilateral, denoise_nl_means,␣
 ↪estimate_sigma
```

1 Noise - zoom

[ ]:
```
im = data.camera()
imn = im[250:300,250:300]

fig = plt.figure()
ax = fig.add_subplot(1, 2, 1)
p = plt.imshow(im, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)

ax = fig.add_subplot(1, 2, 2)
p = plt.imshow(imn, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)
```

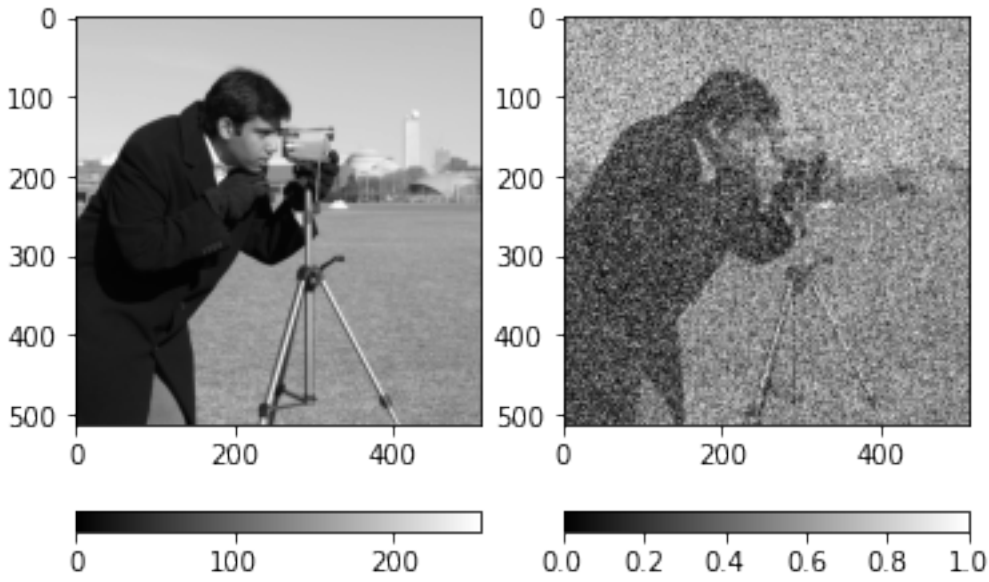


2 Noise - s&p

[3]:
```
im = data.camera()
imn = random_noise(im, seed=42, mode='s&p', amount=0.5, salt_vs_pepper=0.5)

fig = plt.figure()
ax = fig.add_subplot(1, 2, 1)
p = plt.imshow(im, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)

ax = fig.add_subplot(1, 2, 2)
p = plt.imshow(imn, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 1)
```

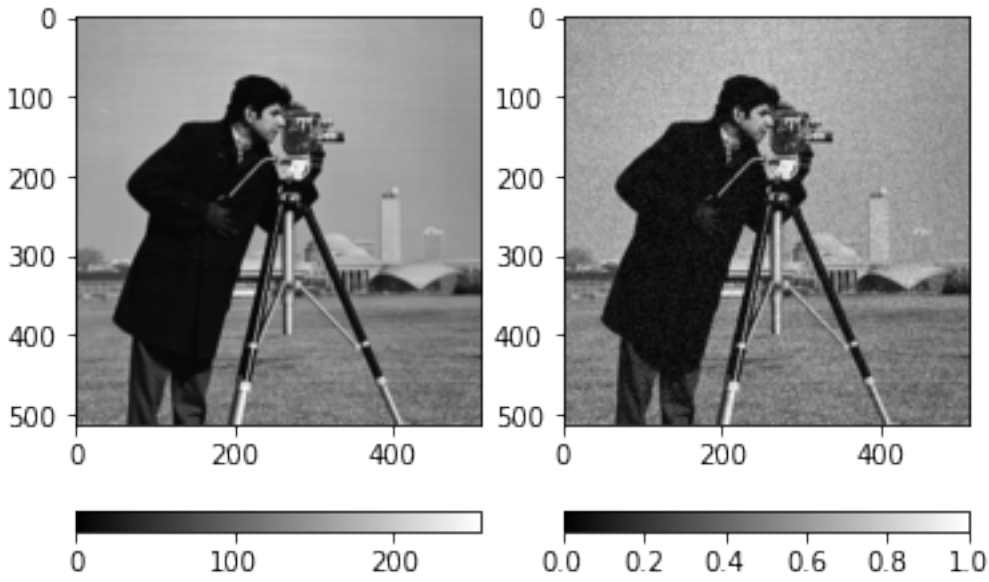


3 Noise - Gaussian

[ ]:
```
im = data.camera()
imn = random_noise(im, seed=42, mode='gaussian')

fig = plt.figure()
ax = fig.add_subplot(1, 2, 1)
p = plt.imshow(im, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)

ax = fig.add_subplot(1, 2, 2)
p = plt.imshow(imn, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 1)
```



4 Mean - Gaussian

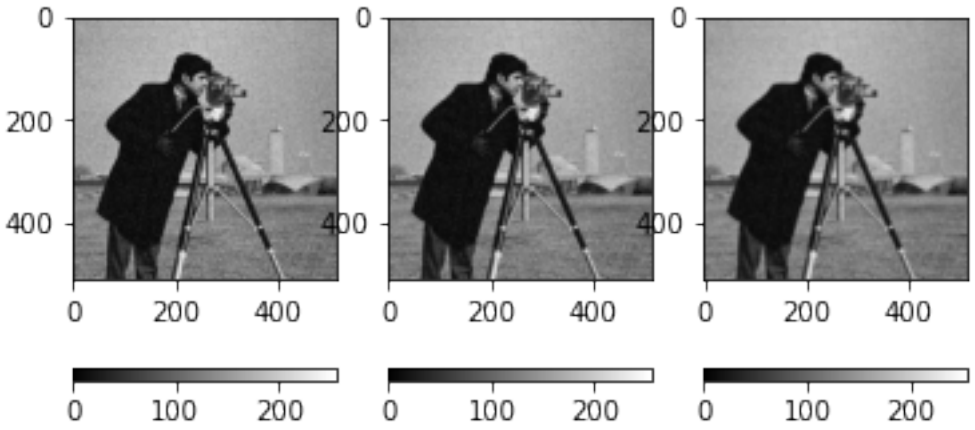
[ ]:
```
im = data.camera()
imn = random_noise(im, seed=42, mode='gaussian')
imn = img_as_ubyte(imn)

se = square(3)
imm3 = rank.mean(imn, selem=se)
se = square(5)
imm5 = rank.mean(imn, selem=se)

fig = plt.figure()
ax = fig.add_subplot(1, 3, 1)
p = plt.imshow(imn, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)

ax = fig.add_subplot(1, 3, 2)
p = plt.imshow(imm3, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)

ax = fig.add_subplot(1, 3, 3)
p = plt.imshow(imm5, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)
```



5 Mean - Gaussian & SP

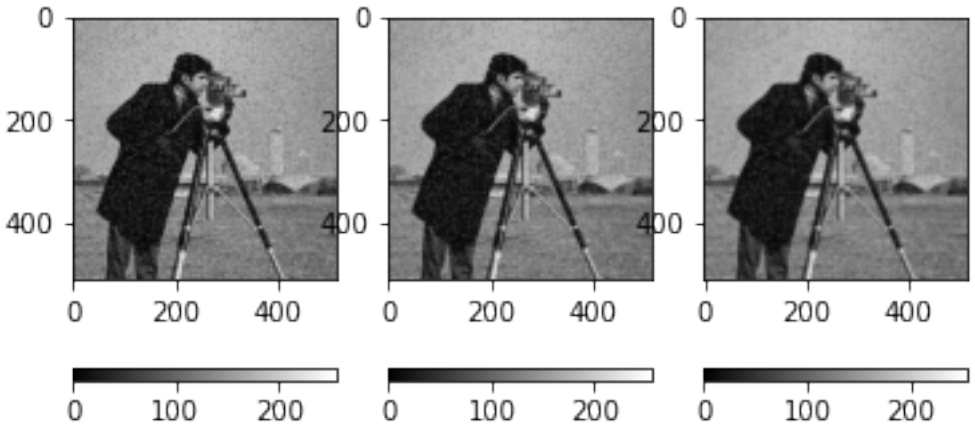
[ ]:
```
im = data.camera()
imn = random_noise(im, seed=42, mode='s&p', amount=0.1, salt_vs_pepper=0.5)
imn = img_as_ubyte(imn)

se = square(3)
imm3 = rank.mean(imn, selem=se)
se = square(5)
imm5 = rank.mean(imn, selem=se)

fig = plt.figure()
ax = fig.add_subplot(1, 3, 1)
p = plt.imshow(imn, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)

ax = fig.add_subplot(1, 3, 2)
p = plt.imshow(imm3, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)

ax = fig.add_subplot(1, 3, 3)
p = plt.imshow(imm5, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)
```



6 Median - Gaussian & SP

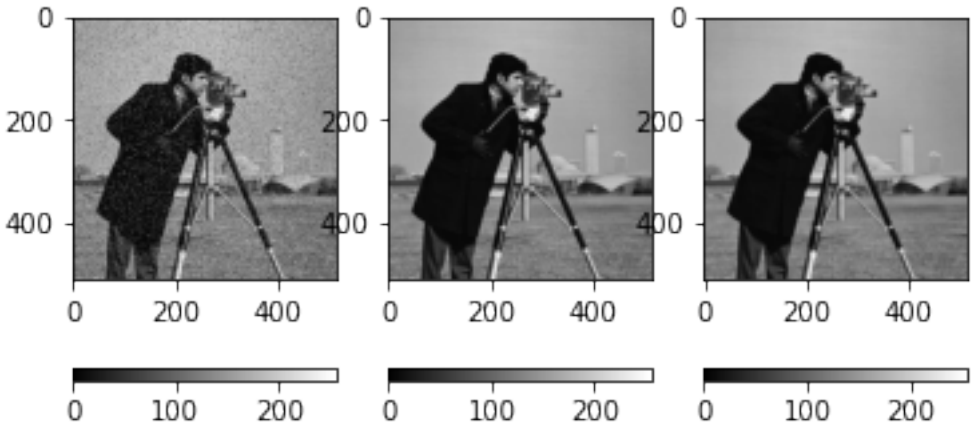
[ ]:
```
im = data.camera()
imn = random_noise(im, seed=42, mode='s&p', amount=0.1, salt_vs_pepper=0.5)
imn = img_as_ubyte(imn)

se = square(3)
imm3 = rank.median(imn, selem=se)
se = square(5)
imm5 = rank.median(imn, selem=se)

fig = plt.figure()
ax = fig.add_subplot(1, 3, 1)
p = plt.imshow(imn, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)

ax = fig.add_subplot(1, 3, 2)
p = plt.imshow(imm3, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)

ax = fig.add_subplot(1, 3, 3)
p = plt.imshow(imm5, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)
```



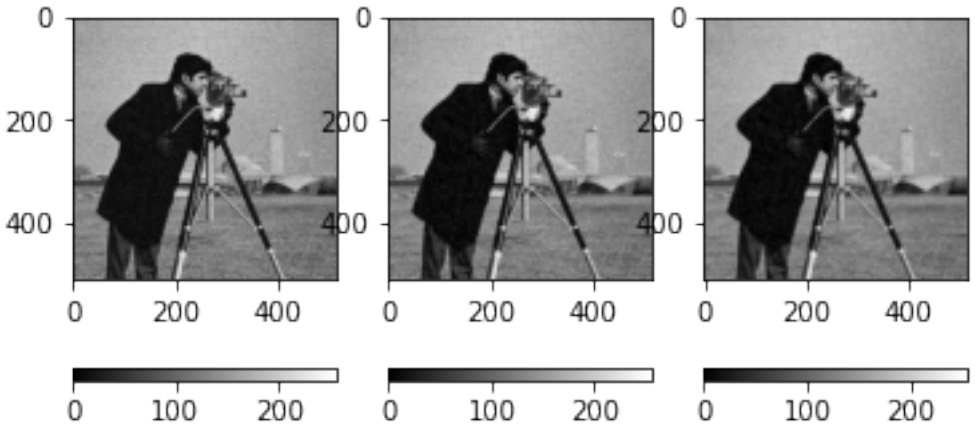
[ ]:
```
im = data.camera()
imn = random_noise(im, seed=42, mode='gaussian')
imn = img_as_ubyte(imn)

se = square(3)
imm3 = rank.median(imn, selem=se)
se = square(5)
imm5 = rank.median(imn, selem=se)

fig = plt.figure()
ax = fig.add_subplot(1, 3, 1)
p = plt.imshow(imn, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)

ax = fig.add_subplot(1, 3, 2)
p = plt.imshow(imm3, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)

ax = fig.add_subplot(1, 3, 3)
p = plt.imshow(imm5, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)
```



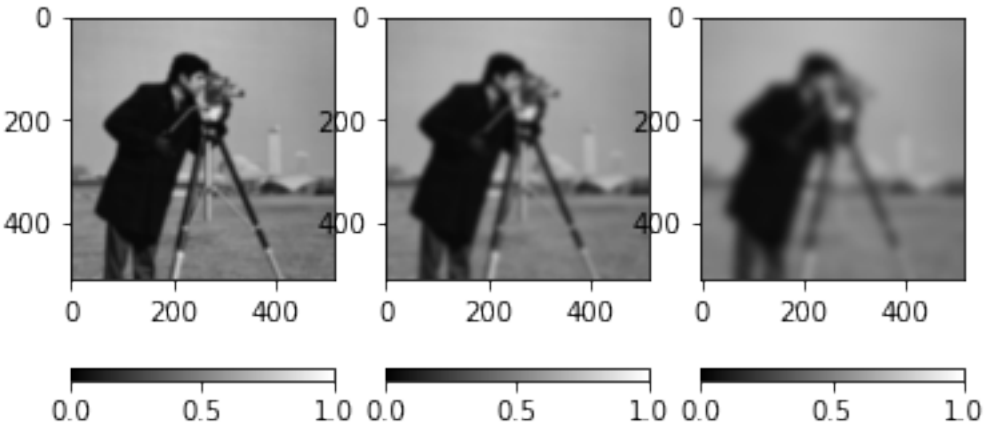
7 Gaussian

[ ]:
```
im = data.camera()
img3 = gaussian(im, sigma=3)
img5 = gaussian(im, sigma=5)
img10 = gaussian(im, sigma=10)

fig = plt.figure()
ax = fig.add_subplot(1, 3, 1)
p = plt.imshow(img3, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 1)

ax = fig.add_subplot(1, 3, 2)
p = plt.imshow(img5, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 1)

ax = fig.add_subplot(1, 3, 3)
p = plt.imshow(img10, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 1)
```

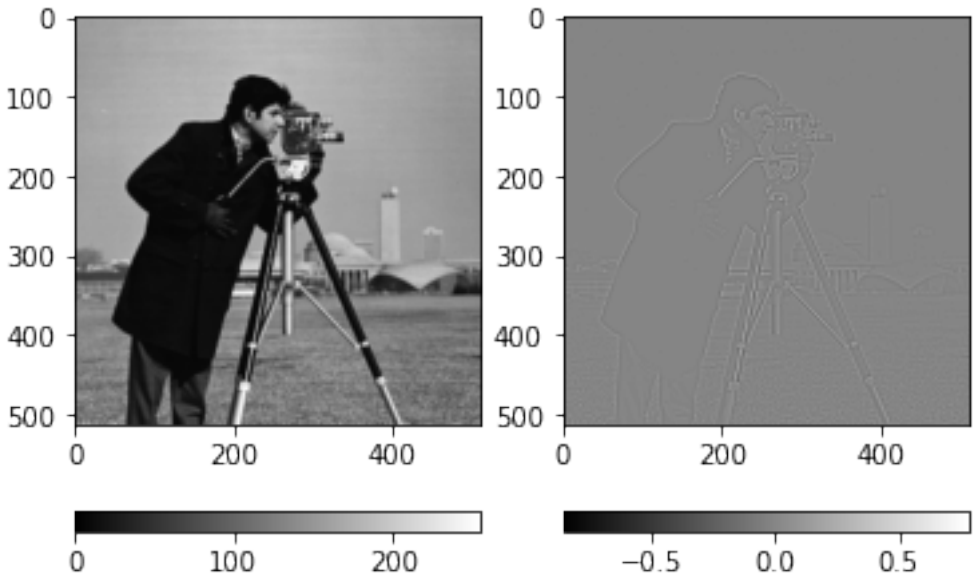


8 Laplacian

[ ]:
```
im = data.camera()
imf = laplace(im, ksize=3)

fig = plt.figure()
ax = fig.add_subplot(1, 2, 1)
p = plt.imshow(im, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 255)

ax = fig.add_subplot(1, 2, 2)
p = plt.imshow(imf, cmap='gray')
c = plt.colorbar(orientation='horizontal')
```

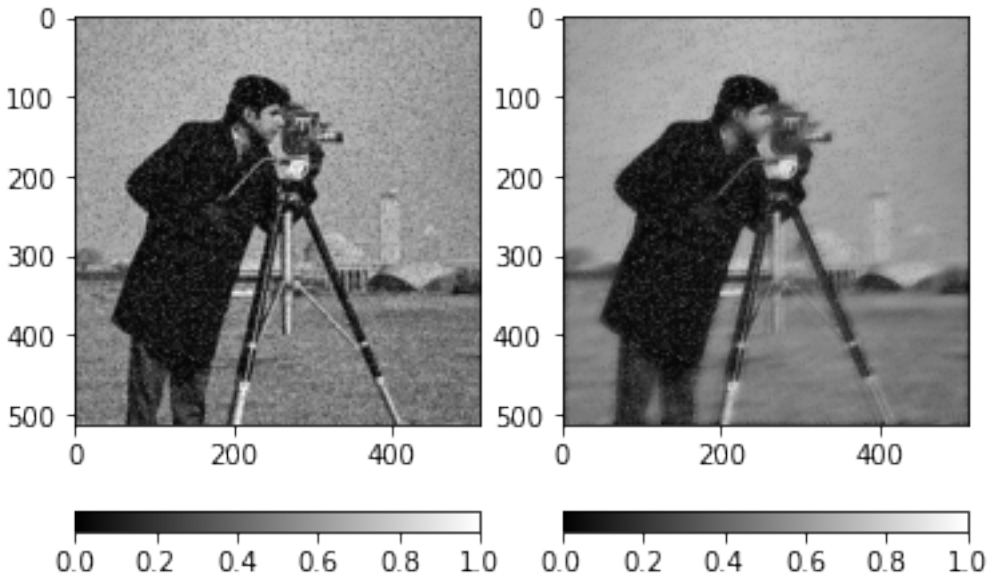


9 Bilateral

[ ]:
```
im = data.camera()
seed = 42
imn = random_noise(im, seed=42, mode='s&p', amount=0.1, salt_vs_pepper=0.5)
imf =  denoise_bilateral(imn, sigma_spatial=3)

fig = plt.figure()
ax = fig.add_subplot(1, 2, 1)
p = plt.imshow(imn, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 1)

ax = fig.add_subplot(1, 2, 2)
p = plt.imshow(imf, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 1)
```



10 Non-local Means

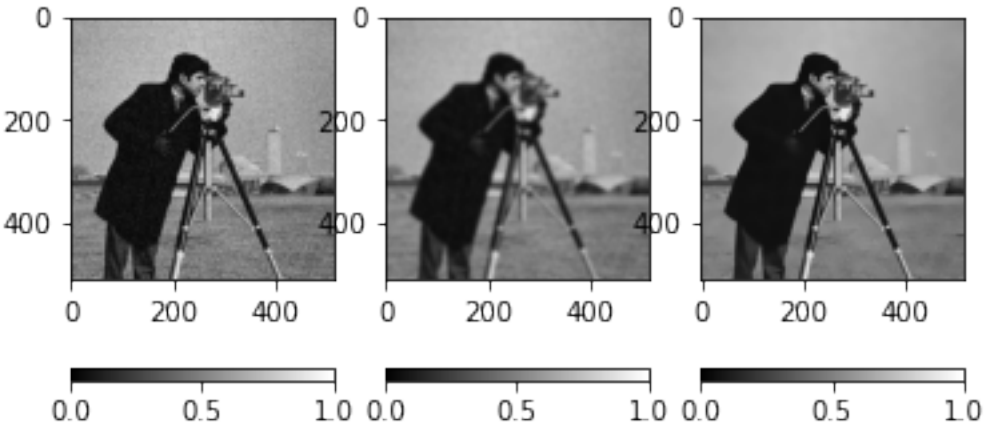
[ ]:
```
im = img_as_float(data.camera())
imn = random_noise(im, seed=42, mode='gaussian')
imf = gaussian(imn, sigma=3)

sigma_est = np.mean(estimate_sigma(imn, multichannel=True))
imd = denoise_nl_means(imn, h=0.6 * sigma_est, sigma=sigma_est, fast_mode=True)

fig = plt.figure()
ax = fig.add_subplot(1, 3, 1)
p = plt.imshow(imn, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 1)

ax = fig.add_subplot(1, 3, 2)
p = plt.imshow(imf, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 1)

ax = fig.add_subplot(1, 3, 3)
p = plt.imshow(imd, cmap='gray')
c = plt.colorbar(orientation='horizontal')
plt.clim(0, 1)
```


0
200
400
0
200
400
0.0
0.5
1.0