

### ANALYSIS OF EDGE-DETECTION TECHNIQUES WITH IMPROVED SOBEL OPERATOR FOR CRACK IDENTIFICATION IN BRIDGES

<sup>1</sup>\*Gagandeep Kaur, <sup>2</sup>Dr. Gurpreet Singh and <sup>3</sup>Er. Kajal

<sup>1</sup>M. Tech CSE

<sup>2</sup>Professor in CSE

<sup>3</sup>Assistant Professor in CSE

St. Soldier Institute of Engg. & Technology, Near NIT, Jalandhar.

Article Received on 29/03/2023

Article Revised on 19/04/2023

Article Accepted on 09/05/2023

#### \*Corresponding Author

**Gagandeep Kaur**

M. Tech CSE St. Soldier  
Institute of Engg. &  
Technology, Near NIT,  
Jalandhar.

#### ABSTRACT

The appearance and development of cracks in the concrete bridge will seriously affect the safe use of bridge buildings. In order to better satisfy the crack detection requirement, this research comes up with an image preprocessing scheme combining multiple adaptive filtering and contrast enhancement based on the image processing technology of

concrete crack, which can improve the removal effect of background noise and obtain the characteristic vein information of tiny cracks. Then we designed a improved sobel operator and integrated with other operators for removing isolated noise spots, so as to extract the crack edge information and improve the positioning accuracy of the crack boundary.

**KEYWORDS:** PSNR, MSE, MAE.

#### INTRODUCTION

In order to highlight the edge of crack and eliminate useless interference, the median filter is usually adopted to remove noise. It has a significant effect on processing salt and pepper noise but is not applicable to process signals which contain a large number of overlapping noise. As a nonlinear smoothing filter, adaptive filter changes the output result by calculating the local variance of pixels within the filter window and has a very good adaptability on removing the kinds of superimposed noise. In addition, the appropriate template selection of filter window size will have a great impact on the processing efficiency of the internal pixel.

Edges are significant local changes of intensity in a digital image. An edge can be defined as a set of connected pixels that forms a boundary between two disjoint regions. There are three types of edges:

- Horizontal edges
- Vertical edges
- Diagonal edges

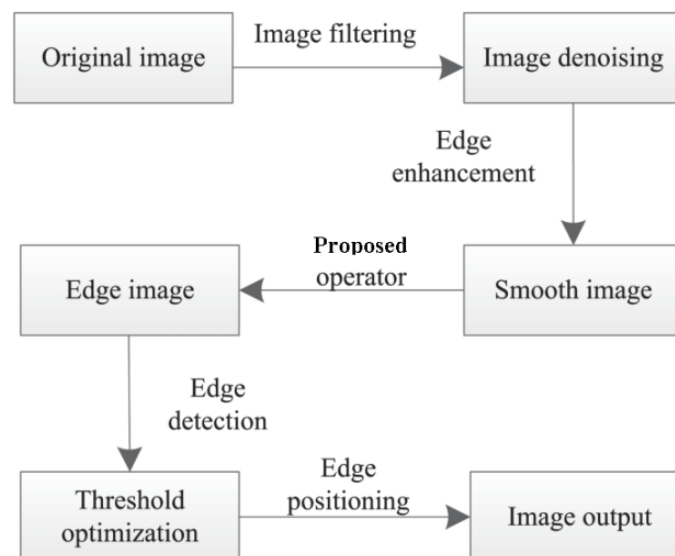
### 1.2 Objectives of the study

1. To finding the boundaries of objects within images.
2. To identifying edges, curves in a digital image at which the image brightness changes sharply.
3. To improve the accuracy with improved edge detection technique based on PSNR, MSE and MAE values.

### 1.3 The Proposed Edge Detection Algorithm

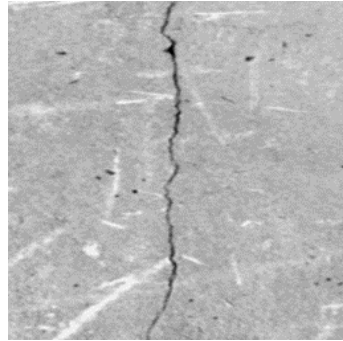
After the above denoising and contrast enhancement, a relatively clear and ideal grayscale image is obtained. In order to further identify and analyze the characteristics of concrete cracks, the bridge cracks need to be accurately extracted and segmented from the image. In this case, the improved sobel operator with good segmentation effect is adopted, which is also known as the method of maximum classes square error.

### 1.4 Flow Chart of Proposed Technique

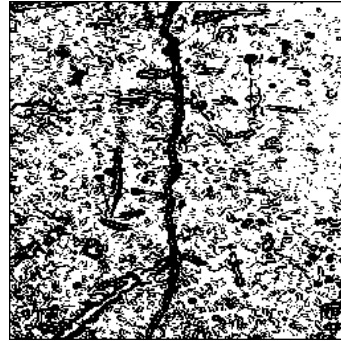


**Fig. 1: Flow Chart of Proposed Technique.**

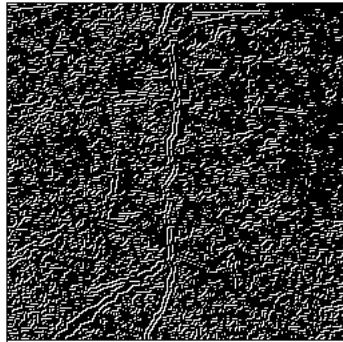
This method effectively protects the edge of the crack based on reducing image noise and improving image quality. The enhancement result of the crack image1 is shown in Fig. 2.



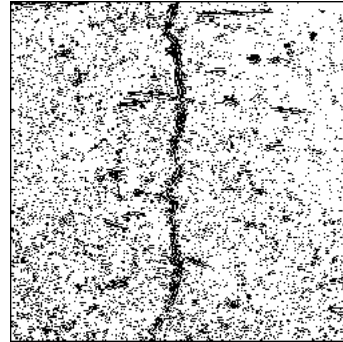
(a) Crack image of the concrete bridge



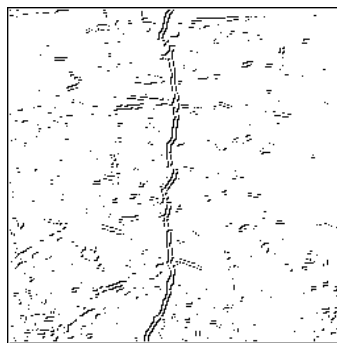
(b) Prewitt Operator



(c) Sobel Operator



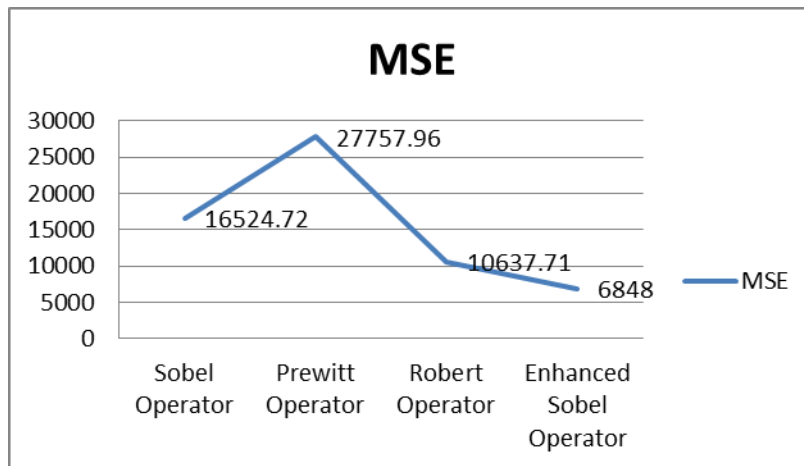
(d) Robert Operator



(e) Enhanced Sobel Operator

**Table 1: PERFORMANCE COMPARISON in MSE of IMAGE 1.**

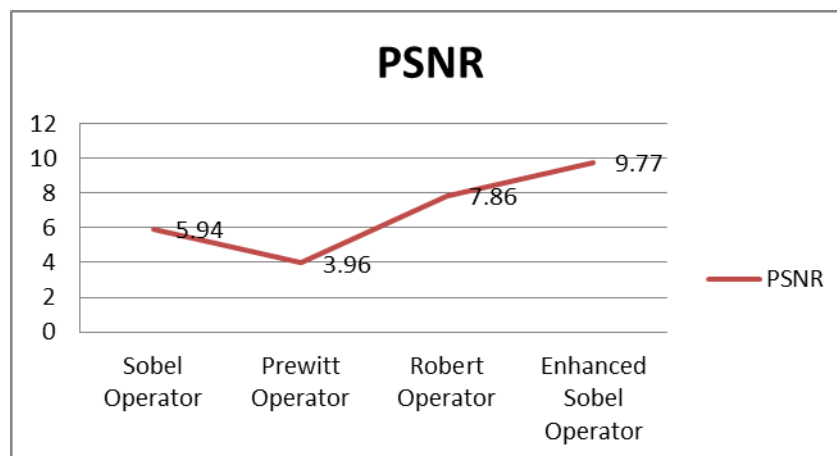
Parameters	Sobel Operator	Prewitt Operator	Robert Operator	Enhanced Sobel Operator
MSE	16524.72	27757.96	10637.71	6848



**Fig. 2: PERFORMANCE COMPARISON in MSE of IMAGE 1.**

**Table 2: PERFORMANCE COMPARISON in PSNR of IMAGE 1.**

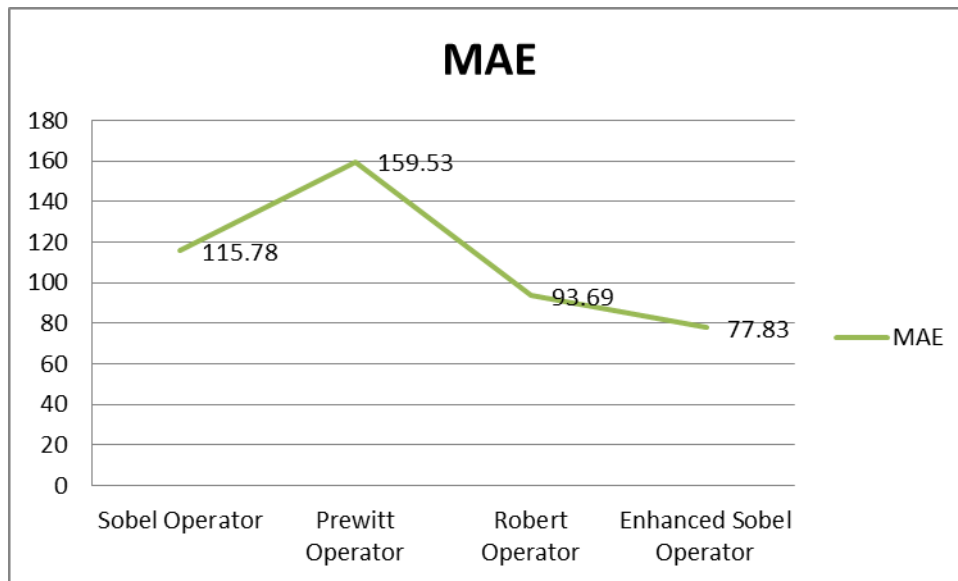
Parameters	Sobel Operator	Prewitt Operator	Robert Operator	Enhanced Sobel Operator
PSNR	5.94	3.96	7.86	9.77



**Fig. 3: PERFORMANCE COMPARISON in PSNR of IMAGE 1**

**Table 4: PERFORMANCE COMPARISON in MAE of IMAGE 1.**

Parameters	Sobel Operator	Prewitt Operator	Robert Operator	Enhanced Sobel Operator
MAE	115.78	159.53	93.69	77.83



**Fig. 5: PERFORMANCE COMPARISON in MAE of IMAGE 1.**

### 1.5 RESULTS AND DISCUSSION

In this research we have studied and evaluate different edge detection techniques. We have seen that improved sobel operator gives better result as compared to others with some positive points. In this research different edge detection techniques like Sobel, Prewitt, Roberts, and improved sobel operator for extracting different retinal boundaries are compared for bridge crack image. The image quality obtained after applying four algorithms is assessed with metrics. These metrics include Peak Signal To Noise Ratio (PSNR), and Mean Square Error (MSE) and MAE. From the results enhanced sobel operator detection succeeds because it has higher PSNR, Lower MSE and MAE value. Hence, the edge detecting operators can obtain optimal results in feature extraction of high contrast connected edges.

### REFERENCES

1. De Rosal Ignatius Moses Setiadi, "Improved payload capacity in LSB image steganography uses dilated hybrid edge detection", Journal of King Saud University – Computer and Information Sciences, 2022; 34.
2. Akshi Kumar, Sahil Raheja, "Edge Detection using Guided Image Filtering and Enhanced Ant Colony Optimization", Procedia Computer Science, 2020.
3. Remya Ajai A Sa, Sundararaman Gopalan, "Comparative Analysis of Eight Direction Sobel Edge Detection Algorithm for Brain Tumor MRI Images", Science Direct Procedia Computer Science, 2022; 201.

4. Shao Yunhong, Yuan Shilei, Zhou Xiaojing, Ye Jinhua, “Edge Detection Algorithm of MRI Medical Image Based on Artificial Neural Network”, 7th International Conference on Intelligent, Interactive Systems and Applications, ScienceDirect Procedia Computer Science, 2022; 201(2022).
5. Ranjitha Rajan, S.N Kumar, “Gauss Gradient Algorithm for Edge Detection in Retinal Optical Coherence Tomography Images”, International Conference on Machine Learning and Data Engineering , ScienceDirect Procedia Computer Science, 2023; 201.
6. Soheila Elmi, Zahra Elmi, “A robust edge detection technique based on Matching Pursuit algorithm for natural and medical images”, Biomedical Engineering Advances, 2022.
7. Chu Hui, Bao Xingcan, Li Mingqi, “Research on Image Edge Detection Method Based on Multi-sensor Data Fusion”, IEEE International Conference on Artificial Intelligence and Computer Applications (ICAICA), 2020.
8. G. Bhargavi, J. Cyril Robinson Azariah and S. Sivasakthiselvan, “Integrated report on brain tumor detection from MRI Image using Prewitt horizontal edge emphasizing filtering technique”, International Conference on Communication and Signal Processing, 2020; July 28 - 30.
9. G Elizabeth Rani, R Murugeswari, N Rajini, “Edge Detection in Scanning Electron Microscope (SEM) Images using Various Algorithms”, Proceedings of the International Conference on Intelligent Computing and Control Systems (ICICCS 2020) IEEE Xplore.