

SEMI-NATURAL SIMULATION OF DETECTING MOVING OBJECTS AGAINST A COMPLEX BACKGROUND

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Keywords: image processing, detection of moving objects, filtering, defocusing images, pre-processing, stabilization, maximum difference of the Fourier spectra.

Abstract. The paper presents and analyzes the results of semi-natural simulation of image preprocessing in the detection of moving objects in difficult mountain conditions. The efficiency of image processing of a series of frames is estimated by defocusing, as well as by using a new algorithm based on comparing the values of the maximum difference of the Fourier spectra of image frame Windows.

ПОЛУНАТУРНОЕ МОДЕЛИРОВАНИЕ ОБНАРУЖЕНИЯ ДВИЖУЩИХСЯ ОБЪЕКТОВ НА СЛОЖНОМ ФОНЕ

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Ключевые слова: обработка изображений, обнаружение движущихся объектов, фильтрация, расфокусировка изображений, предварительная обработка, стабилизация, максимум разности Фурье спектров.

Аннотация. В работе рассмотрены результаты полунатурного моделирования обнаружения движущихся объектов на сложном фоне. Произведена оценка эффективности обработки изображений серии кадров путём расфокусировки, а так же в результате использования нового алгоритма, основанного на сравнении значений максимумов разности Фурье - спектров окон кадров изображений.

A lot of work has been devoted to the problem of detecting moving objects from a sequence of video frames, but this problem has not yet been completely solved. This is due to the complexity and variability of the external background and the instability of observation conditions, especially in mountainous conditions.

It is also necessary to take into account that with the most advanced orientation and stabilization systems, there are residual fluctuations that cause uncontrolled changes in the direction of the optical axis of the sensor over time and corresponding temporary changes in the observed background picture. All this ultimately leads to a significant decrease in the quality of time filtering, which is close to the quality of spatial filtering of a single frame, unsatisfactory in the case of strong spatial variability of the background [1].

The aim of the experiment was to study the effectiveness of pre-processing to stabilize (hold) the image of the scene with several observations and improve the initial conditions for solving the problem of selecting a moving small-sized object. The experiment was based on a sequence of frames obtained using a Canon EOS 450 DEF-S digital camera in a fixed shutter speed mode similar to the "night shutter mode". A series of images of a parachutist on the background of a locality in a mountainous area were processed (Fig. 1a). The minimum value of the mean square discrepancy function, the maximum value of the brightness gradation of false

marks, and the number of pixels with brightness greater than the threshold level were selected as efficiency criteria.

For clarity of figure 1A, the image in which the skydiver is best observed in a series of frames is selected. This image was not used in further processing. The selection of the parachutist by means of spatial filtering is impossible because its dimensions are unknown to him at the scene. And in addition, in the image of the scene, there are objects that have a shape and size similar to the shape and size of the parachutist.



Fig. 1. (a) Image of a parachutist on the background of a locality in a mountainous area, (b) Brightness image of the difference between two frames

Each frame counted the number of P pixels with a brightness of more than 10 units. The threshold of 10 units was selected based on the values of the brightness of the image of the skydiver in the difference of two frames.

As seen in Fig. 1b, along with the release of the parachute, a large number of false marks were formed. Selection of the parachutist in such conditions is impossible.

The results obtained confirmed the effectiveness of pre-focusing. When processing without correction of geometric distortions, the performance criteria indicators improved: the maximum value of the I gradation of brightness of false marks is twice, the number of pixels P with brightness is nine times higher than the threshold level. When processing with geometric distortion correction, the performance criteria decreased: I by two and a half times, P by seventeen times.

References

1. Kim A.K., Kolessa A.E., Lagutkin V.N., Lukyanov A.P., Repin V.G. Problems and principles of information processing in space sensors with mosaic photodetector // Problems of detection and tracking of space objects in near-earth space: Scientific and technical seminar of young scientists, September 27, 2007. – Moscow: JSC "interstate joint stock Corporation "Vympel", 2007. – P.17-21.

Список литературы

1. Ким А.К., Колесса А.Е., Лагуткин В.Н., Лукьянов А.П., Репин В.Г. Проблемы и принципы обработки информации в космических сенсорах с мозаичным фотодетектором // Проблемы обнаружения и сопровождения космических объектов в околоземном космическом пространстве: Научно-технический семинар молодых ученых, 27 сентября 2007г. – Москва: ОАО «Межгосударственная акционерная корпорация «Вымпел», 2007. – С. 17-21.

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