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Moving Object Detection in Aerial Infrared Images with Registration Accuracy Prediction and Feature Points Selection

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Abstract

Moving object detection in aerial infrared sequences is widely used in many applications, such as automatic traffic monitoring, border protection, and area surveillance. Feature-based image registration is the key step to compensate the background motion before detecting the moving objects. However, in practice it is often difficult to ensure the accurate registration, resulting in incomplete background compensation and thus decreasing detection performance. We find that the feature points in the object regions (FPOs) always impede the accurate registration of background. Besides, when the inlier points chosen by RANSAC excessively concentrate over the image, it will lead to inaccurate registration, especially in the case of insufficient feature points. These two issues are seldom studied before. In this paper, we propose a new framework of moving object detection, in which feature points selection and registration accuracy prediction are devised to improve detection accuracy. To do this, the detection information of previous frame is fed back to feature extraction of current frame for eliminating FPOs. Moreover, a quantitative metric is presented to measure the concentration of inlier points' distribution over the image, with which one can predict the registration accuracy and determine whether to introduce additional cues for improving detection accuracy. Furthermore, we comprehensively investigate several classical feature extractors for aerial infrared image registration in terms of accuracy and running time, and suggest Speeded Up Robust Features (SURF) as feature detector and Local Difference Binary (LDB) as feature descriptor for image registration in aerial infrared sequences. Experimental results on benchmark infrared sequences show that our proposed method can greatly reduce false positives and also suppress false negatives, and performs favorably in terms of accuracy and efficiency.

Keywords: Moving object detection, Aerial infrared sequence, Image registration, Feature extraction

1. Introduction

Moving object detection in aerial infrared sequences is widely used in many applications, such as automatic traffic monitoring, border protection, and area surveillance. However, there exist several challenges in aerial imaging condition. Firstly, the imaging platform flies along with the aircraft, leading to the background motion within image sequences. Thus, the object motion mixes with the background motion in aerial image sequences. Secondly, the object appears of small size in images from the long distance. Moreover, infrared image usually suffers from the issues of low spatial resolution, image blurry and few details. These challenges make the moving object detection in aerial infrared sequences even more difficult.

Many methods have been proposed to deal with these challenges in the past decades. To separate the moving object from the background, the appearance information about the objects [2], or motion information [3][4][5][6][7][8], or both [9][10][11] are often used. Most methods resort to background motion compensation by feature-based image registration and then detect object with the motion information. Therefore, the registration accuracy becomes the key factor of complete background compensation and accurate detection. Many feature extractors (including detector and descriptor) are studied for accurate registration. In the work [4], feature extractor with Harris [15] detector and SIFT [16] descriptor is used for image registration. Lin et al. [5] use SURF [17] for image registration and background motion recovery. Walha et al. [6] propose to integrate

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