

# Infrared Harbor Background Suppression based on Multistage filtering and Phase Grouping

Zuyi Chen<sup>1,a</sup>, Taixiang Zhao<sup>2,b</sup>

<sup>1,2</sup> Department of foundation Aeronautical maintenance sergeant school of Air Force  
Engineering university ,Xinyang, China

<sup>a</sup>[Zychen7410@163.com](mailto:Zychen7410@163.com), <sup>b</sup>[ztx304@126.com](mailto:ztx304@126.com)

**Key words:** Harbor background image suppression; multistage filtering; phase grouping method

**Abstract:** In order to solve the problem of false tracking caused by background interference in infrared moving target detection under the port background, a port background suppression method based on multi-level filtering and phase marshalling is proposed. Firstly, a number of benchmark areas and feature line groups are extracted. Then, benchmark area and straight line group are cross validated. Based on cross validation results, port background suppression reference points are determined. The background restraining base points are suppressed according to the background so as to realize the port background suppression of the sequence image. The feasibility and effectiveness of the proposed method are verified by the background suppression experiment on the actual port background infrared image.

## 1 Introduction

The infrared monitoring of ship targets in port is a hot topic in current research. The complex scenes in ports pose great challenges to the detection of all kinds of ships. Usually, the background of the port has the following characteristics: 1, port land background (such as different types of buildings, some peaks, etc.), infrared gray strong and wide distribution; 2, the port sea background in infrared image occupies a gray low level distribution which has a strong continuity and relativity; 3 in the surf, specular and reflection scales under the background of infrared image, the gray port fluctuation changes greatly [1]. All these characteristics have a serious impact on the detection of ship targets in ports. Therefore, how to effectively suppress the port background is the key step to achieve accurate detection and robust tracking.

At present, the usual methods of IR image background suppression at home and abroad include airspace and frequency domain filtering [2], wavelet domain filtering [2], partial differential equation method [3] and so on. The spatial and frequency domain filtering to achieve simply, but when the background and the target texture is similar, the target may be suppressed as background; when the small change of target in the field, using wavelet domain multiresolution filtering algorithm has better effect; when the target for the meteorological environment causes dramatic changes,

poor effects and operations occur; method of partial differential equations of general aims to identify and enhance the target at the same time can restrain and smooth background, but The iterative computation is large, it is sensitive to noise and is disturbed greatly.

In order to effectively and accurately suppress background information of infrared port background, combined with the characteristics of port infrared background, a background suppression method of infrared port based on multi-level filtering and phase marshalling method is proposed in this paper. Firstly, on the one hand, according to the threshold obtained by Otsu image segmentation, we use multi-level filtering to extract the background suppression reference area; meanwhile, we use phase marshalling method to extract the straight line group in the original image. Then, the above two features are cross validated to determine the base point of image suppression. Finally, the background suppression is realized by the method of inter frame subtraction before and after.

## **2 multistage filtering**

The basis of multistage filtering is based on the assumption that the background is in the low frequency part, the target is in the middle frequency, and the noise has a large proportion in the high frequency part. The essence is the band pass filter [4] in the frequency space. Therefore, through multilevel filtering of images, we get the salient target in the area of the sky line, that is, the reference area takes the center of the target as the background suppression reference point of the sequence image. According to the background suppression reference points in the sequence image, we can achieve the background suppression.

## **3 phase formation method**

When the image contrast of infrared image is low due to weather and other reasons, the baseline area of multi-level filtering is blurred. At this time, the straight line group extracted from the phase marshalling method can be cross validated with the reference area to solve the fuzzy problem of the baseline area.

Phase grouping method is proposed for the two major weakness of most of the edge and line extraction algorithm: on the one hand most of the algorithm is based on the gray change in some way so as to measure the magnitude of local edge importance, so it often can not detect the gray change of weak contrast, such as the Canny operator; on the other hand, before the local decision to the edge characteristic, it lacks of a global understanding of image structure. Phase grouping method proposed by Burns[5] et al, unlike most of the algorithms that amplitude of the gray change as the first role, it paints the phase of the gray change as the first element to consider. Another characteristic is that before making local decisions on the edge, first as a global organization support edge context relations, the results can be extracted contrast the line is quite low in the complicated image.

#### 4 experiment and result analysis

An infrared imaging device with a resolution of  $384 \times 288$ , a response band of 3 to 5  $\mu\text{m}$  and a frame rate of 50 frames per second is used to carry out a complex dynamic port background suppression test. The experimental computer is configured for the processor of Intel Core2 Duo 2.8GHz, the memory of 4GB, and the programming environment of VS2013.

Experimental contents: three frame images are selected from the dynamic port background sequence images, and the background suppression test is carried out. Figure 1-1 - figure 1-3 is the original infrared image of tenth, 255th and 272 frames; Figure 2-1 - figure 2-3 is the image obtained by multistage filtering for the tenth, 255th and 272 frame original images; Figure 3-1 - Figure 3-3 is a linear image extracted by the application phase grouping method (the line length is not less than 9); Figure 4-1 - diagram 4-3 is the final background suppression Image.

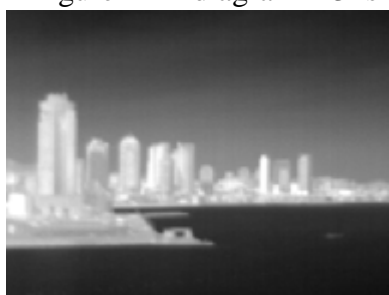


Fig 1-1 10<sup>th</sup> raw image



Fig 1-2 255th raw image

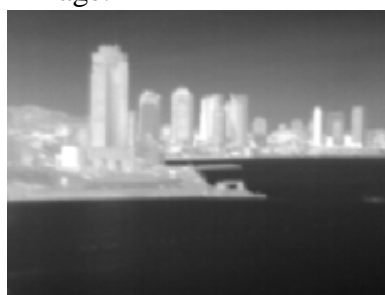


Fig 1-3 272th raw image

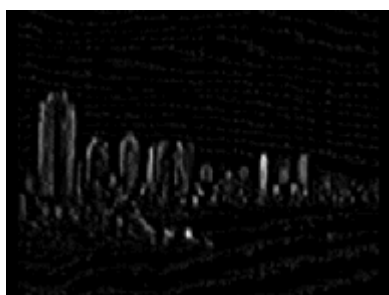


Fig 2-1 multistage filtering image

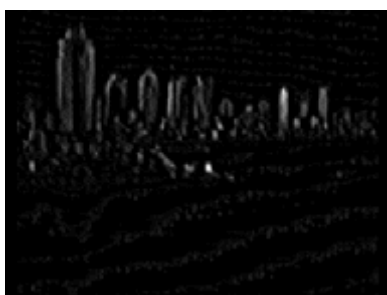


Fig 2-2 multistage filtering image



Fig 2-3 multistage filtering image

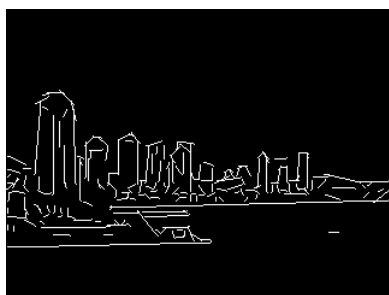


Fig 3-1 line extraction filtering



Fig 3-2 line extraction image



Fig 3-3 line extraction image

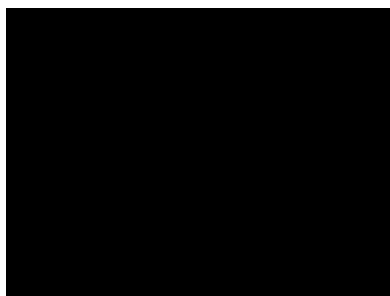


Fig 4-1 background suppression

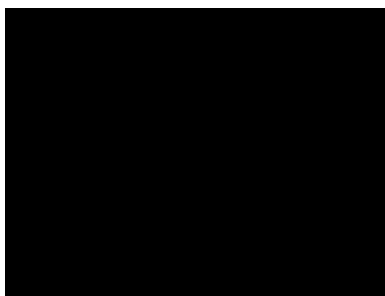


Fig 4-2 background suppression

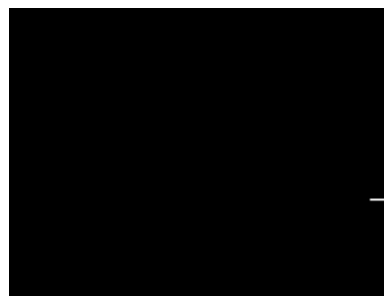


Fig 4-3 background suppression

## 5 concluding remarks

In the algorithm, using a multilevel filter can extract the reference area of port in the background; on the other hand, using the phase grouping method can extract the linear feature images; and then using the cross validation of two features of the obtained reference point after inhibiting background realizes the image background suppression. The experiment shows that the time of completion of a background suppression is about 0.8 seconds, and the algorithm is a more effective background suppression method in the port background.

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