

QUALITY ASSESSMENT OF CONCRETE STRUCTURE USING IR THERMOGRAPHY

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Abstract— Crack detection is a method for detecting defects in reinforced concrete structures by using the method of IR Thermography. Infrared Thermography is one of the Non-destructive thermal method which is becoming even more popular in non destructive testing of materials and structures as well. This project is developed with an aim in detecting crack as well as length and depth. This project is implemented by using MATLAB. It is automated to increase the reliability and thus reduce the effect of human errors and wrong diagnosis. Finally Triangulation technique is implemented for cross checking the process. It was concluded that the method IR Thermography can be used for the detection and quantification of defects in reinforced concrete structures.

Keywords—Non-destructive testing,IR Thermography,Defect Identification

Introduction

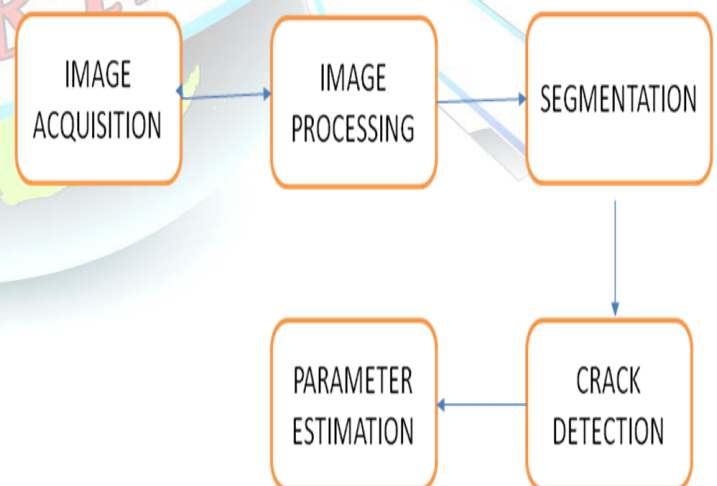
In the modern communication system ,non destructive testing (NDT) of concrete structures is becoming increasingly important due to aging and deterioration of infrastructures. Infrared thermography technique (IRT) relies on the variation in the temperature caused by air packets in concrete. This method uses the infrared rays emitted by the investigated object to access it temperature gradient on the surface of the specimen. An infrared camera is used for capturing the infrared rays from the object. For the non-destructive evaluation in concrete components, the active IRT method is being used. The main goal of any non-destructive evaluation technique is to detect and locate the anomalies within an optically opaque medium through appropriate imaging technique. Advanced NDT techniques which will facilitate rapid, cost efficient and reliable condition assessment of existing infrastructure to ensure public safety

DESCRIPTION

A. INFRARED THERMOGRAPHY

Infrared thermography is equipment or method, which detects infrared energy emitted from object, converts it to temperature, and displays image of temperature distribution. In a similar way, an infrared camera creates an image by converting radiant heat energy into a signal that can be displayed on a monitor . There are two general types of infrared instruments that can be used for condition monitoring : Infrared thermometers and Infrared focal plane area(FPA)

B. Block diagram



II. PROPOSED METHODOLOGY

ACQUISITION

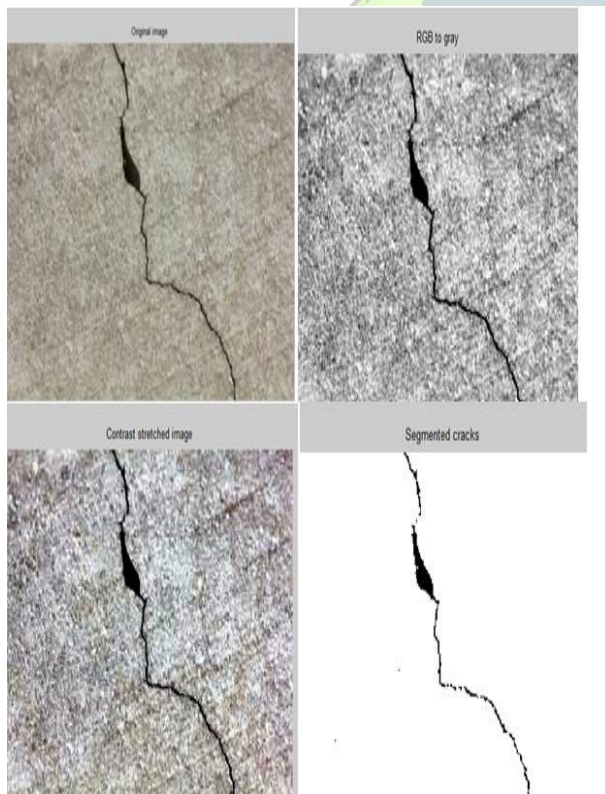
Digital imaging or digital image acquisition is the creation of digital images typically from a physical scene. The term is often assumed to imply or include the compression, storage, printing, and display of such images. The most usual method is by digital photography with a digital camera but other methods are also employed

IMAGE PROCESSING

The major advantage of the image based analysis of the crack detection is that by using the image processing technique. It provides accurate result compared to conventional manual methods.

IMAGE SEGMENTATION

Image segmentation is the process of dividing an image into multiple parts. This is typically used to identify objects or other relevant information in digital images



CRACK DETECTION

$$E = \frac{1}{N} \sum_{k=1}^N \left[R_k \frac{\sum_{i=1}^{w_k} \sum_{j=1}^{h_k} W_k(i,j) \cdot O_k(i,j) - T_k(i,j)}{\sum_{i=1}^{w_k} \sum_{j=1}^{h_k} W_k(i,j) \cdot V_{max}} \right]$$

E=

Where,

\hat{N} - No of training images in database

T_k - K-th target image

O_k - Output image

W_k - weighted image

EXISTING METHODS

Pulse Thermography (PT): Fast inspection relying on a thermal stimulation pulse, with duration going from a few milliseconds for high thermal conductivity material inspection to a few seconds for low thermal conductivity specimens.

Step Heating (SH): Contrary to PT scheme for which the temperature decay is of interest, the increase of surface temperature is monitored during the application of a step heating pulse

Lock-in thermography: Based on thermal waves generated inside the specimen under study in the permanent regime. Here, at a frequency, the specimen is submitted to a sine modulation heating, which introduces highly attenuated a dispersive thermal waves.

Vibrothermography: A mechanical vibration induced externally to the structure direct conversion from mechanical to thermal energy occurs and the heat is released by friction

RESULT

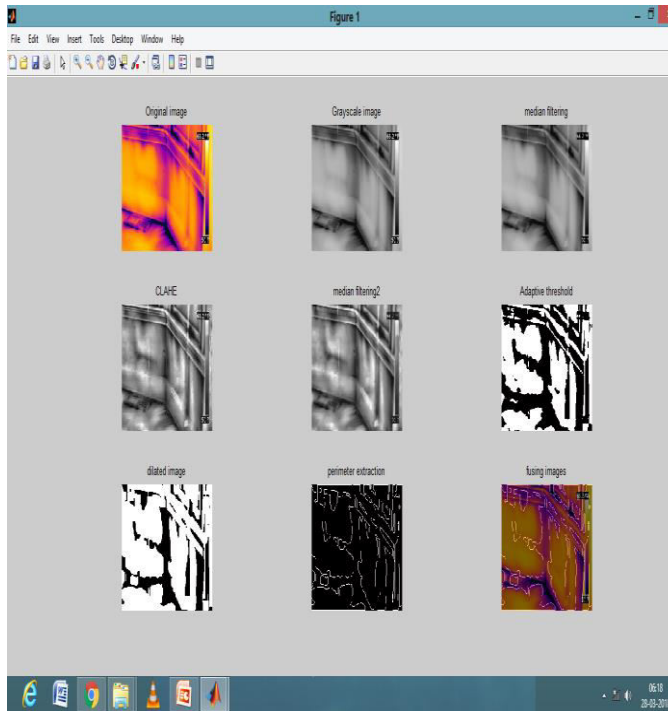


FIG: IDENTIFICATION OF CRACK

INFRARED THERMOGRAPHY

Infrared thermography is equipment or method, which detects infrared energy emitted from object, converts it to temperature, and displays image of temperature distribution. In a similar way, an infrared camera creates an image by converting radiant heat energy into a signal that can be displayed on a monitor

TABLE : CALCULATION OF CRACK

IMAGES	BLOB	AREA	WIDTH
Dataset 1	234.00	45673	124.28

Dataset2	324.00	43524	116.76
Dataset3	433.22	34562	108.56

TRIANGULATION

Triangulation is a powerful technique that facilitate validation of data through cross verification from two or more sources. It tests the consistency of findings obtained through different instruments and increases the chance to control, or at least assess, some of the threats or multiple cause influencing our results. The tracing and measurement of a series or network of triangles in order to determine the distances and relative positions of points spread over a territory or region, especially by measuring the length of one side of each triangle and deducing its angles and the length of the other two sides by observation from this baseline

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