Noise Addition in Images using Python

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April 7, 2025

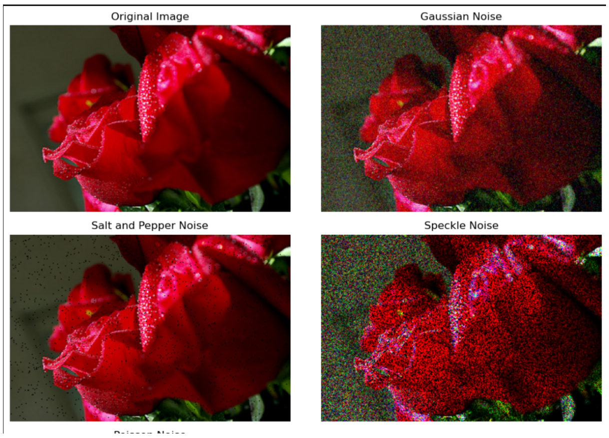
Introduction

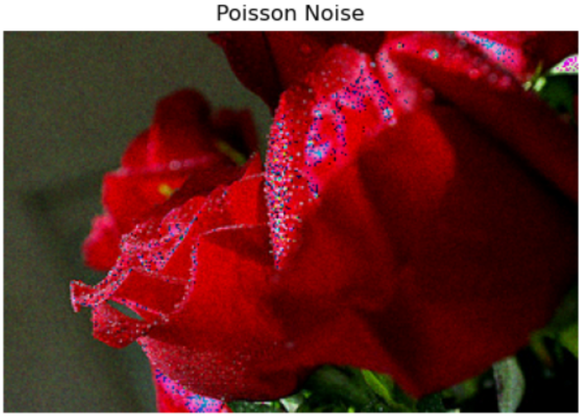
This document demonstrates the addition of different types of noise to an image using Python and OpenCV. The noise types include Gaussian noise, Salt-and-Pepper noise, Speckle noise, and Poisson noise.

Python Code

```
import numpy as np
import cv2
import matplotlib.pyplot as plt

# Function to add Gaussian Noise
def add_gaussian_noise(image, mean=0, sigma=25):
    row, col, ch = image.shape
    gauss = np.random.normal(mean, sigma, (row, col, ch))
    noisy = np.clip(image + gauss, 0, 255)
    return noisy.astype(np.uint8)

# Function to add Salt-and-Pepper Noise
def add_salt_and_pepper_noise(image, prob=0.02):
    noisy = image.copy()
    row, col, ch = image.shape
    s_vs_p = 0.5
    amount = prob
    # Salt noise
    num_salt = int(amount * row * col * s_vs_p)
    salt_coords = [np.random.randint(0, i-1, num_salt) for i in image.shape]
    noisy[salt_coords[0], salt_coords[1]] = 1
    # Pepper noise
    num_pepper = int(amount * row * col * (1.0 - s_vs_p))
    pepper_coords = [np.random.randint(0, i-1, num_pepper) for i in image.shape]
    noisy[pepper_coords[0], pepper_coords[1]] = 0
    return noisy

# Function to add Speckle Noise
def add_speckle_noise(image):
    row, col, ch = image.shape
    gauss = np.random.randn(row, col, ch)
    noisy = np.clip(image + image * gauss, 0, 255)
    return noisy.astype(np.uint8)

# Function to add Poisson Noise
def add_poisson_noise(image):
    noisy = np.random.poisson(image / 255.0 * 256).astype(np.uint8)
    return noisy

# Read an example image
image = cv2.imread('/home/ai-ds3/Downloads/6.jpg')  # Replace with your image path
image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
```

```python
# Adding different noises
gaussian_noisy_image = add_gaussian_noise(image)
# Adding different noises
salt_and_pepper_noisy_image = add_salt_and_pepper_noise(image)
speckle_noisy_image = add_speckle_noise(image)
poisson_noisy_image = add_poisson_noise(image)

# Display the original and noisy images
plt.figure(figsize=(10, 10))

# Original Image
plt.subplot(3, 2, 1)
plt.imshow(image)
plt.title("Original Image")
plt.axis('off')

# Gaussian Noise Image
plt.subplot(3, 2, 2)
plt.imshow(gaussian_noisy_image)
plt.title("Gaussian Noise")
plt.axis('off')

# Salt-and-Pepper Noise Image
plt.subplot(3, 2, 3)
plt.imshow(salt_and_pepper_noisy_image)
plt.title("Salt and Pepper Noise")
plt.axis('off')

# Speckle Noise Image
plt.subplot(3, 2, 4)
plt.imshow(speckle_noisy_image)
plt.title("Speckle Noise")
plt.axis('off')

# Poisson Noise Image
plt.subplot(3, 2, 5)
plt.imshow(poisson_noisy_image)
plt.title("Poisson Noise")
plt.axis('off')

# Display the images
plt.tight_layout()
plt.show()
```





Output Images

Conclusion

Noise simulation is useful in image processing research to test and develop denoising algorithms. This script helps understand the visual effects of various types of noise on a clean image.