1. **Real Time Image Processing System for Detecting Infrastructure Damage: Crack**

The paper states a crack detection algorithm using a small camera and an embedded board that is Jetson TX2. There are three methods for crack detection. They are laser sensor based, acceleration sensor based and camera based. The laser method has high accuracy but it is very slow in scanning and the acceleration sensor based method also has low accuracy. The camera based method is cost effective and is very good in terms of accuracy. The algorithm is divided in two parts, the image preprocessing and crack detection. In the preprocessing part color image is converted to gray scale and after that preprocessing methods are applied to remove noise from the image. In the detection part the outline of the crack is obtained and then filtering methods are applied to the image and finally the crack is obtained. When the algorithm was tested it was 89.33% accurate and it correctly classified nine out of ten images.

1. **Image Processing Based Analysis of Cracks on Vertical Walls**

The paper proposed an approach to identify various type of cracks and for calculating the width of the crack on walls. For crack detection the binarization algorithm is used. The image undergoes binarization and gets converted to a grayscale image and then to binary image by setting a threshold value. The obtained binary image undergoes edge detection and the width of the crack is calculated. Due to issues in binarization caused by changing user parameters (sensitivity and window size) the cracks sometime remain undetected. For increasing the accuracy of the binarization, preprocessing is done for removing the distortion in the image and then the image is converted to grayscale. A hybrid image processing algorithm is applied on the preprocessed image with two new user parameters, they are Pw and Pl. By using these parameters two binary images will be obtained and they will undergo the edge detection algorithm. This approach is been tested and compared with Savola’s method and it gives better results than traditional binarization. Cracks visible to human eyes are still not classified by the hybrid approach.

1. **Inspection, Identification and Repair Monitoring of Cracked Concrete structure –An application of Image processing**

The paper proposed an image processing algorithm for detecting cracks and using UAVs for capturing images. The algorithm is as follows: after capturing the image 1) The RGB image is converted to grayscale image to reduce the intensity of the image and to represent the image in single channel. 2) Void detection is done to find any voids present on the surface cause by air bubbles or water droplets between the concrete. This is done using MATLAB. 3) Image stitching is done to merge the different images captured by UAVs from different positions so as to get a clear vision of the crack. 4) Next step is median filtering followed by edge detection for which CANNY and SOBEL filters are used. It is done to reduce the pixels to process the image faster. 5) Texture analysis is carried out using SOBEL and CANNY to filter out a specific color from the image. 6) Then a binary image is formed and then thresholding is done to remove skeleton pixels from the image. This method can be used to detect cracks in chimney, etc.

1. **Detection and analysis of large-scale WT blade surface cracks based on UAV-taken images**

Traditional method for defect detection on the wind turbine is by using telescope and sensors which are very costly and have low efficiency and take lots of time. This paper suggest an approach using image processing algorithm and UAVs. UAV is just used for capturing the images of WT. The algorithms is as follows: Wiener filter is applied on the image remove the motion blur. An adaptive median filtering method is used for removing the noise from the image. After these steps are performed the image losses some quality, so to regain the quality enhancement algorithms are used to the image will be better for analysis. Using this approach there is an improvement in the crack detection as that of the traditional method. Comparing the proposed method with the extended Haar cascade classification method, the proposed method analysis crack with more detail.

1. **Automatic Pavement Crack Detection Using HMRF-EM Algorithm**

The paper proposed an algorithm for crack detection on pavement using the adaptive line detector and hiddenMarkov random field model and its expectation-maximization algorithm. First step of the proposed method is to preprocess the original image using band pass filter method to reduce the noise in the image and then an adaptive line detector is used due to changing region size and direction. The second step is to use the HMRF-EM algorithm to increase the accuracy to label the data. The labels obtained in this step are also consisting of noise. Third step uses start and end points of the labeled data and cluster them on relative position so to get the true end points. When compared with other methods the proposed method is much more accurate and has a Recall of 94.54%, Precision of 90.89% and F-measure of 93.04% which is an improvement over other method.

1. **Crack Detection in Concrete Elements from RGB Pictures using Modified Line Detection Kernels**

This paper proposed a modified line detection kernel algorithm to detect crack. Main aim of the paper is to find cracking patterns in concrete from the image captured. Necessary steps are digital image processing to reduce the noise and image sharpening, spatial filtering, feature detection, hypothesis and then the algorithm which is as follows: 1) Edge detection is carried out to reduce the pixels. 2) The pixels obtained from edge detection are yet not the crack pixels, to get the crack pixels we have to perform mean detection. 3) In the orientation kernel step, the group of pixels which are dark but not crack are removed by passing it through modified line kernel. 4) In angle detection the pixel matrix is multiplied element wise with kernel. 5) Calculating the width of the crack. After apply this algorithm the results are not good. This method works very well on plain surface but not on rough surfaces.

1. **Track Crack Detection Method in Complex Environment**

This paper states an algorithm for crack detection in rail slabs using image processing. The sample image is preprocessed to remove the noise, uneven brightness. Then the image size is scaled to 25% of the original size. There are 3 types of cracks they are deformation, crack and surface damage. To classify them edge detection algorithm is used, but normal edge detection is not enough so CANNY edge detection algorithm is used to extract information from the preprocessed image. After performing these steps we get three characteristics: 1) crack is long, 2) relatively large length and width and 3) center ratio is large. These characteristics of the image are calculated by the algorithm. With the values of the three characteristics, we determine which crack it is. When the experiment was performed the accuracy was 87.73%. Total 220 images were captured and used for testing and 193 images were correctly identified.

1. **ROBUST IMAGE-BASED CRACK DETECTION IN CONCRETE STRUCTURE USING MULTI-SCALE ENHANCEMENT AND VISUAL FEATURES**

This paper states an algorithm for detection of crack using image processing. As the captured image has low contrast and noise. For making the image more enhance a multi-scale enhancement method is used. The method uses a MESG algorithm. After this step proposed algorithm is applied as follows: 1) Taking this enhance image apply SOBEL filter on the image. 2) Then obtain the binary image. 3) Morphological processing is done to remove noise and join parts of cracks. 4) refine the obtained image so that cracks are clearer. The proposed algorithm is compared with OSMA and PMM algorithm. The dataset selected for the testing purpose has 200 concrete images of dimension 4000 × 6000 pixels captured at NSH of CMU. It performed very well against OSMA and slightly well against PMM and got a score of 94.22% on average TRP.