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Infrared Small Target Enhancement based on Variance Difference

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Abstract
In surveillance and early warning systems, the enhancement of targets is a very important stage for the high reliability detection and tracking in Infrared images with complex backgrounds. In order to enhance small targets in an Infrared image and suppress the background clutter, consequently increasing the contrast between them, this paper proposes a method using a model for the target area with a three-layer patch-image model and based on the difference between the variance of the layers in the neighboring areas of the investigated pixel. Results of the experiments indicate that the proposed method is quite effective on the enhancement of small targets as well as suppression of the background clutter in IR images with a minimum false alarm rate. This is realized while the runtime of the proposed method is minimal compared to other commonly used methods, which makes it effective to be used in real time applications.
Keywords: IR Image, Target, Enhancement, Variance, Patch-image

1. Introduction

Surveillance systems need to identify hostile targets of an enemy in early stages and send an early warning to defense systems. For it realization, infrared (IR) identification and tracking systems are one of the best systems for detection and tracking of targets. In IR images, the thermal difference of targets, like a vessel on the surface of the sea, leads to a difference in the values of their intensities with the background and their appearance in the image consequently. Yet, in spite of having many advantages, an IR image has much clutter and noise in complex backgrounds. A target being small as a few pixels out of the whole image caused by its far distance to the sensor as well as clutters and noise in complex backgrounds is a challenging issue for the common methods of target detection and tracking in IR images.

A target detection method in IR images generally consists of two stages; first the enhancement of targets and suppression of clutters in the IR image background and then the extraction and verification of targets from the enhanced image. In target detection methods of IR images, the first stage is highly important in such a way that in a desired enhanced image, the extraction and verification of targets can easily be done with a simple thresholding. Therefore, the systems of target detection and tracking need a vital stage in its processing section to enhance targets and suppress clutters in an IR image, in order that an enhanced image is obtained so that targets are extracted and verified in the next stages of processing with higher reliability.

A variety of methods with desirable results in some collections of IR images data have been proposed for the enhancement of targets and the suppression of clutters in the IR images background. These methods can be divided into two categories: methods based on single frame

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