TEAM 14

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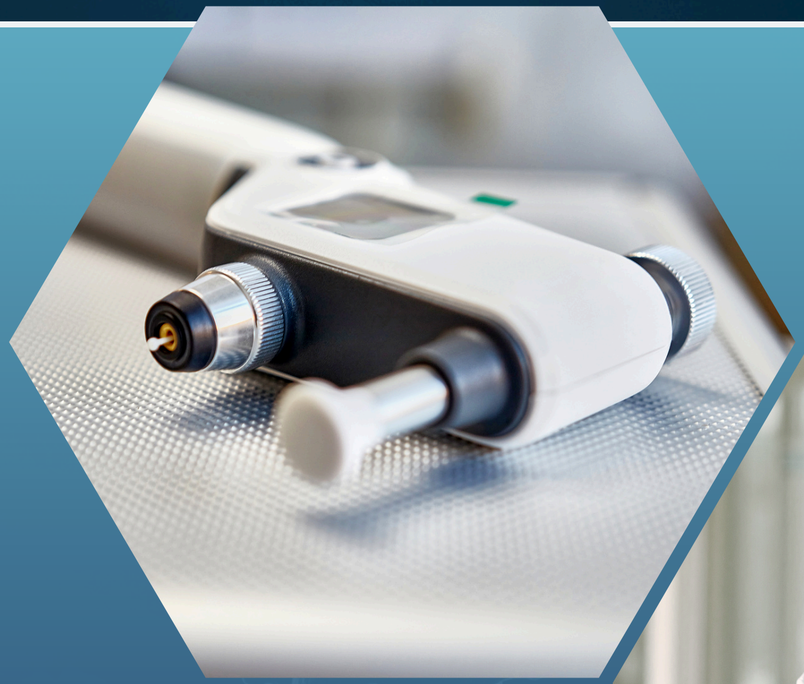

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BACKGROUND

Noise Types

Salt & Pepper Noise

Gaussian Noise

Gamma noise

Exponential noise

Uniform noise

Salt & Pepper Noise

salt and pepper noise is impulse noise that shows as random occurrences of black and white pixels in an image.

The PDF of impulse noise

$$p(z) = \begin{cases} P_a & \text{for } z = a \\ P_b & \text{for } z = b \\ 0 & \text{otherwise} \end{cases}$$

Gaussian Noise

It is a statistical fluctuations in pixels values following a normal distribution

The PDF of a Gaussian noise is

$$p(z) = \frac{1}{\sqrt{2\pi}\sigma} e^{-(z-\bar{z})^2/2\sigma^2}$$

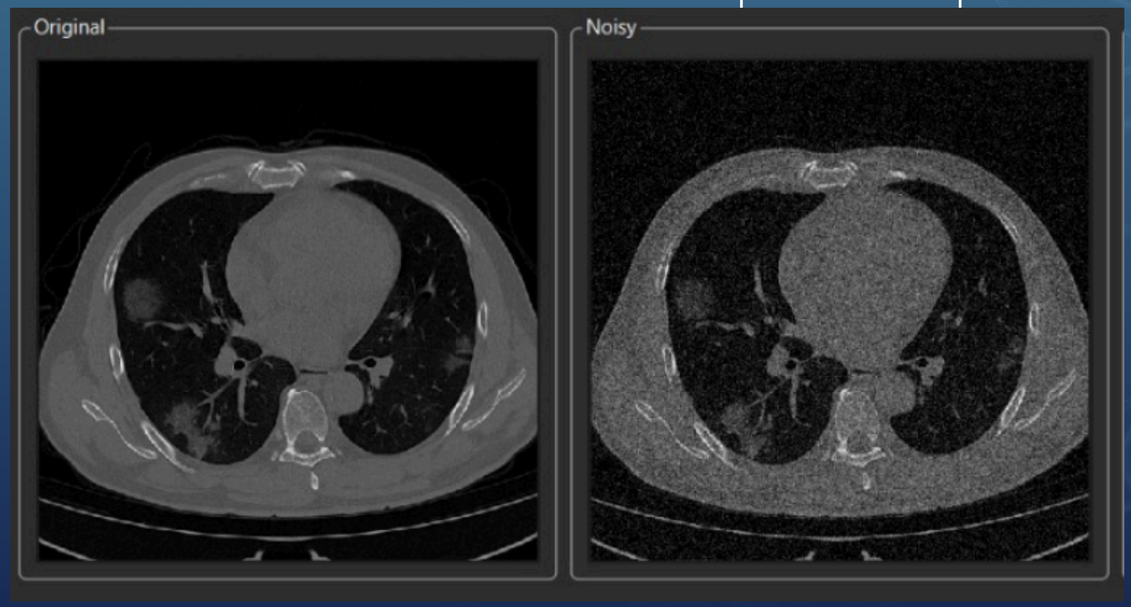


Image Denoising Techniques

01.

Wavelet filtering

02.

Bilateral filtering

03.

DnCNN filtering

Wavelet filter

- Transform the Image from the spatial domain to the wavelet domain.
- Separates the image into Approximation part and Detail parts.
- Filter the Detail Components
- Inverse wavelet transform to rebuild the Image

CT Image Processor

File Controls
Load CT Image
Save Results

Slice Controls
Slice Index: 150
View: Axial
Update Slice

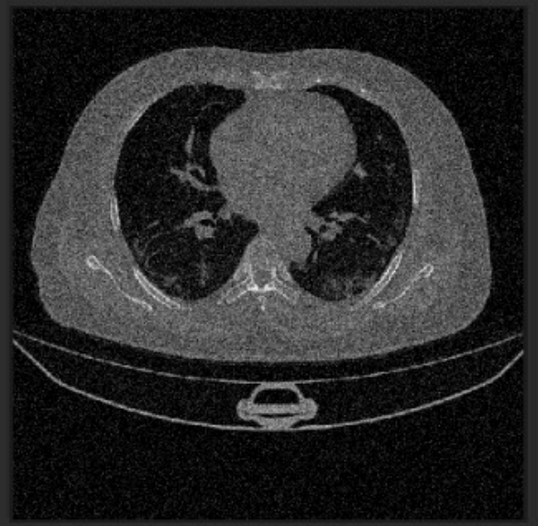
Noise Controls
Gaussian
Noise Level: 25
Add Noise

Filter Controls
Wavelet
Parameter: 2
Apply Filter
Compare All Methods

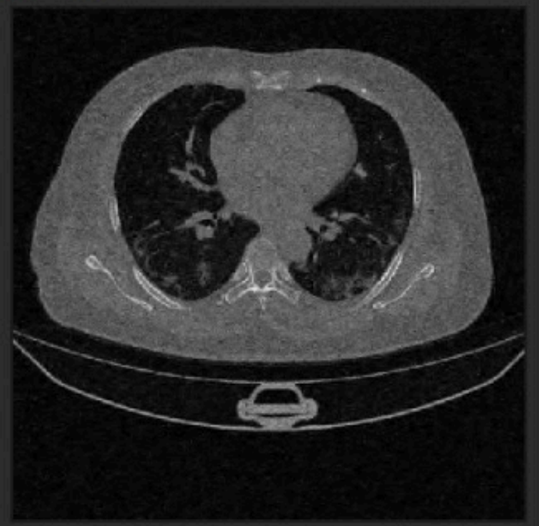
Images | Comparison

Original

Noisy



Processed



Information
PSNR: 27.62 dB
SSIM: 0.5237
Filter: Wavelet

Patient Info
Age: 55
Gender: Male
Clinical Note: have proplems in left lung.

System Suggestions
No specific suggestions available.

Diagnostic Aid Score
4 (Good)

Bilateral filtering

- non-linear,noise-reducing smoothing filter
- Averaging nearby pixel values
- Close pixels ➡ bigger weight

File Controls

Load CT Image

Save Results

Slice Controls

Slice Index: 150

View: Axial

Update Slice

Noise Controls

Gaussian

Noise Level: 25

Add Noise

Filter Controls

Bilateral

Parameter: 2

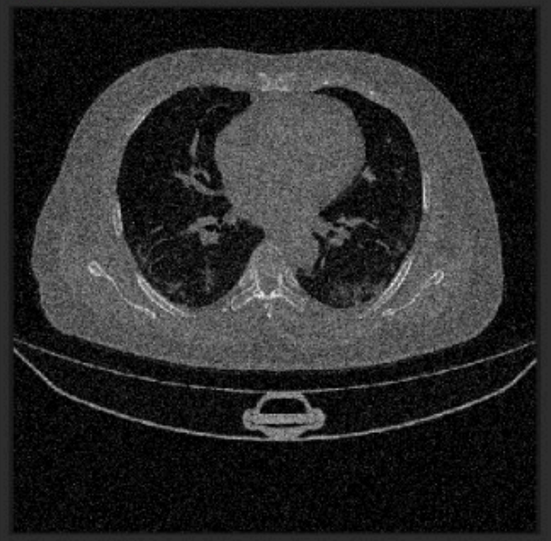
Apply Filter

Compare All Methods

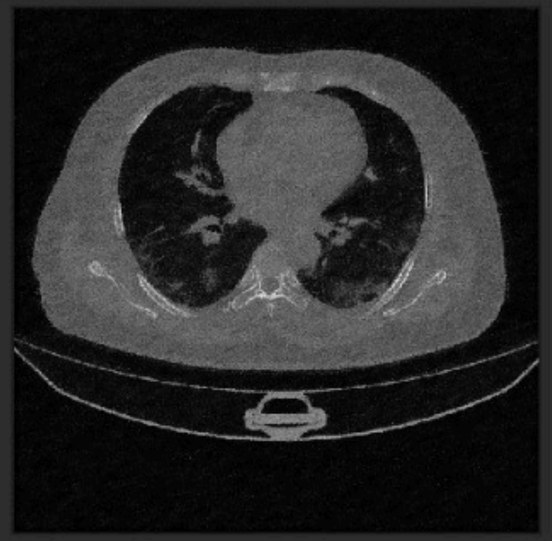
Images | Comparison

Original

Noisy



Processed



Information

PSNR: 26.26 dB

SSIM: 0.4489

Filter: Bilateral, param=2.00

Patient Info

Age: 55

Gender: Male

Clinical Note: have proplems in left lung.

System Suggestions

Gaussian filtering performed best in previous tests. Consider using it instead.

Diagnostic Aid Score

3 (Acceptable)

EVALUATION METRICS

PSNR

peak signal-to-noise ratio)
Higher PSNR → less noise

$$\text{PSNR} = 10 \cdot \log_{10} \left(\frac{MAX_I^2}{\text{MSE}} \right)$$

Where:
MSE is the Mean Squared Error between the original and the noisy image.

MAX I is the maximum possible pixel value of the image

SSIM

Structural Similarity Index
Higher SSIM → better structural preservation

$$\text{SSIM}(x, y) = \frac{(2\mu_x\mu_y + C_1)(2\sigma_{xy} + C_2)}{(\mu_x^2 + \mu_y^2 + C_1)(\sigma_x^2 + \sigma_y^2 + C_2)}$$

x, y : image patches from the original and distorted images
μ_x, μ_y : mean intensity values
σ_x^2, σ_y^2 : variances
σ_{xy} : covariance between x and y
C_1, C_2 : small constants to avoid division by zero

THANK YOU