RESEARCH PROPOSAL

MATHEMATICAL TECHNIQUES FOR IMPROVING IMAGE QUALITY USING TRANSFORM-BASED IMAGE PROCESSING

INTRODUCTION

Image processing is strongly based on mathematical principles such as matrices, probability, calculus, and transforms. Digital images often contain noise due to sensors, transmission errors, or environmental disturbances. To improve clarity and extract useful information, mathematical algorithms are used to enhance images.

PROBLEM STATEMENT

Many existing image denoising methods reduce noise but blur important edges and fine details. Therefore, there is a need for a mathematically optimized approach that removes noise while preserving key image features.

OBJECTIVES

1. To study mathematical noise models: Gaussian, Salt & Pepper, and Speckle.

2. To apply image enhancement using:

Fourier Transform (FT)

Discrete Wavelet Transform (DWT)

3. To evaluate performance using:

PSNR (Peak Signal-to-Noise Ratio)

SSIM (Structural Similarity Index)

METHODOLOGY

Step Description

1 Collect sample images (medical/satellite/natural).

2 Add noise mathematically based on selected noise models.

3 Apply FT, DWT, and a hybrid FT–DWT denoising method.

4 Compute PSNR and SSIM values.

5 Compare results and analyze improvements.

MATHEMATICAL TOOLS INVOLVED

Matrix operations, convolution, probability distributions, Fourier series, wavelet basis functions.

Expected Outcomes

Higher image clarity with preserved edges.

Better PSNR/SSIM than traditional methods.

A strong demonstration of how mathematics improves digital image quality.

SIGNIFICANCE

This research has applications in:

Medical imaging (MRI, CT scan)

Satellite/remote sensing

Security & biometrics

Computer vision and robotics