

Documentation

X-ray Image Processing

This report provides an overview of the implementation of an X-ray image processing application. The code is designed to introduce Gaussian noise to X-ray images, perform noise reduction through median filtering, and apply multi-stage 2D convolution for edge detection. Below are details of our approach, challenges faced, and observations from the processing stages.

Approach to Implementation:

Importing Libraries: We begin by importing the necessary libraries, including OpenCV (cv2), NumPy, scikit-image (skimage), and os.

Convolution Function: The convolve2D function is defined to perform 2D convolution on an input image. It can handle grayscale and RGB images, and it allows specifying padding and strides.

Noise Introduction Function: The introduce_noise function is used to add Gaussian noise to an image. It takes an input image and a noise variance as parameters.

Edge Detection Kernel: We define an edge detection kernel, which enhances significant features in the X-ray images.

Loading X-ray Images: We load X-ray images from a specified folder, filtering for PNG files.

Processing and Saving Results: For each X-ray image, we introduce Gaussian noise, reduce noise through median filtering, and perform convolution in three stages. The outputs for each stage are stored in organized folders.

Challenges and Solutions:

Noise Handling: Gaussian noise introduction led to a grainy appearance. We addressed this by introducing a noise reduction step using median filtering.

Convolution Efficiency: The optimize convoution

Output Organization: We organized the saved results into subfolders for each image and each stage to prevent confusion.

Observations:

The noise reduction stage effectively reduced the grainy appearance caused by the introduced Gaussian noise.

Convolution with the edge detection kernel made significant features in the X-ray images more prominent. This is particularly useful for identifying edges and enhancing the clarity of important structures.

Conclusion:

The implemented X-ray image processing application successfully enhances X-ray images by reducing noise and highlighting edges. This is vital in medical imaging for better diagnosis and analysis. The code and documentation provide insights into the implementation process, challenges, and the visual impact of each processing stage on the X-ray images.