ISSN No:-2456-2165

Digital Image Processing for Recognition of Imperfections in the Submerged Hull

Antonio Eduardo Assis Amorim
Department of Naval Shipbuiding,
College of Technology of Jahu, CEETEPS
Jahu,SP, Brazil

Maria Julia Polastri Cacchi
Department of Naval Shipbuilding,
College of Technology of Jahu, CEETEPS
Jahu, SP, Brazil

Abstract:- Visual inspection in ships is an important task to identify its integrity and this task can be done with underwater digital cameras. Linear filtering techniques can be used to identify edges. This paper shows an implementation of a code to process digital image using Sobel filter, adjusted by two parameters and the results show the code highlights points of corrosion or deformation being an important support tool for the inspection of the ship's structure conditions.

Keywords:- *Image Processing; Filter; Convolution; Sobel Filter; Edge Detection.*

I. INTRODUCTION

Constant ship operation in harsh climatic environments can cause structural damage or corrosion and require periodical inspection. Ship sidewalls suffer from corrosion-erosion effects when sea waves remove small parts of the structure as well as corrosion-cavitation when air bubbles produce a similar effect.

Visual inspection operations on ships are complicated as they involve diving or vessel removal activities in dry dikes. To reduce human risks, activities can be done using underwater remotely operated vehicle – ROV that carry embedded cameras. Thus, when the vessel is taken out of service for repair, it is important to check the points of greatest corrosion attack and this is usually done visually. However, due to water aspects, visual inspection may not work so well.

Image processing is a technique that allows manipulating a digital image through operations, improving or extracting useful information that can be used for a particular purpose [1]. Image processing can be a tool that can assist the inspector in conducting the analysis.

In this way, image processing can be applied to the naval industry for the inspection of vessels, in matters related to welding, corrosion and structural aspects as well as activity of docking or installation of submerged structures in oil wells.

Another type of occurrence on ships involves minor collisions that can deform the structure of the ship's side and often, visually, go unnoticed. The digital processing technique can highlight interesting details useful for evaluation.

In ship docking operations, it is important to verify the process of alignment of the ship with the riding stables, requiring visual monitoring, which can be assisted with digital image processing applications [2]. Another important operation that can be used with image processing is the evaluation of installation and degradation conditions of existing subsea and submerged lines [3]. Some operations in the field of petroleum engineering are done using a ROV or divers being monitored visually. Supporting the operation with digital image processing can generate useful information for the operator, reducing staff uptime.

In view of these facts important to naval industry, it is relevant to develop a support code for these visual inspection activities that will serve as a support tool for decision making. Such an application must process images in real time, generating operator-relevant information that could not be extracted into the original images due to low or excess light, turbidity or noise that generate blurred images.

Usually linear filters are used that detect edges. The filtering technique consists of adjusting the pixel values of the image as a function of the values of the surrounding pixels so that relevant information can be extracted. The way to adjust values involves the concept of convolution. Usually, to reduce the computational effort, in general, color images are transformed into shades of gray, which express the intensity or level of gray[4].

There are several filtering techniques applied to various fields producing good results. The most common filters are Laplacian, Prewitt, Sobel and Gaussian [4–6].

Therefore, this article deals with the process of application development based on Sobel filter, in order to generate images that allow extracting relevant visual information that attest to the deterioration state of the vessel's side structure.

To this end, a picture will be taken of a old pusher and these images will be digitally processed and a new image will be generated in order to highlight points of corrosion or deformation of the vessel's side structure.

The application is made in Octave software using the image processing package.

It is considered that the linear filters can be adjusted to highlight or accentuate points of relevance in the structure

and allow the operator to extract relevant information and to assist in decision making.

It is hoped that with this product, companies engaged in prospecting, inspection, construction and maintenance of vessels will be able to use it as a decision support tool in the naval field.

II. STRUCTURE OF THE CODE

The code involves the following steps: image acquisition, application of the Sobel filter and median filter. Two parameters are applied to the Sobel filter components and added to the median filter. The figure below shows the structure of the code.

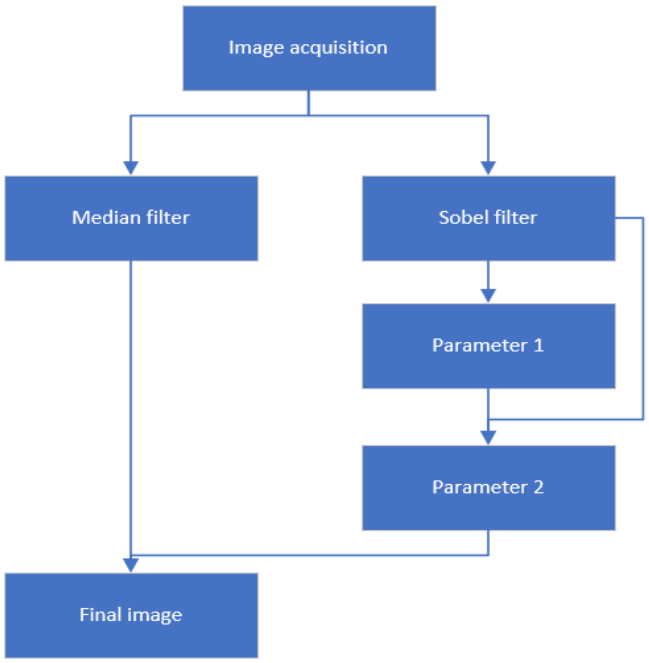

Fig 1:- Code Structure.

III. RESULTS

To assess the quality of the code, the side of an out-of-service pusher was analyzed. Its somewhat precarious state allows the performance of the code to be evaluated. The figure below shows a partial view of the pusher condition and the processed image. The original image is on the left side and the processed image is on the right.

Fig 2:- The original image (left) and the processed image (right).

Note that the code highlights the points at which corrosion or deformation stands out on the ship's plate.

Fig 3 shows another image. On the left side there is the original image, which does not show much detail. On the right side the processed image shows accentuated details of the plate's condition. The code works properly.

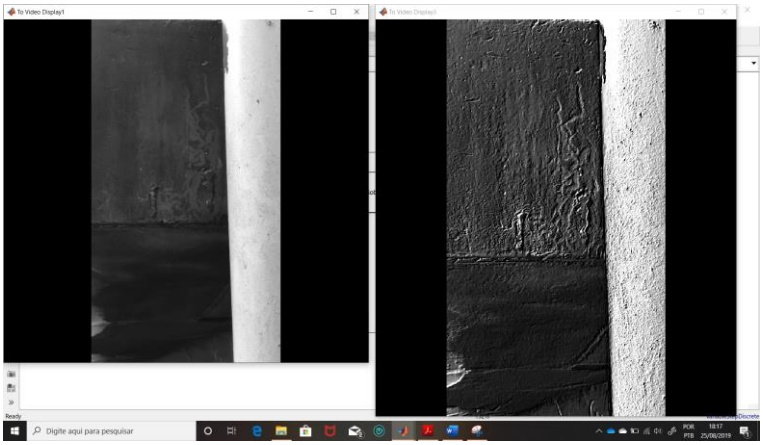

Fig 3:- Details of plate deformation appear accentuated in the processed image.

In the following figure there is another detail of the pusher. It is observed that the weld details are highlighted in the processing, as well as the deformation of the plate.

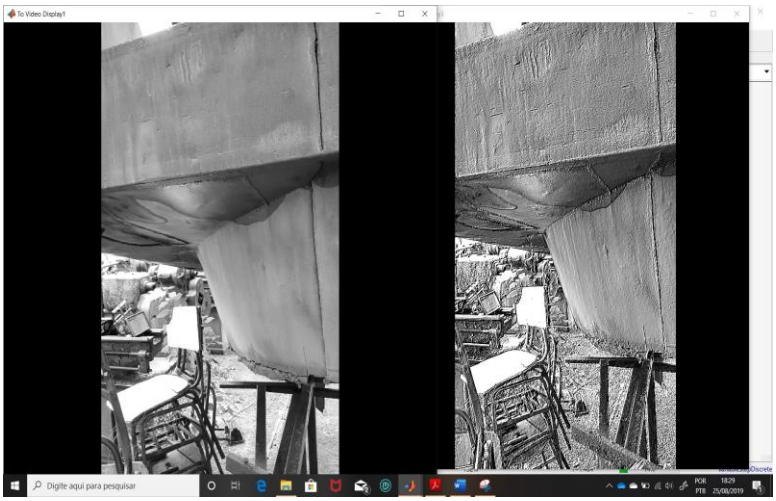

Fig 4:- Details of weld and deformation of vessel side

IV. CONCLUSION

This paper aims to develop and qualitatively evaluate the performance of an application focused on digital image processing that aims to extract relevant information in the structure of the ship's side plate, such as corrosion, deformation and weld details. There are several applications in the literature that perform digital image processing using filters. The application developed in this work uses the median filter and the Sobel filter. The application is promising, showing the deformations present in the plates. The images obtained show that the application can be a useful tool to assist inspection activities. Future work is intended to enhance the application to highlight corrosion points or deformations relevant to inspection. The next step is to develop a code in which to identify, by means of colors, the regions attacked by corrosion.

REFERENCES

[1]. Tanimoto SA. An interdisciplinary introduction to image processing: pixels, numbers, and programs. London - England: The MIT Press, 2013. Epub ahead of print 2013. DOI: 10.5860/choice.50-2706.
[2]. Rodrigues JM dos SS. Simulador Interactivo de Docagem de Navios em Ambiente Tridimensional. Instituto Técnico de Lisboa, 2008.
[3]. Boszczowski RB, Piazza F, Munaro M, et al. Avaliação de Sistemas Submarinos de Distribuição de Energia. In: Anais do II Cinetel, pp. 510–513.
[4]. Gonzalez RC, Woods RE, Eddins SL. Digital Image Processing Using Matlab. Gatesmark Publishing. Epub ahead of print 2004. DOI: 10.1117/1.3115362.
[5]. Marques O. Practical image and video processing using matlab. Wiley, 2011.
[6]. Owotogbe JS, Ibiyemi TS, Adu BA. Edge Detection Techniques on Digital Images - A Review. Int J Innov Sci Res Technol 2019; 4: 329–332.