Noise in Digital Image Processing

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Description

- The goal of this first assignment is implementing any kind of image filtering method using Python, Matlab, or both of them.
- In this assignment, I choose to apply several kinds of noise in the image, implement mean and median filtering to denoise it, and then compare them to decide which one is better.

Tools

- Python 3.7
- Jupyter notebook
- Some Python libraries:
  - Open-CV
  - Matplotlib
  - Numpy

Implementation of Noise

1. Create and activate Python virtual environment

```
$ virtualenv venv -p python3
$ source venv/bin/activate
```

2. Run the script

```
$ bash test.sh
```

The script used to run several Python commands:

```
#!/bin/bash

# to add noises
python3 add_noise.py
# to display the result (noised image)
python3 display.py img
# to display the histogram
python3 display.py hist gray
python3 display.py hist rgb
```

At first, I tried to detect type of noise by the histogram, but not yet realized.

3. List of implemented noises:

   - **Gaussian Noise**

```
def apply_gaussian(img):
    output = cv2.GaussianBlur(img, (5,5), 0)
    return output
```

   - **Salt-Pepper Noise** (Salt, Pepper, Salt-Pepper)

```
def apply_salt_pepper(img, is_salt=True, is_pepper=True,
prob=0.05):
    output = np.zeros(img.shape, np.uint8)
    thres = 1 - prob
    for i in range(img.shape[0]):
        for j in range(img.shape[1]):
            rand = random.random()
            if rand < prob:
                output[i][j] = 0 if is_pepper else img[i][j]
            elif rand > thres:
                output[i][j] = 255 if is_salt else img[i][j]
            else:
                output[i][j] = img[i][j]
    return output
```

   - **Poisson Noise**

```
def apply_poisson(img):
    noise = np.random.poisson(50, img.shape)
    output = img + noise
    return output
```

   - **Speckle Noise**

```
def apply_speckle(img, prob=0.07):
    output = np.zeros(img.shape, np.uint8)
    thres = 1 - prob
    for i in range(img.shape[0]):
        for j in range(img.shape[1]):
            rand = random.random()
            if rand < prob:
                output[i][j] = 128
                for k in range(5):
                    output[i-k][j-k] = 128 + 10*rand
```

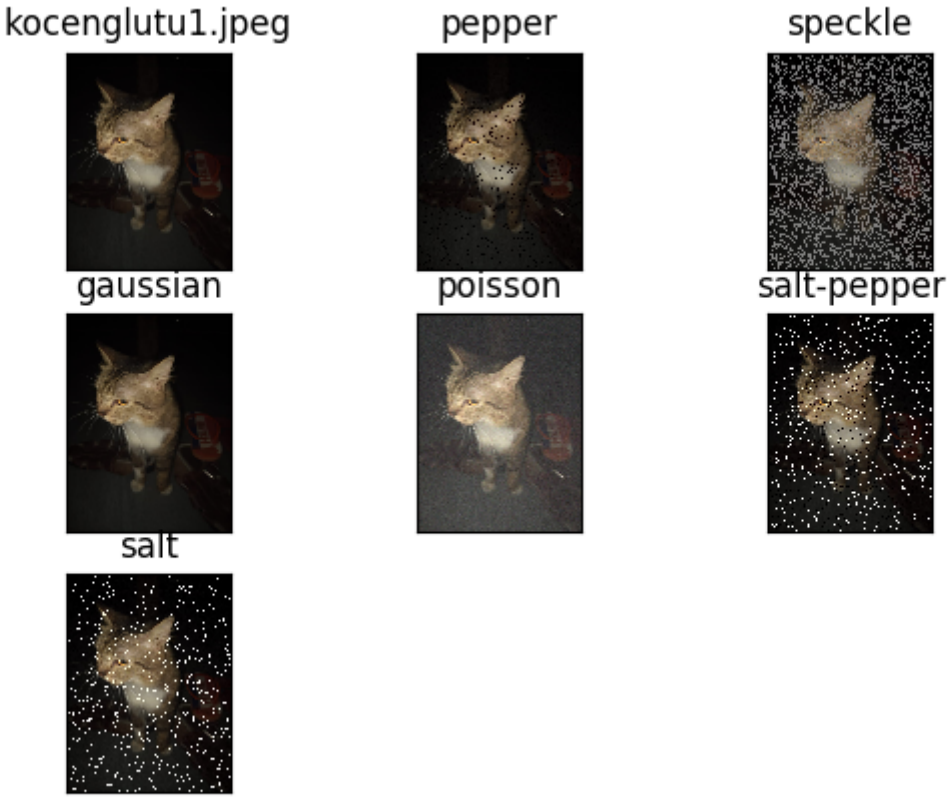
```
                else:
                    output[i][j] = img[i][j]
        return output
```

The complete script can be found here.

Result

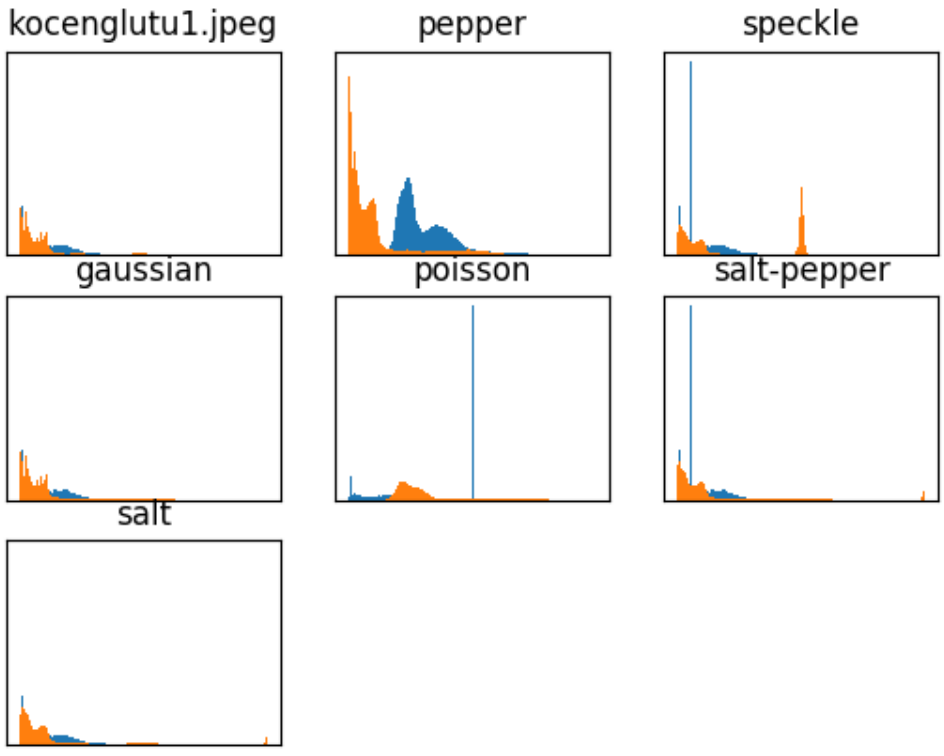
1. Original image

2. Noised images

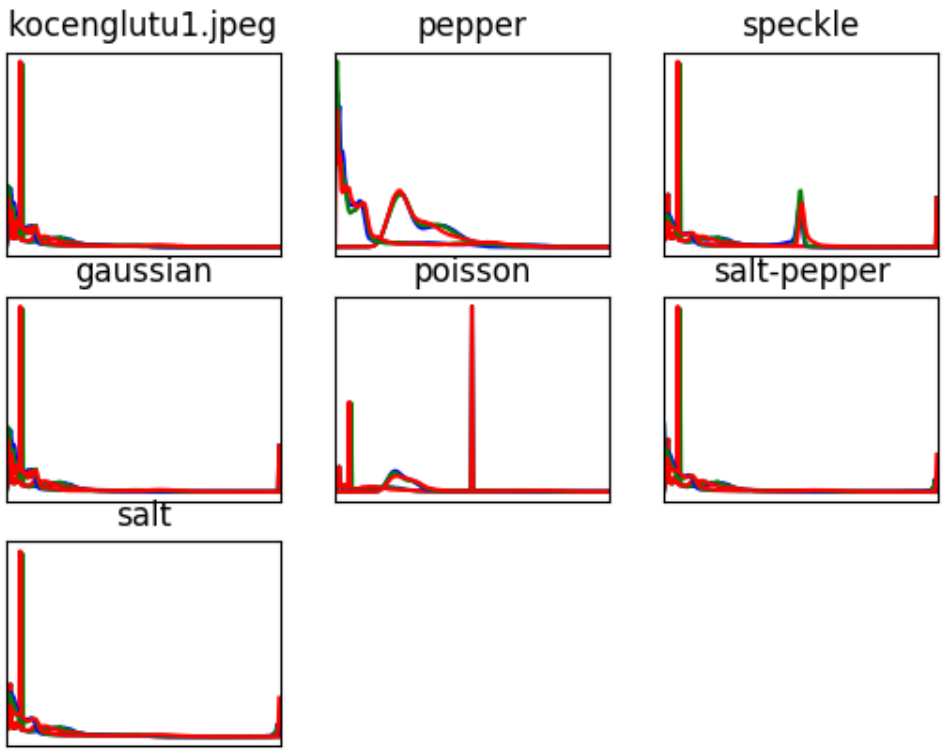


3. Histogram of noised images

    - Grayscale



- RGB



Implementation of Filtering for Denoising Image

- Mean Filter
- Median Filter

References

- Noise in Digital Image Processing